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Looking ahead: new approaches to medieval Iberian heritage

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ABSTRACT

This special issue, "Looking ahead: new approaches to medieval Iberian heritage", is the main output of a fruitful collaboration between the humanities and the experimental sciences, which has greatly contributed to increase our knowledge of creative processes in medieval Iberia. The articles examine a wide range of objects produced using very different media, such as illuminated manuscripts, glass, monumental painted altarpieces and *azulejos* (glazed tiles). Some of these objects were studied for the first time in the framework of this project, while others had received very little attention previously. Moreover, several of the case studies concern unfinished works, which gives us an opportunity to better approach the creative processes. This introductory article aims to establish the main overarching themes that have emerged from the joint efforts of the participating scholars and teams. These themes include the multicultural context of medieval Iberia, a revision of the traditional notion of the medieval workshop, a consideration of the materials used to construct colours and molecular palettes, and the transfer of technological processes between the different cultural and religious horizons that coexisted in the Iberian Peninsula. This paper also investigates the new avenues of research that the articles have opened, such as the role played by medieval Iberia in a broader European, Mediterranean and global context regarding the arrival of precious materials from the Far East.

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The realm of the sciences and the arts is far removed from the vulgar world; it is a realm in which discoveries are made every day, but many fanciful tales are told about them. It was important to verify the true ones, to forestall those that are false, to establish the points of departure, and thus to facilitate the search for what remains to be discovered. Facts are cited, experiments compared, and methods elaborated only in order to excite genius to open unknown routes, and to advance onward to new discoveries, using the place where great men have ended their careers as the first step. This has been our aim as we have combined the principles of the sciences and the liberal arts with the history of their origin and of their successive advances.

Jean le Rond d'Alembert, Preliminary Discourse to the Encyclopedia of Diderot, 1751.

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Introduction

This special issue, "Looking ahead: interdisciplinary approaches to medieval Iberian heritage", is the main output of a project which dealt with a past-future dichotomy: its main aim was to increase our knowledge of the artistic creations and material culture of the past, in order to better understand them, and preserve them for future generations.

The project brought together several research teams working on artefacts produced in different territories and cultures in the Iberian Peninsula between the twelfth and the late fifteenth century, and it encouraged a collaborative scientific exchange methodology based on sound empirical and theoretical foundations.

Developing this kind of research by employing diverse methodologies is an exciting and motivating challenge, but it is also very demanding and not without risks; it should also be noted that the term interdisciplinary has become a buzzword. It is also important to point out that the combination of different methodologies in the study of artefacts and works of art has a long tradition. For instance, we might point to Sigmund Freud's interpretation of Leonardo da Vinci's Virgin and Child with St. Anne, in which he tried to combine art historical and psychoanalytical approaches, but failed due to an error in the translation of Leonardo's Codex Atlanticus.[1] Also noteworthy is Aby Warburg's trip to New Mexico to visit the Pueblos in 1895–1896,[2] long revered by art historians as a pioneering example of the rapprochement between art history and anthropology, but now questioned not only for the doubtful anthropological and ethical behaviour of the German art historian, but also for the discrepancy between the substantial literature that art historians generated about the trip and the absolute silence within the field of anthropology, which does not consider Warburg's approach relevant.[3]

Keeping these challenges and risks in mind, the objectives of this project have been to spur on effective and rigorous collaborative research conducted by scholars who represent a range of disciplinary specialties and also to give them the opportunity to engage and debate with each other in order to avoid one-sided conclusions. As project leader, I was further guided by the principle that the resulting articles should be relevant to all of the disciplines involved in the investigation, so that their impact is not restricted to a single field of inquiry, as was ultimately the case with Warburg's research on the Pueblos.

The project integrates some of the main disciplines that, from the second half of the twentieth century, started to apply a combination of scientific techniques and the expertise of the experimental sciences with the knowledge of artistic production contexts provided by the humanities.[4] These include archaeometry, history of material culture, and technical art history.[5] The teams of this project are thus formed by researchers specialising in different disciplines, and at various stages in their academic careers. Regarding the disciplines

[1] Freud used a passage of Leonardo's writings in which he described a childhood memory of having been attacked in his crib by the tail of a vulture, an animal that Freud identified with a form of the Virgin's garment when viewed sideways in the above-mentioned painting. He further used it to establish a connection with Leonardo's sexual orientation. However, he used a German version of the text, which mistranslated the Italian word for kite – the bird that Leonardo imagined according to the text – as a vulture, which thwarted Freud's interpretation. See Andersen, "Leonardo da Vinci".

