UNRAVELLING THE SECRETS OF MAGIC LANTERN SLIDE PAINTING

Ângela Santos, Vanessa Otero, Beatriz Rodrigues and Márcia Vilarigues

The magic lantern has been recognised for its value as an optical instrument for projection ever since its creation. In recent years, besides the value attributed to the magic lanterns themselves, the enormous significance of the heritage of magic lantern glass slides has been increasingly recognised. Collections of glass slides, held in museums, private and educational collections, libraries and archives, are gradually being studied in an attempt to unveil the role and relevance of the magic lantern in historical, social and cultural contexts around the world.[1] Sometimes accompanied by documentation such as catalogues, flyers, trade press, readings and written testimonies, the magic lantern glass slides should be perceived as material evidence that is a reflection of society.[2]

In the last 15 years, several projects have made extremely important contributions regarding the interpretation, digitisation and classification of collections of magic lantern slides (e.g. the *Million Pictures* project (AMP, 2018)[3]), and these recent developments have made the slides gradually more available to scholars and the general public. Even though collections of slides frequently have hundreds or even thousands of items, institutions are rarely able to prioritise these collections in terms of time or personnel since, according to Sarah Dellmann, specialised knowledge on magic lantern slides is not accessible to most curators, archivists and cataloguers.[4] The lack of people dedicated to these collections is reflected in severe conservation problems. Most institutions do not have an inventory, or it is very incomplete and missing an adequate identification, description or classification according to current metadata standards. Photographic documentation is scarce and often lacks high resolution, and the improper packing of slides and uncontrolled environmental conditions when in storage or exhibition puts at stake the integrity of these collections.

Over the years, slides have been presented to the general public and digitally preserved as still, rigid, static images, or as simple animated image loops. However, when we look at a magic lantern slide as a form of artistic or social expression, we easily see much more than a static image. In addition to the efforts to gradually catalogue and preserve the digital images represented in glass slides, there is an urgent need to start looking at these artefacts beyond their imagery. These objects have a tangible identity and their materiality goes far beyond their representations. Their intentional use included touch and movement during projections, from the horizontal 'panoramic' sliding motion to the animation of mechanical slides. The sound and speed of all these actions and the sequences of images and stories presented were also part of the experience of their use. These multisensorial experiences with glass slides as a central focus have been rediscovered during recent years by scholars and enthusiasts, and their engaging performances have brought to life the original intention of these historical objects. In order to preserve, interpret and appreciate the materiality of magic lantern slides, we need to comprehend both material and intangible aspects of this cultural heritage.

