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**Elizabethan and Jacobean Miniature
Paintings in Context**

**Edited by Catharine MacLeod and
Alexander Marr**

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Cover image: Left portrait: Isaac Oliver, Ludovick Stuart, 2nd Duke of Lennox, later Duke of Richmond, circa 1605, watercolour on vellum, laid onto table-book leaf, 5.7 × 4.4 cm. Collection of National Portrait Gallery, London (NPG 3063); Right portrait: Isaac Oliver, *Ludovick Stuart, 2nd Duke of Lennox, later Duke of Richmond*, circa 1603, watercolour on vellum, laid on card, 4.9 × 4 cm. Collection of Fitzwilliam Museum, Cambridge (FM 3869). . Digital image courtesy of National Portrait Gallery, London (All rights reserved); Fitzwilliam Museum, Cambridge (All rights reserved).

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Secrets of a Silent Miniaturist: Technical Study of Miniatures Attributed to Isaac Oliver

Christine Slottved Kimbriel and Paola Ricci

Abstract

An evidently accomplished draughtsman, Isaac Oliver (circa 1565–1617) remains an enigmatic artist in many respects. While Nicholas Hilliard’s treatise on the art of limning provides considerable insight into his material use, techniques, and self-perception, no equivalent documentary evidence survives from Oliver’s hand, and many questions regarding his training, approach, and oeuvre have yet to be answered. This article presents key findings from the collaborative and technically focused research project “Secrets of a Silent Miniaturist: Technical Analysis of Isaac Oliver’s Miniatures”, undertaken by the Fitzwilliam Museum and the Hamilton Kerr Institute in Cambridge (UK). The project aims to shed light on Oliver’s artistic practice through the detailed, technical study of a representative selection of his surviving miniatures, investigated through an up-to-date, non-invasive analytical and technical lens. The article discusses the discovery of near-invisible changes to compositions implemented during the initial execution, differences in execution and later history between two versions of a portrait of Henry Frederick Prince of Wales, the first identification in a miniature of a rare mercury-based white pigment whose deterioration led to later campaigns of repainting, and the use of a hitherto unacknowledged range of pigments and media in Oliver’s landscape miniatures that raises further questions about Oliver’s connection with artistic traditions on the Continent.

Authors

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Introduction

This article presents key findings from the collaborative and technically focused research project “Secrets of a Silent Miniaturist: Technical Analysis of Isaac Oliver’s Miniatures”, undertaken by the Fitzwilliam Museum and the Hamilton Kerr Institute in Cambridge (UK).

An evidently accomplished draughtsman, who successfully expanded on the subject matter of the English miniature to include elaborate landscapes as well as religious imagery, Isaac Oliver (circa 1565–1617) nevertheless remains an enigmatic artist in many respects. While Nicholas Hilliard’s treatise on the art of limning provides considerable insight into his material use, techniques, and self-perception, no equivalent documentary evidence survives from Oliver’s hand, and many questions regarding his training, approach, and oeuvre have yet to be answered.

In September 2016, the Hamilton Kerr Institute (HKI) received from the National Trust (NT) the recently acquired cabinet miniature of Lord Herbert of Cherbury.¹ The National Trust commissioned conservation treatment and a full technical examination of the miniature, prior to its reinstatement as a key piece in the *House of Portraits* exhibition at Powis Castle in Wales. In order to analyse the condition, materials, and techniques of the miniature comprehensively, technical imaging of the work was undertaken, and further non-invasive analysis was carried out in the analytical research laboratory of the Fitzwilliam Museum, as well as at the Scientific Department of the V&A Museum in London. While the collected data revealed a great deal about the materials and execution of the miniature, limited comparable research was available to allow for comparison and broader contextualisation.² In response to this fact, funds were raised to undertake a pilot study employing the same analytical protocol on the Fitzwilliam Museum’s own collection of miniatures attributed to Isaac Oliver, in addition to select works from other institutions ([Fig. 1](#)).³

[View this illustration online](#)

Figure 1.

List of miniatures analysed during the pilot project, compiled by Christine Slottved Kimbriel and Paola Ricciardi.