[2] It led to his famous lecture "Bilder aus dem Gebiet der Pueblo-Indianer in Nord-Amerika", delivered in 1923 and published a few years later under the auspices of Fritz Saxl. See Aby Warburg, "A Lecture on the Serpent Ritual".

[3] Farago, "Re(f)using art"; Farago, "Silent moves"; Freedberg, "Pathos a Oraibi"; Freedberg, "Warburg's mask".

[4] See for instance Hermens, Ouwerkerk and Costaras, *Looking through Paintings*.

[5] Hermens, "Technical Art History"; Mannoni, "Arqueología, Arqueometría e Historia de la Cultura Material"; Muthesius, "Introduction: Studies on Material Culture".

from the humanities that were involved, these are art history, history, archaeology and literary studies. As far as the experimental sciences are concerned, the teams included researchers from the areas of physical and chemical studies, as well as conservation and restoration. Together we attempted to carry out a holistic research approach to study the creative processes, material composition of artefacts, techniques used, and deterioration processes.

A laboratory for medieval Iberian heritage

Medievalists were among the first scholars to realise the value of collaborating with, for example, molecular scientists, in order to better understand the material composition of art, as the pioneering work published by D.V. Thompson in 1936 shows.[6] For medieval Iberia, this kind of cross-disciplinary research has developed further, especially in the past decades, with in-depth studies on materials and techniques, as well as technological sources and treatises.[7] Furthermore, along with approaches to those arts traditionally considered the major arts, such as painting,[8] several shining examples of studies have been devoted to other kinds of material culture, for instance jewellery and textiles.[9]

The present project aims to follow this impetus and also go a step further. I aimed to be innovative in inviting teams that study a wide range of artefacts, an approach that fostered comparisons of different processes of artistic production. Some of these media – such as illuminated manuscripts and glass – are common to other European territories, while others are characteristic of medieval Iberia, such as monumental painted altarpieces and *azulejos* (glazed tiles). This wide scope allowed the project to shed light on the particularities of the Iberian Peninsula; moreover, by examining a range of objects, we were able to look beyond Iberia and contextualise it in relation to art throughout Europe and the Mediterranean.

Another significant value of the present special issue is that some of the artworks are approached for the first time here, while others have received very little scholarly attention or have never been explored by a multidisciplinary team. Iberian glass production, for instance, has long been understudied; the two articles herein that focus on this medium exemplify the pioneering nature of this collection of studies. This special issue includes the first archaeometric study of an assemblage of medieval glass found in an excavation in Portugal,[10] as well as an examination of the transmission of glass-making techniques in the late Middle Ages.[11] The glazed tiles that paved the apse of the Portuguese monastery of Alcobaça – a Cistercian institution founded with the support of the first Portuguese king, Afonso Henriques (r. 1139–1185), and built between 1178 and the mid-thirteenth century – here receive their first technical and historical analysis, which has determined

[6]Thompson, *The Materials and Techniques*.
[7]Cifuentes and Córdoba de la Llave, *Tintorería y medicina*; Gasol, *La técnica de la pintura mural*; Kroustallis, "Quomodo decoretur pictura librorum"; Kroustallis, "Los recetarios medievales"; Afonso, *As matérias da imagem*; Miguel et al., "The Book on How One Makes Colours"; Vilella-Petit, "Les Recettes pour l'enluminure".
[8]Castiñeiras, "Catalan Romanesque Painting Revisited"; Ibáñez-Insa et al., "Heat Alteration of the Blue Pigment Aerinite"; Verdaguer and Alcayde, "Descobrint i interpretant la matèria".
[9]Perea, *El tesoro visigodo de Guarrazar*; Rodríguez Peinado and Cabrera Lafuente, *La investigación textil*; *Tejidos hispanomusulmanes*; *Vestiduras pontificales del Arzobispo Rodrigo Ximénez de Rada*.
[10]Coutinho et al., "First Archaeometric Study".
[11]Govantes-Edwards, Córdoba de la Llave and Duckworth, "Recipes and Experimentation".

their chemical composition and contextualised them in relation to Alcobaça's particular dynamics and the Cistercian tradition in general.[12]

Other works are also studied by a multidisciplinary team for the first time here, such as the Cancioneiro da Ajuda (Ajuda Songbook), which is an example of Galician-Portuguese medieval lyric poetry;[13] this manuscript had been studied by individual scholars since it was rediscovered in the nineteenth century, but important questions on its manufacture had been left unanswered. The present collaboration among art historians, literary scholars, chemists and conservators aims to achieve a better understanding of the origins, provenance and date of the manuscript. As for the fourteenth-century Winter Breviary from the scriptorium of Alcobaça, only very brief accounts of this work were available in scientific literature prior to this special issue. The fact that this Breviary has been long understudied is striking since it exhibits an unusual profusion of silver and brazilwood. The in-depth study in the present volume provides a starting point for future avenues of investigation.[14]