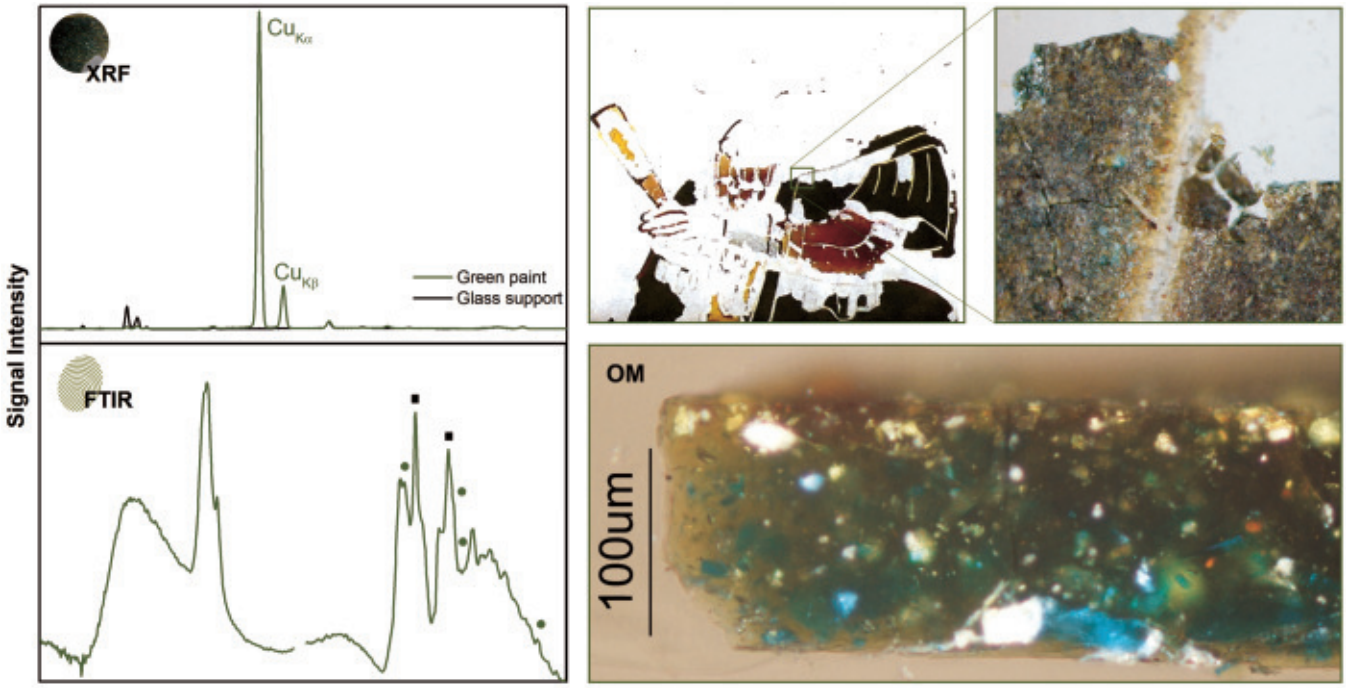
With our project '*Lanterna Magica* – Technology and Preservation of Painted Glass Slides'[5] we are starting to unravel the secrets behind the production of such fascinatingly detailed, transparent and vividly colourful paintings. Only through a multidisciplinary approach will it be possible to understand which materials were used and why, allowing a better in-depth comprehension of the slides' historical, cultural and artistic impact.

The study of the materials and techniques used to produce exclusively hand-painted and printed outlines with hand colouring remains an almost unexplored field. Fortunately, with the increasing popularity of the magic lantern during the 18th and 19th centuries, numerous treatises, manuals and handbooks on the methods and materials used to produce painted glass slides for magic lanterns were written, and they provide valuable information and insight into the painter's choice of materials.[6] Winsor and Newton (W&N), one of the most important 19th-century artists' colourmen, also published a manual on the "method of painting [...] and materials employed in producing subjects for dissolving views, magic lanterns [...]" (Groom, 1855)[7] which demonstrates the importance of the market for hand-painted glass slides.

Lanterna Magica will uniquely link the critical analysis of these historical written sources with the reconstruction of W&N 19th-century recipes in the laboratory and the chemical analysis of historical glass slides of the same period.

With the development of a systematic multi-analytical methodology, it will be possible to enrich our knowledge and identify the chemical composition of the glass substrate, unravel the painting techniques through their morphology and stratigraphy and infer which painting materials were applied, from the colourants and fillers to the binders and varnishes. This material analysis will allow us to assign production periods and producers as well as further our understanding

1. Examples of exclusively hand-painted magic lantern glass slides studied from Portuguese collections. (top) 18th century, attributed to Italy, from the Cinemateca Portuguesa collection, 8.6 x 39.7 cm (inv. PC002/002); (bottom left) 19th century, attributed to England, from the Cinemateca Portuguesa collection, 10 x 17 cm (inv. PC3302/009); (bottom right) 19th century, attributed to England, from the Museu Nacional de História Natural e da Ciência collection, 10 x 17.5 cm (inv. MUL/MUHNAC UL000067).