The research project aimed to establish the extent to which useful information could be gleaned about the miniatures’ make-up by employing an extensive, non-invasive technical protocol. We did not set out with the intention of solving attributional questions, although this is an area in which work remains to be done. Instead, we were interested chiefly in gauging and documenting the breadth of materials and technical characteristics these

works possess, and in considering this information in the context of broader, outstanding questions about the artist's working practices and potential collaborations, his liaison with clients, his relationship with art production on the Continent and his possible movements abroad. The systematic employment of an extensive technical approach constitutes an attempt to gain supplementary insight through the surviving miniatures themselves.

This article offers a brief overview of the history of technical analysis into miniatures and the analytical protocol employed for the "Secrets of a Silent Miniaturist" project. It goes on to present key findings from the study, first giving examples of near-invisible original pentimenti and examining the relationship between repeat compositions in surviving miniatures of Ludovic Stuart and Henry, Prince of Wales, respectively. In this context, it also discusses how subtle deterioration, historical damage, and later interventions—often difficult to appreciate with the unaided eye—can skew our assessment of the quality of the miniatures.

The article then discusses the unprecedented discovery in a portrait miniature of calomel, a mercury chloride compound employed as a white pigment. It is argued that this material corresponds with the "quicksilver white" mentioned by Hilliard in his draft treatise, and an explanation is offered for his enigmatic statement that this white is what "women painters" use, by turning to the writings of Richard Haydocke, Hannah Woolley, and the contemporary apothecaries' trade.

As already mentioned, this project has its origin in the conservation and technical examination of a cabinet miniature, whose subject matter provides an opportunity for the artist to employ a greater range of materials than in small-scale conventional portrait miniatures, when rendering landscape backgrounds and complex figure groups. Further evidence about Oliver's wide-ranging technical skills and material use, based on the comparative study of two further cabinet miniatures, as well as a Netherlandish landscape miniature from Burghley House, will also be discussed.

Research Methodology

The technical investigation of miniatures was spearheaded in the 1980s at the V&A through the pioneering work of the late Jim Murrell, the Museum's miniatures conservator at the time. The non-invasive methods available to Murrell in the 1980s for his technical examinations included microscopy, surface examination in raking and ultraviolet light, infrared photography and x-radiography.⁴ Since then, the range of analytical tools applicable to miniatures has grown considerably and now allows unprecedented insight into the material composition and the technical refinement of miniatures.

Despite this, beyond some work which continues to be carried out mainly at the V&A,⁵ portrait miniatures from all periods have only very rarely been subjected to scientific investigation, due to a number of physical factors, some of which they have in common with other types of objects in museum and library collections: their small dimensions, extreme fragility, and light sensitivity, for example, are shared by medieval and Renaissance illuminated manuscripts. Both types of materials require a fully non-invasive approach, because in order to safeguard the objects' integrity, the removal of physical samples of paint, however small, is currently considered unacceptable by the majority of institutions. Light sensitivity and the presence of leanly bound paint layers impose further constraints on the technical specifications of the equipment used for analyses; methods that rely on the measurement of visible and infrared light reflected by the object's surface, for example, can only be used if the light exposure is low enough to guarantee that no fading or other light-induced degradation of the pigments will occur. Equally, the power of lasers employed by Raman spectrometers has to be kept below certain limits in order to avoid photo-degradation.⁶

The scientific analysis of miniatures presents an additional level of complexity, in comparison with manuscripts, because access is made difficult by the fact that they are, for the most part, housed in sealed lockets. Usually crafted in wood, ivory, or metal, and in the majority of cases only paired with the miniatures at a late point in their history (often during the Victorian period), these lockets have safeguarded their contents against damage for hundreds of years, but severely restrict direct access to a miniature's surface for the scientific investigator. Surface access is indispensable for most scientific methods to be used reliably;⁷ our technical study has therefore required the opening of lockets. The decision to carry out such a procedure is never taken lightly. Choices are made on a case-by-case basis, and rest on the feasibility of gaining access to the miniature's surface without causing damage to the miniature or to the locket.