This special issue also addresses Beatus manuscripts, those masterpieces of Iberian medieval heritage, which in 2015 were integrated into UNESCO's Memory of the World Register, a programme that seeks to recognise and preserve the most precious artefacts of global documentary heritage. Although these manuscripts have been well studied by scholars throughout the twentieth century, the copies of the Commentary on the Apocalypse attributed to Beatus of Liébana still prompt vigorous debates in the scientific community, as many aspects of their textual and pictorial traditions remain unclear. The recent discovery of new copies, such as the eleventh-century Geneva Beatus, has made discussions of these manuscripts all the more animated.[15] This special issue contributes to the discussion by analysing the Alcobaça Beatus.[16] Along with the Lorvão Beatus, which was previously studied by the same team, the Alcobaça Beatus has been studied from an interdisciplinary viewpoint that combines the humanities and experimental sciences. Our approach opens the door for future Beatus manuscripts to be analysed using this combination of chemical and historical approaches.

Finally, this volume includes a study of monumental painted altarpieces – one of the most characteristic art forms of the Iberian Peninsula – focusing on the technique of gilding, as a key aspect that differentiates Iberian altarpieces from their counterparts in the rest of Europe.[17]

Along with studying artefacts produced in different media and choosing objects approached for the first time, this issue is even more "special" because several articles explore and examine unfinished works. Our aim is thus to contribute to a better understanding of how creative processes were developed in medieval workshops and scriptoria. This includes studying the systematisation, distribution and progression of work, connections between ateliers near and far, and the characteristics shared by workshops within a particular geopolitical region or of a particular religious order.

[12]Carvalho et al., "The Cistercian Glazed Tiles of the Monastery of Alcobaça".
[13]Melo et al., "Singing with Light".
[14]Barreira et al., "Through the Eyes of Science and Art".
[15]See Williams, *Visions of the End*.
[16]Miguélez Cavero et al., "Beatus Manuscripts under the Microscope".
[17]Kroustallis et al., "Gilding in Spanish Panel Painting".

For the material study of the works, teams carried out both on-site and laboratory-based investigations. Several instrumental analytical techniques were used, with preference given to non-invasive methods, and minimal sampling was undertaken. Among the most useful analytical methods used were spectroscopic techniques, including PIXE (particle-induced X-ray emission with micrometre lateral resolution), Raman microscopy (micro-Raman), Fourier transform infrared spectroscopy (microFTIR), emission fluorescence spectroscopy (microspectrofluorimetry) and fibre optic reflectance spectroscopy in the UV-visible (FORS).

The research teams also used new proteomic techniques, which involved the large-scale study of proteins, in order to determine their structure and function; this approach is especially useful for the analysis of artistic heritage since it assists in the identification of proteins such as egg or milk, which were routinely used in the production of art. When analysing glass artefacts and their chemical composition, the most important techniques included electron microprobe analysis (EMPA) and inductively coupled mass spectrometry (ICP-MS), as well as fibre optic reflectance spectroscopy (FORS). FORS has been utilised in the analysis of works of art since the late 1970s, and this technique is now starting to be applied more frequently to the study of archaeological glass objects.

Multicultural context/s

Throughout the central and late Middle Ages, the period on which the articles in this issue focus, the geopolitical borders of Iberia were continually shifting, resulting in repeated political reconfigurations and alterations of the power structures. However, it was also a time of crucial changes in the relations among the coexisting cultures of Christians, Muslims and Jews. This multicultural context could be compared to that of Egypt from the first to the twelfth century, when the political evolution from the Roman empire to the Fatimid dynasty was accompanied by the coexistence and exchange of Christian, Muslim and Jewish communities, a theme recently revisited on the occasion of the major exhibitions *One God: Abraham's Legacy on the Nile* (Berlin, Bode-Museum, 2 April–13 September 2015), and *Egypt: Faith after the Pharaohs* (London, British Museum, 29 October 2015–7 February 2016).[18]

The comparative approach of this present project aimed to investigate further the current revisitation of multicultural contexts, and the resulting collection of articles has led to a number of conclusions as well as new questions to ponder. This can be noted, for example, in the study on the transmission of glass-making techniques in medieval Iberia, for which the team coordinated by Ricardo Córdoba analysed glass recipes as well as archaeological and compositional evidence. They suggest that as far as glass production is concerned, our traditional designation of Islamic and Christian "periods" or "areas" is nothing more than a convention. The use of plant ashes in the glass-making process, for instance, was introduced by Muslims, but adopted early on by Christians, who used it continuously. The first archaeometric study of medieval glass in Portugal, carried out by Márcia Vilarigues and her team in the framework of this project, confirms that ashes from coastal plants were employed there as well.