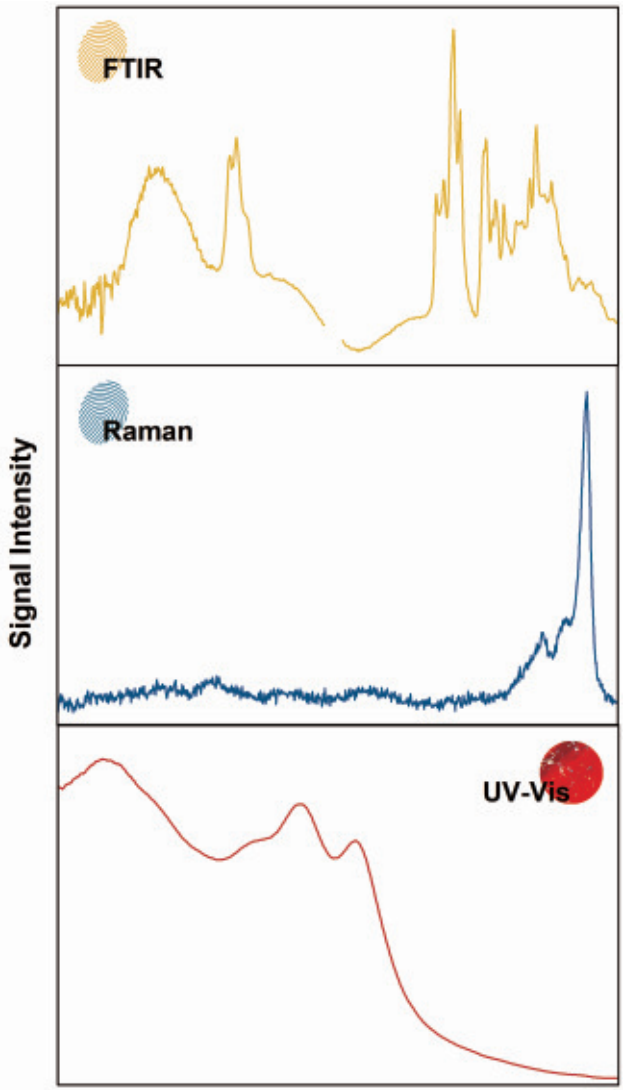


2. Material analysis of the green paint present in hand-painted glass slides from the 18th century (Cinemateca Portuguesa collection). (top left) The presence of copper (Cu) is detected by XRF, visible by the peaks at 8 keV and 8.9 keV. Its signal is much stronger when compared with the spectra of the glass substrate. (bottom left) Degradation products such as carboxylates (■) at 1606 and 1400 cm^{-1}, and oxalates (●) at 1680, 1365, 1321 and 830 cm^{-1}, were detected by FTIR analysis in a mastic matrix. (top right) Sampling area of the green colour and detail with 63x original magnification. (bottom right) Stratigraphy of the green sample observed in cross-section by an optical microscope with 200x original magnification, where the colour alteration from green to brown is evident.

of the key factors and mechanisms that lead to the degradation of the historical hand-painted glass slides. Ultimately, this will enable the development of preservation guidelines for existing collections.

At NOVA School of Sciences and Technology (Portugal) we studied first the hand-painted magic lantern slides from the collections of the Cinemateca Portuguesa (Cinema Museum) and the Museu Nacional de História Natural e da Ciência (Museum of Natural History and Science) (MUHNAC) of the University of Lisbon. These slides date from the 18th and 19th centuries with probable provenance attributed to England, France and Italy (Fig. 1). Small sets of slides from both collections were characterised using sophisticated equipment capable of creating complex images called spectra. These are acquired through complementary analytical techniques, namely XRF[8] for the detection of elements present in the glass matrix and inorganic colourants and fillers, UV-Vis[9] to identify which electronic transitions are responsible for the colours observed, and the combination of FTIR[10] and Raman[11] to provide the molecular fingerprint of the painting materials. Optical microscopy was also used to observe the paint's surface and stratigraphy.