The similarity between sixteenth- and seventeenth-century miniatures and illuminated manuscripts is not limited to their minute details and stringent conservation requirements. Both types of object were almost always painted on vellum with finely ground pigments bound in a water-soluble medium. Because of this material similarity, we were able to employ the same rigorous, non-invasive analytical protocol, originally developed for research on illuminated manuscripts, which has been used extensively at the Fitzwilliam Museum during the past eight years in the context of an ongoing large-scale and cross-disciplinary research project on medieval and Renaissance manuscripts.⁸

The first step of the protocol is the technical imaging of each miniature, which includes near-infrared (NIR) and ultraviolet (UV) imaging, x-radiography, as well as close observation under magnification, both in normal and in raking light. A range of point-specific spectroscopic methods is employed next, including UV-visible-NIR reflectance spectroscopy (commonly termed FORS) ([Figs 2 and 3](#)), Fourier-transform infrared spectroscopy (FTIR), and x-ray fluorescence spectroscopy (XRF).⁹ When used in combination, these methods allow us to visualise underdrawing, compositional changes, and previous conservation treatments; to identify pigments and paint binders; and to enhance our understanding of the painting techniques employed. The protocol was adapted for off-site work, that is, whenever it was not possible to transport the miniatures to the Fitzwilliam Museum, and the equipment had instead to be brought to a different institution.¹⁰ The numerous techniques included in the protocol are truly complementary and most effectively used in combination with each other, not only because of the different scale at which they operate, but also because they each perform better at the identification of a different range of materials.¹¹



Figure 2.

FORS analysis setup in the laboratory at the Centre for Art Technological Studies (CATS), Copenhagen. Digital image courtesy of Centre for Art Technological Studies (CATS), Copenhagen.



Figure 3.

Close-up image of the analytical probe in proximity to the artwork, *during FORS analysis*. Digital image courtesy of Centre for Art Technological Studies (CATS), Copenhagen.

Because of the practical challenges posed by the scientific study of miniatures, and of the need to employ a multi-modal analytical approach, the successful and safe completion of the analysis—including opening of the miniatures, data collection, as well as its meaningful interpretation and contextualisation—relies on a broad set of specialist skills, which can only be found in cross-disciplinary research teams. The expanded insights that such a comprehensive, in-depth technical approach can provide will be exemplified throughout this article by the discussion of selected case studies.

Key Discoveries: Pentimenti and Repeat Compositions

The fundamental requirements of the limning technique employed by Oliver and his contemporaries allow extremely limited scope for alterations. This is evident from Hilliard’s instructions on the laying in of the carnation which, if slightly too dark, cannot be modified, and must possess just the right consistency during application to not result in a “patched and rough” appearance. Then, the ensuing outlining of facial features in faint red lake, once visible, cannot be altered and must be suitably proportioned to the sitter’s features: later attempts to rectify faults are described as “botching and mending [which] will be perceived [...] for the carnation [to] never be of the same colour again.”¹² The further work to build up the colours is done “with the point of the pencil [paint brush] by little light touches, with colour very thin, and like hatches” and with a warning to “touch not too long in one

place, lest it glisten, but let it dry an hour or two, then deepen it again".¹³ With the accompanying instructions regarding the thorough purification and preparation of pigments mixed with just the right proportions of gum Arabic and varying additives, the delicacy of the entire process is as evident as is the delicate perfection of a successfully executed miniature. It was therefore surprising to find evidence of pentimenti in the miniatures examined, and two examples—both of which constitute costume changes—serve to illustrate how the artist sought to execute them and to what effect.

In the miniature of Lord Herbert of Cherbury lying by a brook,¹⁴ the fastening method, position, and colour of the sitter's scabbard were altered. Initially, the scabbard was blue to match Lord Herbert's elaborate outfit and lay loose in the grass behind him (Fig. 4). Across his chest, the faint diagonal line of what is likely to be a sword strap can still be appreciated (Fig. 5).¹⁵ Its nature becomes more evident with x-ray and raking light imaging, because it was painted thickly, with lead white paint, over the light grey base of the costume (see Figs 5 and 6). Under magnification, it is evident that it was outlined with a pale blue wash. Similarly, bodied grey-white bands with pale blue outlines are present throughout the costume. These have received further decorative detailing consisting of blue zigzag lines interspersed with minute silver hatching (now tarnished to dark grey and black) meant to indicate the shimmering dazzle of silver stitching. The sword strap never received these final embellishments but was instead disguised by the silver hatching strokes employed across the grey panels of the doublet and continuing across the strap feature. However, the pale lead white paint of this abandoned feature, perhaps coupled with the slight darkening through ageing of the vellum support that shines through the thin grey paint surrounding the strap, betray its presence.



Figure 4.