[18]See Fluck, Helmecke and O'Connell, eds., *Egypt: Faith after the Pharaohs*.

The team led by David Govantes-Edwards questions whether the glass-making industry in al-Andalus and Iberia might have influenced the later use of plant ashes for glass production elsewhere in southern Europe, for instance in Italy. Such exchanges with Italy with regard to glass production are confirmed by the study by Márcia Vilarigues's team, who found that Venetian glass was arriving in Portugal as early as the fourteenth century.

The Portuguese monastery of Alcobaça

The argument that Islamic and Christian "periods" and "areas" are nothing more than a convention gathers even more strength when we analyse the results in several articles within this special issue that have approached the study of artefacts produced using different media at the Portuguese Cistercian monastery of Alcobaça. A holistic technical analysis has proved extremely useful to help us draw conclusions about this Cistercian monastery during its two first centuries of existence.

The team conducting research on the glazed-tile pavement at the church of Alcobaça shows how in this institution the Islamic technique of tin-glazing was used. Chemical analysis demonstrates that all of the colours identified in the set of tiles were most likely obtained through Islamic technology. The article further suggests that this technique was later applied in other Cistercian houses in France, such as the abbey of Grandselve, an institution with deep links to the Cistercian monastery of Santes Creus in Catalonia. This means that the use of Islamic artistic techniques at Alcobaça is not an isolated case, and that the Iberian Peninsula played an important role in exporting this method to northern territories.

Other articles that focus on artistic processes at Alcobaça and analyse illuminated manuscripts produced at the monastery's scriptorium provide crucial information. As was the usual procedure in Cistercian monasteries, the house received manuscripts from Clairvaux and other institutions within the order from the twelfth through fourteenth centuries, the period under consideration here; but its international connections go much further: chemical analysis of the materials used at the scriptorium reveals that some of the most expensive colourants were from such distant places as Afghanistan and India. At the same time, the manuscripts copied at the scriptorium at this time also prove that Alcobaça was deeply attached to its Iberian roots, as indicated by the copies of works such as Beatus's Commentary on the Apocalypse or the Codex Calixtinus. This Iberian Christian reality coexisted with Islamic technology in the pavement of its church.

The overall analysis of this data set reveals the complex identity of this Portuguese monastery, which should be considered a true multicultural context in itself. It seems to have been a melting pot of ideas, influences, techniques and materials: prime materials came from far-away Asian territories, and French Cistercian thought was important; also, there was deep attachment to the monastery's Iberian roots, along with connections to Islamic culture. All of these factors converged in an institution located in the western-most territories of the Iberian Peninsula.

Making objects in medieval Iberia

The concept of "makers" of art has recently been advocated by Therese Martin to describe the various, usually anonymous, individuals responsible for the production of medieval

objects.[19] She proposed this term in the context of a research project focusing on the roles played by medieval women in artistic production, and it has proven to be most useful since it allows us to be more open in our understanding of the many levels of participation involved in the process. The expansive nature of the term "makers" is well-suited to the present project, as it incorporates a wide variety of objects from different media that were created by several kinds of professionals, who are generally unnamed.

Also, the term is well-suited to this project because we consider the essential roles played by the patrons who commissioned these artefacts, as well as their recipients and audiences. The present volume aims also to analyse the connections between artworks and their intellectual authors, an area which has been deeply explored by scholars of Spanish and Portuguese historiographies over the past decade.[20] For instance, Portuguese historiography has emphasised the role played by certain kings. Research on this matter has provided evidence of the privileges of King Manuel I (r. 1495–1521) in relation to the trade of Venetian glass in Portugal and its colonies.[21] This special issue discusses the connections between Portuguese kings and specific works of art. Maria João Melo and her team propose that the Cancioneiro da Ajuda may have been produced in the context of the court of King Dinis (r. 1279–1325) or that of his son Pedro (c. 1285–1354), whose high intellectual profile and interest in court literature may have prompted the commissioning of such a work.

Finally, the term "makers" is also useful for artworks that are clearly the result of large and dynamic workshops, such as the monumental painted altarpieces studied within this issue, in which multiple makers would have been involved. The term helps us avoid not only the patron versus artist distinction, but also master versus assistant. It seems appropriate to highlight here the traditional tendency of art historians to classify artworks according to masters, workshops or circles as a means of addressing the problem of anonymity; however, this can lead to misattributions of objects and incorrect assumptions that a workshop was more productive than it actually was or that the maker was a man, when actually we know nothing about gender. One of the best examples for medieval Iberia is the so-called Erill la Vall workshop.