With the analysis of the glass, sometimes it is possible to attribute a date and centre of production based on the chemical composition and production methods, since for some countries these are well established due to extensive studies published on flat glass production (e.g. in England).[12] From the slides studied, it was possible to attribute the manufacture of a set of five soda-lime silicate glass slides from MUHNAC to England between 1870 and 1900,[13] and determine that the glass of a set of 11 slides from the Cinemateca Portuguesa, visually assigned to 18th-century Italy, had been produced with a potassium-rich glass composition commonly used in Central Europe during that time, suggesting the glass may have been imported to be painted in Italy.



3. Examples of colours identified in 19th-century slides attributed to England from both collections. (top) Identification of Gamboge yellow by its characteristic molecular fingerprint by FTIR analysis. (centre) Identification of Prussian blue by Raman spectroscopy through the peaks at 2092, 2126 and 2155 cm^{-1}. (bottom) UV-vis spectra of the red colour where an anthraquinone chromophore of animal origin (such as cochineal) was identified by the absorption bands at 522 and 562 nm.

Painting on glass required the mastery of a difficult skill since projection greatly magnifies details and imperfections. Colour transparency was a constant concern. Watercolours were said to be preferred to oil, but they could also be combined with excellent results.[14] Varnishes would also be mixed with the paints to give them more transparency or applied on top for protection.

Preliminary results on the painting materials have already revealed a correlation between what was mentioned in written historical sources on the production of hand-painted slides and what is found in historical slides of the same date. A change in the colour palette over time was observed. Analyses of the 18th-century slides revealed that, in the early stages of production, pigments such as haematite for red and goethite for yellow were used, as well as copper green, Prussian blue and carbon black pigments,[15] also found in written sources from the same period (e.g. Denecke, 1757)[16] (Fig. 2). In 19th-century English slides from both collections, it was possible to identify colourants mentioned by British authors such as Groom (1855),[7] Rintoul (1857)[17] and Middleton (1876).[18] Examples are the yellow colour Gamboge, Prussian blue, a carbon black pigment and a possible indication for Crimson Lake with the identification of an anthraquinone red lake of animal origin (such as cochineal) with gypsum as filler (Fig. 3).[13] Regarding the varnishes applied, shellac and mastic resins were identified through FTIR analysis in slides from the 18th and 19th centuries, which is also in accordance with the literature of the same period.

The material analysis was found to be essential for an accurate assessment of the conservation state. Although the paintings' poor state of conservation is macroscopically visible in the 18th-century slides by the extreme loss of the paints' cohesion and adhesion to the glass substrate, metal carboxylates and oxalates – known degradation products – were detected along with colour alterations, which is indicative of severe degradation problems (Fig. 2). On the other hand, using as an example the slides from the 19th century from the MUHNAC collection, it is possible to find paints with no macroscopic signs of degradation but with evidence of it at the molecular level, being only a matter of time before this degradation progresses unless the appropriate preventive conservation action is taken.

Furthermore, by understanding in depth how these artefacts were conceived, we can move towards the development of efficient methods for the preservation and reconstruction of original slides. These reconstructions will enable this heritage of magic lantern slides to be experienced in all essentials without putting at risk the safety and integrity of the original slides.

The authors were awarded a Special Commendation in the first MLS Mervyn Heard Award (see* TML *21) for the research described in this article.