Isaac Oliver, Sir Edward Herbert, later 1st Lord Herbert of Cherbury (detail of visible light image), circa 1613-14, 18.1 × 22.9 cm. Powis Castle, National Trust (NT 1183954). Digital image courtesy of Hamilton Kerr Institute.



Figure 5a.

Isaac Oliver, Sir Edward Herbert, later 1st Lord Herbert of Cherbury (detail of visible light image), circa 1613-14, 18.1 × 22.9 cm. Powis Castle, National Trust (NT 1183954). Digital image courtesy of Hamilton Kerr Institute.

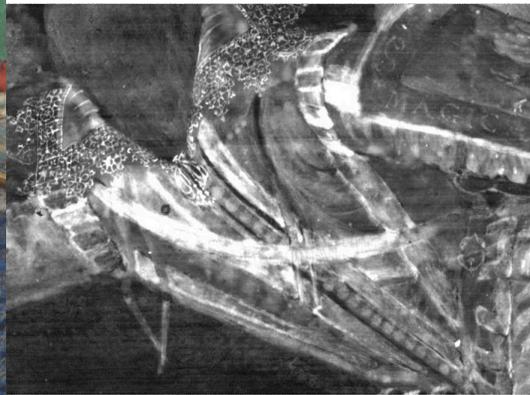


Figure 5b.

Isaac Oliver, Sir Edward Herbert, later 1st Lord Herbert of Cherbury (detail of x-radiograph), circa 1613-14, 18.1 × 22.9 cm. Powis Castle, National Trust (NT 1183954). Digital image courtesy of Hamilton Kerr Institute.



Figure 6.

Isaac Oliver, Sir Edward Herbert, later 1st Lord Herbert of Cherbury (detail of raking light image), circa 1613-14, 18.1 × 22.9 cm. Powis Castle, National Trust (NT 1183954). Digital image courtesy of Hamilton Kerr Institute.

The blue scabbard in the grass was concealed beneath a layer of green paint. The pale green paints employed throughout the miniature consist of coarse mineral pigment, which would have provided body to the paint and good covering power, likely to have concealed the blue scabbard well. Ageing has diminished the binding power of the medium holding together the coarse green pigment. This has resulted in the subtle crumbling away of pigment from these passages, thereby lessening their covering power and allowing the scabbard to show through much more clearly than it would have done originally.

Notwithstanding the effects of the passage of time however, it should be stressed that even with the artist's skilful use of the means available to him, they would not have sufficed to fully conceal the changes.

The ambitious composition of the cabinet miniature of Lord Herbert befits its sitter, who, as evidenced through his autobiographical account and general historical record, ceaselessly staged his own multifaceted character of noble soldier and knight, international diplomat, melancholic thinker, metaphysical scholar and poet, musician, and heart-throb. Seeking to express the majority of the above within this composition, it is more than likely that the (to

modern eyes minor) change to the sword's prominence, position, and appearance were requested by Lord Herbert himself, and that the request overruled the technical considerations of the artist's technique.

The Fitzwilliam Museum's portrait miniature of Ludovic Stuart, Duke of Lennox and of Richmond, ¹⁶ is at first glance a flawless example of Isaac Oliver's mastery of the limning technique, coupled with his powerful ability to depict his sitters with character. The portrait itself is of an immaculately styled and dressed nobleman with handsome features and a piercing gaze (Fig. 7). The entire composition speaks of a controlled and well-planned execution. When examined a bit closer however, two apparent flaws can be seen: first, the proper right collar section, as opposed to the left, has suffered flaking and associated losses of paint (Figs 8 and 9); and second, the top section of the proper left part of the Order of the Garter ribbon has a different blue tonality to the rest. These inconsistencies make no apparent sense, until the miniature is examined beyond what can be perceived with the naked eye. The near-infrared (NIR) image shows a clearly demarcated area above both shoulders that bears little resemblance to the finished composition (Fig. 7). The copper-based blue pigment azurite used for the ribbon and the carbon black of the doublet absorb these wavelengths of light and appear dark in the NIR image. The face and the area above the shoulders, including also the uppermost section of the Order of the Garter ribbon, however, appear light in the NIR image. This signals areas where the vellum support was left in reserve, or which were painted with different, non-IR-absorbent pigments. There is an exact correlation between the cracked and flaking area in the collar and the part of the collar *not* left in reserve when the azurite background was floated in. ¹⁷



Figure 7a.