The existence of this workshop was first suggested in the 1930s by Arthur Kingsley Porter, who posited that a certain group of wooden sculptures from Catalonia might be accredited to a single workshop, and perhaps even a single artist.[22] Its name stems from the provenance of its supposed masterpiece, the Deposition group from the church of Erill la Vall (Vall de Boí, current province of Lleida). However, the list of objects associated with the workshop has grown significantly since Arthur Kingsley Porter's original identification. Moreover, later studies have suggested that the productivity of this workshop was not limited to Deposition groups, but also included altar furnishings as well as figural

[19]Martin, "Exceptions and Assumptions"; Martin, "The Margin to Act".

[20]Two research projects are particularly noteworthy in this regard. The first, focusing on artistic patronage in the kingdoms of León and Castile, was led by María Herráez Ortega at the University of León, funded in two phases by the Ministerio Español de Ciencia e Innovación under the titles *El patronazgo artístico regio en el territorio castellano-leonés. El papel del clero (1055–1200)* (2011–2014, no. 2011/00020/001) and *El patronazgo artístico en el reino de Castilla y León (1230–1500). Obispos y catedrales*. (2014–2016, no. 2014/00076/001). See recently, Teijeira, Herráez and Cosmen (eds.), *Reyes y prelados*. The other project, focusing on medieval women as artists and patrons, was led by Therese Martin at the CSIC, funded by the European Research Council under the title "Reassessing the Roles of Women as 'Makers' of Medieval Art and Architecture" (2010–2015, no. 263036). See recently Martin (ed.), *Reassessing the Roles of Women*.

[21]Custódio, *A real fábrica de vidros*, 43–4.

[22]Porter, *Spanish Romanesque Sculpture*; Porter, "The Tahull Virgin"; Porter, "Una nota del profesor Kingsley Porter".

sculpture.[23] Additionally, the geographical area in which works attributed to the workshop have been found was recently enlarged to include the valleys of Aran and Boí, and the regions of Pallars and Noguera.[24] This makes the revisitation of this workshop in particular, and the notion of medieval workshops in general, vital. The traditional methodology of art history using data only from stylistic analysis is not sufficient, but needs to be combined with technical, chemical and physical analyses, which are useful tools for either supporting or dismissing traditional assumptions and for advancing knowledge in creation processes.

Materials and techniques

Two articles in the volume deal with illuminated manuscripts that are unfinished and therefore highly valuable for what they reveal about decorative processes. In the Cancioneiro da Ajuda, which was analysed by Maria João Melo and her team, throughout its program of illumination there are several figures with unfinished clothing and in varying degrees of completion. Furthermore, some faces are uncoloured, allowing the parchment's natural colour to come through. This detail led the research team to make an interesting connection with the Cantigas de Santa Maria, in which the same tendency has been noted. The study of the Alcobaça Beatus undertaken by Alicia Miguélez and her team includes an unprecedented in-depth analysis of its unfinished initials. A comparison with other manuscripts from Alcobaça, both finished and unfinished, allowed the researchers to propose the main sequence of steps involved in creating illuminated initials.

One of the main issues in studying artistic production is colour: the materials used to create the different hues, the origin of those materials, and the ways in which they are applied. The use of experimental sciences and technical analysis when investigating artefacts reveals crucial information; the identification of pigments and colorants cannot be achieved through more traditional art-historical inquiries alone. One of the main results of this special issue in relation to this matter is the confirmation that the rich and precious materials such as lapis lazuli, brazilwood and gold were not only extensively used across the Iberian Peninsula during medieval times on different media, but that they were used in a deliberate and sophisticated way. For instance, turning lapis lazuli into a stable pigment required a particular knowledge, and its selective deployment within a single artwork suggests a particular attitude towards the material.

A similar situation may be noted in relation to the gold leaf which was used for gilding monumental painted altarpieces by using a complex technique. According to the study by Stefanos Kroustallis and his team, it was important for artists not only to master the technique, but also to know details of the size, thickness and even the price of the gold leaf. This article also provides evidence of another important point: the panel paintings and altarpieces that were the object of study bear witness to the turn from medieval to Renaissance techniques. However, several historical sources, including contracts and treatises on artistic techniques, in combination with laboratory analyses, have shown that this

[23] *Jo, Joan; Obres mestres del romànic.*
[24] In terms of church administration, this would include up to three bishoprics: Comminges, Urgell, and Roda de Isábena. See Camps et al., "The Importance of Being John".

transition may have never taken place. The complex process of gilding with gold leaf remained virtually unchanged throughout the period in question.