NOTES AND REFERENCES

1. Joe Kember, 'The Magic Lantern: Open Medium', *Early Popular Visual Culture*, 17(1), 2019, pp.1–8
2. Carmen Segundo, Francisco Frutos, Beatriz Domínguez and Marta Prieto, 'El Género Discursivo de Las Placas de Linterna Mágica: Una Definición Operativa En El Contexto Metodológico Del Análisis de Contenido', in À. Quintana and J. Pons (eds), *Presencias y representaciones de la mujer en los primeros años del cine 1895-1920*, Fundació Museu del Cinema-Collecció Tomàs Mallol, Girona, 2019, pp.381-388
3. *A Million Pictures* project, *https://a-million-pictures.wp.hum.uu.nl*
4. Sarah Dellmann, 'Beyond and with the Object: Assessing the Dissemination Range of Lantern Slides and Their Imagery', *Early Popular Visual Culture*,14(4), 2016, pp.340–358
5. Project *Lanterna Magica*, *https://sites.fct.unl.pt/lanterna_magica/home*
6. Francisco Frutos, 'From Luminous Pictures to Transparent Photographs: The Evolution of Techniques for Making Magic Lantern Slides', *The Magic Lantern Gazette* 25(3), 2013, pp.3–11
7. Edward Groom, *The Art of Transparent Painting on Glass*, Winsor and Newton, London, 1855
8. Energy Dispersive X-Ray Fluorescence (XRF) spectroscopy is an analytical technique which measures the emissions characteristic of particular elements when exposed to X-rays.
9. Ultraviolet-Visible (UV-Vis) is an absorption or reflectance spectroscopy that measures the electronic transitions between the ground and excited states of the colourants' atoms and molecules.
10. With Fourier Transform Infrared (FTIR) spectroscopy it is possible to obtain spectra images that result from the interaction of infrared radiation with matter. A Fourier transform is a mathematical operation that enables the best signal to noise ratio in the resulting spectra.
11. Raman is a spectroscopic vibrational technique that enables identification of the components in the sample at molecular level.
12. For example, the studies on window glass production in England by David Dungworth.
13. Beatriz Rodrigues, Ângela Santos, Maria J. Melo, Vanessa Otero and Márcia Vilarigues, 'Magic Lantern Glass Slides Materials and Techniques: The First Multi-Analytical Study', *Heritage* 2(154), 2019, pp.2513-2530
14. Francisco Frutos, 2013 (see note 6 above); Edward Groom, 1855 (see note 7)
15. Ângela Santos, Vanessa Otero and Márcia Vilarigues. 'Characterisation of Glass and Painting Materials from 18th-Century Hand-Painted Glass Slides Used for Projection with Magic Lanterns', in J. Mandrus and V. Schussler (eds), *Recent Advances in Glass and Ceramics Conservation 2019: Interim Meeting of the ICOM-CC Glass and Ceramics Working Group and Icon Ceramics and Glass Group Conference*, 2019, London, pp. 223-228
16. C.L. Denecke, *Vollständiges Lehrgebäude Der Ganzen Optik, Oder Der Sehe-Spiegel-Und Strahlbrech-Kunst*, Berlegis David Sversen, Altona, 1757
17. A.N. Rintoul, *Transparent Painting on Glass in Water, Oil and Varnish Colours*, Brodie & Middleton, London, 1867
18. Charles Middleton, *Magic Lantern Dissolving View Painting*. London: Brodie & Middleton, London, 1876

ACKNOWLEDGMENTS

The authors would like to acknowledge the Portuguese Foundation for Science and Technology (FCT-MCTES) for the support through the doctoral program CORES-PD/00253/2012, the PhD grant PD/BD/136694/2018 (Ângela Santos), and the Research Units VICARTE (UIDB/00729/2020) and LAQV-REQUIMTE (UIDB/50006/2020). The authors would like to thank the Cinemateca Portuguesa and the Museu Nacional de História Natural e da Ciência (MUHNAC) of the University of Lisbon for their collaboration in this project ('*Lanterna Magica* – Technology and Preservation of Painted Glass Slides for Projection with Magic Lanterns'). This research has also benefitted from the use of the infrastructure PRISC (Portuguese Research Infrastructure of Scientific Collections).

THE MAGIC LANTERN WITHIN

Just one slide this time, but it is the ultimate 'show within a show'. This rackwork slide sent to us by **Patrice Guérin** (Diaprojection) revolves to reveal different images 'projected' by the magic lantern in the centre.

Please keep sending in any slides you have with images of magic lanterns, slides or peepshows and, if possible, let us have some information about them.