Isaac Oliver, Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond, circa 1603, 4.9 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3869). Digital image courtesy of Fitzwilliam Museum.



Figure 7b.

Isaac Oliver, Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond (near-infrared image), circa 1603, 4.9 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3869). Digital image courtesy of Fitzwilliam Museum.



Figure 8.

Isaac Oliver, Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond (photo-micrograph), circa 1603, 4.9 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3869). Digital image courtesy of Fitzwilliam Museum.



Figure 9.

Isaac Oliver, Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond (photo-micrograph), circa 1603, 4.9 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3869). Digital image courtesy of Fitzwilliam Museum.

XRF analysis of the slightly mismatched section of the Garter ribbon revealed that unlike the rest of the ribbon, which was executed in azurite, the separate section was painted with natural ultramarine, thus accounting for the subtle colour difference. While azurite dominates the original scheme, it should be noted that a small amount of ultramarine was employed over the finished white collar to suggest the translucency of the starched material (Fig. 9). There is no reason to suspect this use of ultramarine to be non-original.

Why was ultramarine chosen over azurite for these details? The choice may betray Oliver's keen material knowledge and technical know-how. While the copper-carbonate mineral must remain as coarse as is feasible to retain its intense blue colour associated with "good" azurite, high-quality lapis lazuli can be ground very finely while retaining its brilliant blue colour. This makes it much easier to paint with, as it allows for smoother, more controlled applications and greater covering power at reduced thickness compared to azurite. Oliver's mastery in applying azurite in the floating-in technique for the blue backgrounds is evident in raking light, where it can be seen to have settled perfectly around the contour of the sitter's curly hair (Fig. 10).

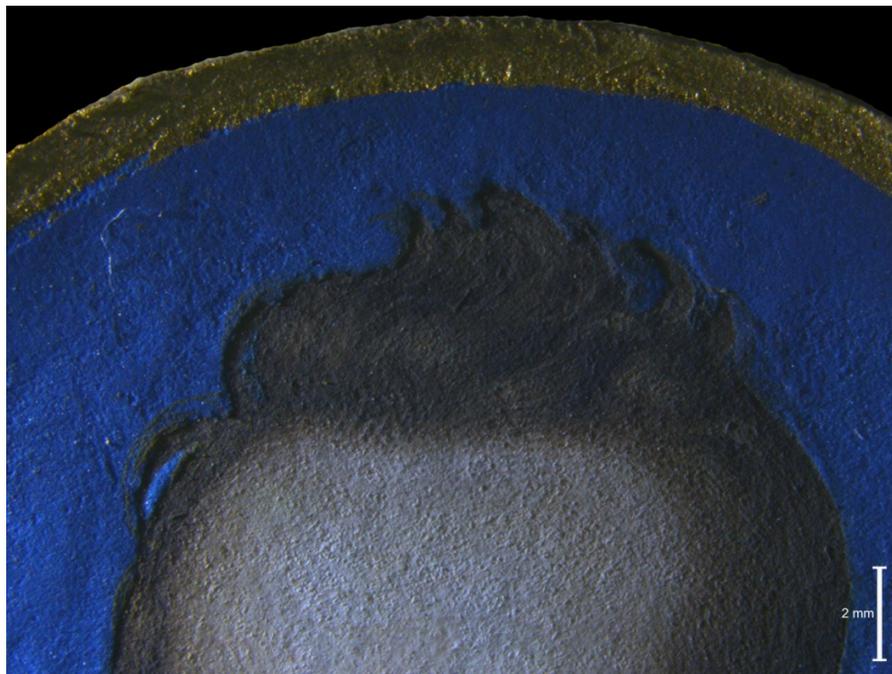


Figure 10.

Isaac Oliver, Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond (photo-micrograph in raking light), circa 1603, 4.9 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3869). Digital image courtesy of Fitzwilliam Museum.

However, for the gradated and extremely thin application of blue used to suggest the translucency of the starched, white collar fabric, azurite would most likely have been less suitable. Likewise, in order to achieve the best possible transition between the existing, azurite blue Garter ribbon and the necessary addition, using ultramarine would have provided superior control and increased the painter's prospect of integrating the pentimento successfully. While the colour difference is noticeable today, it is also conceivable that it has increased since its execution, as natural ageing of the paint applications may have impacted on the various colour-passages differently.