The colour blue in medieval Iberia

Research on the colour blue in the Middle Ages is challenging since it was inconspicuous until it became fashionable in the twelfth century, after which point the Western world became, in the words of Michel Pastoureau, a "Blue Civilization".[25] Research conducted over the course of our present project contributes greatly to this discussion, and so I offer the colour blue as a case study in the present paper.

The relative lack of blue in medieval Europe before the twelfth century is surprising given its popularity in Egypt and the Near East: the use of a *pâte de verre* known as Egyptian blue was widespread, and several families of artificial blue materials, including the "manufactured" or "moulded lapis lazuli", which was produced in Egypt, Mesopotamia and Phoenicia and exported throughout the Mediterranean world, were also used.[26]

In medieval Europe, blue was obtained from several sources. Two of these sources are plants: the woad or glastum (*Isatis tinctoria*), which was found in numerous European regions, and *Indigofera tinctoria*, from which indigo dye derives, which was imported from Africa and Asia.[27] A third source was the semi-precious stone lapis lazuli, which was imported primarily from Afghanistan. The copper mineral azurite was another source of blue pigment; it was found in Armenia and Cyprus but also in several mountains in Germany and Bohemia.[28] Finally, the element cobalt was used to produce blue-coloured glass as well as blue pigment for the decoration of ceramics; it could also be used as a dye. Cobalt deposits are to be found in Central Europe, in the Ore Mountains (Erzgebirge) dividing Saxony and Bohemia, and also in Hungary.[29]

The Iberian Peninsula played an important role as far as materials for producing blue is concerned. Woad was extensively cultivated, for instance in the region of Toledo, and even exported to other territories.[30] However, in addition to the above-mentioned materials, artists in medieval Iberia also made use of aerinite, a bluish-purple inosilicate mineral found in parts of Aragon and Catalonia. It was used between the eleventh and fifteenth centuries in many Romanesque frescoes in the Pyrenees and southwest France, and also in panel painting and polychrome sculpture in Catalonia, such as the painted crucifix known as the Batlló Majesty.[31]

Investigations of the production and use of the colour blue in al-Andalus have also yielded interesting results. In the thirteenth century, during the Nasrid dynasty, artists used a blue made from cobalt oxide to decorate pottery, applying it on a white background in combination with gold. Alberto García Porras has previously suggested the possible influence of pottery from the Mediterranean basin, especially Tunisia, on this new artistic

[25]Pastoureau, *Bleu*; Pastoureau, "La couleur et l'historien", 23; Schweppe, "Indigo and Woad".
[26]Delamare, *Blue Pigments*, 36.
[27]India is home to forty members of the *Indigofera* genus, ten of which yield sufficient dye for commercial extraction. One of these, *Indigofera coerulea* (wild indigo), may have been the origin of *Indigofera tinctoria*, the chief source of commercial indigo. See Balaram, "Indian Indigo".
[28]Pastoureau, *Bleu*, 16–23.
[29]Delamare, *Blue Pigments*, 37–45.
[30]Lombard, *Les textiles dans le monde musulman*, 138ff.
[31]Daniel et al., "Le pigment d'aérinite"; Campuzano et al., "Noves aportacions"; Casas and de Andrés, "The Identification of Aerinite"; Ibáñez-Insa et al., "Heat Alteration"; Verdaguer and Alcayde, "Descobrint i interpretant la matèria".

development. After arriving in the Peninsula and influencing Nasrid pottery production, this fashion would then have reached other areas in Iberia, especially Valencia and other eastern regions of the Peninsula.[32]

The article by Márcia Vilarigues and her team in this volume contributes new information on these issues, owing to their use of complementary analytical techniques such as UV-vis reflectance spectroscopy, which was decisive in determining the origin of the colour blue in the assemblage of glass found during the archaeological excavation of Beja (Portugal). These techniques revealed that both cobalt and copper were the colourants used to obtain the blue- and turquoise-coloured glass.

Previous research conducted in the field of medieval Iberian studies has addressed the materials and processes used for the colour blue in illuminated manuscripts. The Portuguese interdisciplinary team coordinated by Maria Adelaide Miranda and Maria João Melo determined that the blue found in Portuguese medieval manuscripts was mainly obtained from lapis lazuli, a material that at that time was only found in the Afghan mines of Badakhshan.[33] The monastery of São Mamede de Lorvão (St Mammas) produced a manuscript now named as the "Blue Book" owing to the bountiful presence of this material, which was applied as a very saturated and pure colour.[34]

This is a significant finding, especially since it matches the discoveries of another interdisciplinary team from the University of Durham working on manuscripts produced in the British Isles. The team, formed by Andrew Beeby – professor of chemistry at the University of Durham – and Richard Gameson – one of the greatest specialists on book history in Great Britain – developed a project on how writing and pigment "technology" changed with the migration of the monks and scribes from Lindisfarne to Durham, and under the influence of the Norman invasion.[35] Their studies have shown the use of lapis lazuli in a manuscript containing the work *Libellus de Exordio atque Procursu istius, hoc est Dunelmensis, Ecclesie* (The Little Book on the Origins and Progress of this Church),[36] written by a monk called Symeon who arrived in Durham with the Normans, should be highlighted. He probably brought with him lapis lazuli, and thus its use indicates the existence of a remarkable trade route from Afghanistan, through Europe, to Northumbria.

For the manuscripts studied in this special issue we have been able to provide new data. The researchers determined that the molecular palette in the scriptorium of Alcobaça in the twelfth and thirteenth centuries exhibits a profusion of lapis lazuli, which is in line with previous studies. It seems, however, that illuminators of manuscripts from this scriptorium in subsequent centuries also began to use azurite: this is the material used to create the blue in the illuminations of the fourteenth-century Winter Breviary. This manuscript exhibits another departure from the twelfth- and thirteenth-century colour palette of Alcobaça – the application of silver leaf. According to the study by Catarina Barreira and her team, these changes could be due to the arrival of French university manuscripts in the Portuguese abbey.

[32]García Porras, "El azul", 22–9.
[33]Melo and Miranda, "Secrets et découverts"; Melo, Castro, and Miranda, "Colour in Medieval Portuguese Manuscripts"; Melo et al., "The Color of Medieval Portuguese Illumination".
[34]Lisbon, Arquivo Nacional da Torre do Tombo, Ordem do Cister, Mosteiro de Santa Maria de Lorvão, Liv. 5. Available at: http://digitarq.arquivos.pt/viewer?id=4381076. Castro, Melo, and Miranda, "The Secrets"; Miranda et al., "On Wings of Blue".
[35]Gameson, *From Holy Island to Durham*.
[36]Durham, University Library, Cosin V.II.6.

At the same time, however, the Cancioneiro da Ajuda, dated by Maria João Melo and her team to the late thirteenth or beginning of the fourteenth century, demonstrates an abundant use of lapis lazuli. The material remains in a surprisingly good state of conservation, and appears in far higher quantities than indigo and azurite in the same manuscript. The researchers conclude that the luxurious lapis lazuli was still being imported into Portugal at this time. Even if cheaper materials such as azurite were available, the more expensive lapis lazuli was purchased for sumptuous projects.

The variety of materials coming from Asia earlier than traditionally thought seems thus to increase. Indeed, the presence of lapis lazuli in the twelfth century can now be added to that of indigo, which has been proved to have reached Europe from India long before the sixteenth century, when Portuguese explorers established trade routes to India by sea via the Cape of Good Hope and started to import large quantities of indigo, maintaining supremacy – in terms of indigo – over Dutch and Spanish traders.[37] In fact, records also show that twelfth-century Venetians were already using indigo, which arrived by overland route via the Persian Gulf and Alexandria.[38]

New avenues of investigation

This special issue contributes to scholarly knowledge about medieval Iberian heritage while opening new avenues of investigation and posing new questions regarding the multicultural horizons of medieval Iberia, a fertile field for continued research. The results thus far obtained, while significant, represent just the beginning of the full potential of this collaborative method for future analysis. The path ahead of us is long and challenging, but at the same time highly motivating.

This volume has tried to fight against the traditional convention of designating Islamic and Christian "periods" or "areas". In fact, the existence of other smaller multicultural spaces might need to be considered, as the case of the monastery of Alcobaça indicates. Our findings suggest that the cultural and artistic dynamics of Alcobaça were the result of a combination of Cistercian tradition, the particular legacies of Iberian roots, connections with remote territories and the influence of the nearby Islamic culture. These conclusions stimulate two main avenues of research: first, future comparative studies of artworks in different media from Alcobaça will further determine to what extent the institution adhered to Cistercian observance, the precise role played by the religious order as patron of artworks, the exchanges with the surrounding Islamic culture and even the finds of new materials coming from distant places. Secondly, a question yet to be addressed is the extent to which this was a unique case. The monastery of Alcobaça should be compared to other institutions across the Iberian Peninsula, both Cistercian and other Orders, in order to determine whether it represents an unusual case within this context, or was typical amongst its regional counterparts.