The changes to the collar region described above can be contextualised through comparison with the National Portrait Gallery's (NPG) portrait miniature of Ludovic Stuart.¹⁸ While the compositions are highly similar, they differ in one important respect: the white collar in the NPG version is turned down (Fig. 11). Overlaying the outline of the down-turned collar of the NPG miniature onto the Fitzwilliam Museum version shows near-perfect correlation between the initial reserve left in the latter and the finished collar in the former.



Figure 11a.

Isaac Oliver and studio, Ludovic Stuart, 1st Duke of Richmond and 2nd Duke of Lennox, circa 1605, 5.7 × 4.4 cm. National Portrait Gallery, London (NPG 3063). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

Figure 11b.

Isaac Oliver, Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond (near-infrared image with outline of lowered collar-feature), circa 1603, 4.9 x 4 cm. Fitzwilliam Museum, Cambridge (FM 3869). Digital image courtesy of Fitzwilliam Museum.

As exemplified above, compositional changes introduced during the painting process posed a significant challenge to the limner and were practically impossible to disguise fully. Edward Norgate's treatise of the 1640s¹⁹ outlines the typical three sittings, each

lasting several hours, required to complete the portrait in a miniature—not including the costume; ample time for the sitter to have second thoughts about the details of their chosen outfit. Hilliard praises the “better and wiser sort” who possess “great patience, and mark the proceedings of the workman”, making no comment until the work is completed, and then referring it to “better judgment” to consider the outcome.²⁰ The change to Ludovic Stuart's chosen costume in the Fitzwilliam Museum miniature from the initial conception of the lowered collar to the more showy, French fashion “collet monté”,²¹ which would have necessitated the use of wire to retain its shape, happened at a relatively late stage in the painting process, by which time the face, beard, background, black doublet, and Garter ribbon were already painted. It is again very likely that the sitter himself instigated the collar change, quite possibly against the better judgement of the artist.

The fact that more than one version of the Ludovic Stuart miniature exists supports the possibility that a pattern or replica for the artist's further use may have been produced in connection with the initial commission.²² The present condition of the NPG version has relegated it to an “Isaac Oliver, and studio” attribution based on the lesser quality of the black costume in comparison with the Fitzwilliam Museum version. The NPG version's face and beard are recognised as being of a quality to suggest Isaac Oliver's own hand, despite these features having suffered from the fading of excessive exposure to light.²³ The execution of the face and beard now appears to consist of a limited palette of predominantly dark brown (Fig. 12). In contrast, a multitude of colour-accented achieved with red lake, red lead, vermilion, lead-tin yellow, yellow and red earths, and hints of blue characterise the elaborate working of the Fitzwilliam Museum miniature, which furthermore appears to have been executed with a less heavy use of the dark blackish-brown paint (Fig. 13). These differences cannot be explained by fading in the NPG version. For example, a range of yellow and orange earth pigments were employed in the sitter's fiery beard in the Fitzwilliam Museum miniature. These pigments are not susceptible to fading and seem to be absent in the NPG version.



Figure 12.

Isaac Oliver and studio, Ludovic Stuart, 1st Duke of Richmond and 2nd Duke of Lennox (photo-micrograph), circa 1605, 5.7 × 4.4 cm. National Portrait Gallery, London (NPG 3063). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.



Figure 13.

Isaac Oliver, Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond (photo-micrograph), circa 1603, 4.9 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3869). Digital image courtesy of Fitzwilliam Museum.

The NPG miniature has suffered considerable damage, which further muddies the picture. Raking light examination allows for a clarification of the expanse of damage and speaks of possible water ingress into the locket affecting the entire outer perimeter (Fig.14). It is conceivable, therefore, that the elements now appearing sub-par were in fact the efforts of a less talented miniaturist, who in this instance was serving as a “restorer” replacing what had been lost or damaged rather than completing unfinished passages. ²⁴



It
is
no

Figure 14a.

Isaac Oliver and studio, Ludovic Stuart, 1st Duke of Richmond and 2nd Duke of Lennox (raking light image), circa 1605, 5.7 × 4.4 cm. National Portrait Gallery, London (NPG 3063). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

Figure 14b.