Another major avenue of investigation addressed by this volume is the circulation of materials and trade routes, a line of inquiry that helps situate Portuguese manuscripts within the broader context of European book illumination. Technical analysis has answered some crucial questions on the materials used to produce colours, namely lapis

[37]Balfour-Paul, *Indigo*.
[38]Balaram, "Indian Indigo", 143.

lazuli and brazilwood. But did both lapis lazuli and brazilwood come from the East and reach the Western world through the same trade routes? Taking into account the results of the Portuguese and British research teams cited above, should we presume that lapis lazuli arrived in the Iberian Peninsula, England, and possibly Norman France through a single trade route, or should we consider the possibility of different routes for northern versus southern Europe? In the case of the Iberian Peninsula another key question arises: what role did the Islamic world play in the arrival of such materials on the Peninsula? Likewise, to what extent should we consider medieval Iberia one of the European ports of entry for materials like these? Recent studies have shown that lapis lazuli was used in the polychrome decoration of the Portal of Glory (Pórtico de la Gloria) of the cathedral of Santiago de Compostela around the same time – the turn of the thirteenth century – that it was used in manuscripts at the Portuguese monasteries of Alcobaça and Lorvão.[39] The question remains as to how these materials were distributed to different Iberian regions once they arrived on the peninsula.

Future research should certainly consider media and materials not addressed within this special issue, such as leather, wood, ivory, enamel and pottery. The study of small, easily transportable objects would shed light on trade routes and the movement of materials to, from and across the Iberian Peninsula. The investigation of such materials might involve various methods of laboratory analysis, such as thermoluminescence, dendrochronology and carbon-14 dating (C14), a complementary method that can be used in studies of artefacts of a biological origin.[40]

Finally, new studies should also expand the chronological period considered here, and analyse material culture produced before the twelfth century. Indeed, the period between Late Antiquity (which has been a focus of significant collaborative research in recent decades)[41] and the twelfth century possesses immense potential for technical research since it is a period when the Iberian Peninsula experienced a unique political and social evolution that impacted the creation and circulation of ideas, materials and works.

Final thoughts

Among the main aims of cultural heritage specialists, the following three should be emphasised: to produce knowledge in order to better understand, and, thus, better preserve, cultural heritage; to turn that knowledge into a useful resource for other scientific areas; and to transmit and disseminate this knowledge to society, in order to foster its valorisation and understanding.

The best way to achieve the first of these goals – the production of knowledge – is to create collaborative research teams with dynamic trans-disciplinary expertise. This method of investigation provides an optimal means of testing hypotheses, answering

[39]Cirujano, Laborde and Prado-Vilar, "La restauración del Pórtico de la Gloria".

[40]Carbon-14 dating is, for instance, currently being used by the team led by Therese Martin for the research project "The Medieval Treasury across Frontiers and Generations: The Kingdom of León-Castilla in the Context of Muslim-Christian Interchange (c. 1050–1200)" (El tesoro medieval a través de fronteras y generaciones: el reino de León-Castilla en el contexto del intercambio islámico-cristiano [c. 1050–1200]), National Excellence in Research Grant, Spanish Ministry of Economy and Competitivity HAR 2015-68614-P.

[41]Of particular interest is the recent archaeometric characterization of the stone used to produce several late-antique Christian sarcophagi, such as that reused as the tomb of King Ramiro II of Aragon (d. 1157). See Lapuente Mercadal et al., "Mármoles escultóricos romanos", and Lapuente et al., "Study of Provenance of the Roman Sarcophagus".

questions and verifying conclusions. This is, however, a demanding challenge. It requires scholars to have motivation, patience when waiting for the results of their colleagues, mutual scholarly respect among the disciplines involved, dialogue and empathy when engaging in debates, and a commitment to diligently writing and meeting deadlines. But all of this work ultimately proves worthwhile, since this approach has the potential to provide unexpected results, yield more comprehensive solutions and interpretations, and ultimately produce more complete knowledge. The scholars involved in this project have applied this methodology with this goal in mind.

The second aim specified above concerns turning the produced knowledge into a useful resource for other scientific domains. The combination of various areas of scholarly expertise within this project has been proved truly effective for gaining new insight into the creative processes and ultimately providing a more detailed picture of material culture in medieval Iberia; the results are thus expected to reach very precise areas of expertise, including archaeometry, archaeology, history of material culture and technical art history.

The last of the aims for scholars of material culture is to transmit to society the advances in our understanding of the past. The publication of this special issue, which brings to light the results of the teams involved in this project, is a step toward achieving this goal. We also hope that in-depth knowledge of the artistic creations of the past will assist us in facing twenty-first century challenges in terms of human progress. Only the most comprehensive knowledge of what came before will help us to prepare the most suitable future for the generations to come. We need to delve deep into the past in order to look ahead.

AQ1 Notes on contributor

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