Isaac Oliver and studio, Ludovic Stuart, 1st Duke of Richmond and 2nd Duke of Lennox (raking light image with non-original passages digitally masked), circa 1605, 5.7 × 4.4 cm. National Portrait Gallery, London (NPG 3063). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

longer possible to say whether the rest of the NPG miniature, that is, the costume and background, was ever worked up to the level of the Fitzwilliam Museum version by Isaac Oliver himself. It should perhaps be considered whether it was in fact executed as a pattern for studio use, which later came to be fully worked up. The provenance of the NPG miniature can be traced back to Lennox's third wife, Frances (née Howard) who married the duke in 1621. She was depicted by Van Dyck (1633) and Cornelius Johnson (1635) wearing the distinctly shaped miniature prominently adorning her mourning costume in the portraits painted well after Lennox's death in 1624. In both cases, the details of the miniature were painted with considerable accuracy, in line with the great importance of this miniature to the widowed sitter. While it is unknown *when* the miniature came into Frances' possession, it would almost certainly have been after Oliver's death.²⁵ The Van Dyck portrait's composition only survives through a later copy,²⁶ whereas Cornelius Johnson's extant portrait of Frances provides some insight into the appearance of the miniature at this exact stage (Fig. 15).²⁷ It is noteworthy that the hairstyle strongly recalls that of the Fitzwilliam Museum version. This supports the possibility that the costume, hair, and background were initially

painted to better and more faithful effect than how it has come down to us, at some stage between Ludovic Stuart's sitting to Oliver in or around 1603, and the execution of the portrait by Johnson in 1635.



[View this illustration online](#)

Figure 15.

Cornelius Johnson, Frances Howard, Duchess of Richmond and Lennox, 1635, 210.8 x 134.5 cm. Gilcrease Museum, Tulsa, Oklahoma (0176.1020). Digital image courtesy of Gilcrease Museum.

A second pair of portrait miniatures with identical compositions, in the collections of the Fitzwilliam Museum and the National Portrait Gallery respectively, were examined within the scope of the Isaac Oliver pilot project (Figs 16 and 17). In the case of the Fitzwilliam Museum version (FM 3903), the attribution to Isaac Oliver of the *all'antica* Henry, Prince of Wales of circa 1611, has never been questioned. In contrast, the assignment of the NPG version (NPG 1572) to the category of “studio of” (NPG website),²⁸ “studio version” (Strong),²⁹ and “shop” (Finsten)³⁰ has not been accompanied by

actual argumentation for this demotion from the status of an autograph work, although Strong notes that its condition is “very faded and somewhat rubbed”.

In particular, the level of subtle modelling evident in the flesh tones differs radically. Under magnification, the face of the NPG version appears faintly described in a monochrome palette, whereas the Fitzwilliam Museum miniature’s flesh tones display an attractive glow, achieved with accents of pinkish magenta, translucent yellow, and blue tones for the eye-surrounds to indicate the turbid medium effect of very fair skin (Figs 18 and 19).³¹ The light complexion of Henry’s skin is complemented by the deliberate omission of the bulk of his eyelashes, which suggests convincingly that they are blond and catching the light above the dazzling blue of the iris.

Thus, from close examination, it is evident how the modelling of the fair-skinned Fitzwilliam Museum Henry relies particularly heavily on the part played by magenta pink, yellow, and blue tones, all of which are based on fugitive dyestuffs: red and yellow lakes, and indigo blue. Light-induced fading would therefore be particularly detrimental to this particular composition and would explain why the flesh tones of the NPG version appear so strikingly different from the Fitzwilliam Museum version at first glance. However, it is also evident that the deftness and manner of execution of what remains of the facial features in the NPG miniature is highly comparable to the better-preserved version at the Fitzwilliam Museum. This is also the case for the well-preserved hair in both miniatures, which appears to have been executed without the use of fugitive colours and which looks equally accomplished (Figs 20 and 21).



Figure 16.

Isaac Oliver, Henry, Prince of Wales, circa 1610, 5.3 × 4 cm.
Fitzwilliam Museum, Cambridge (FM 3903). Digital image courtesy
of Fitzwilliam Museum.



Figure 17.

Studio of Isaac Oliver, Henry, Prince of Wales, circa 1610, 5.1 x 4.1 cm. National Portrait Gallery, London (NPG 1572). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

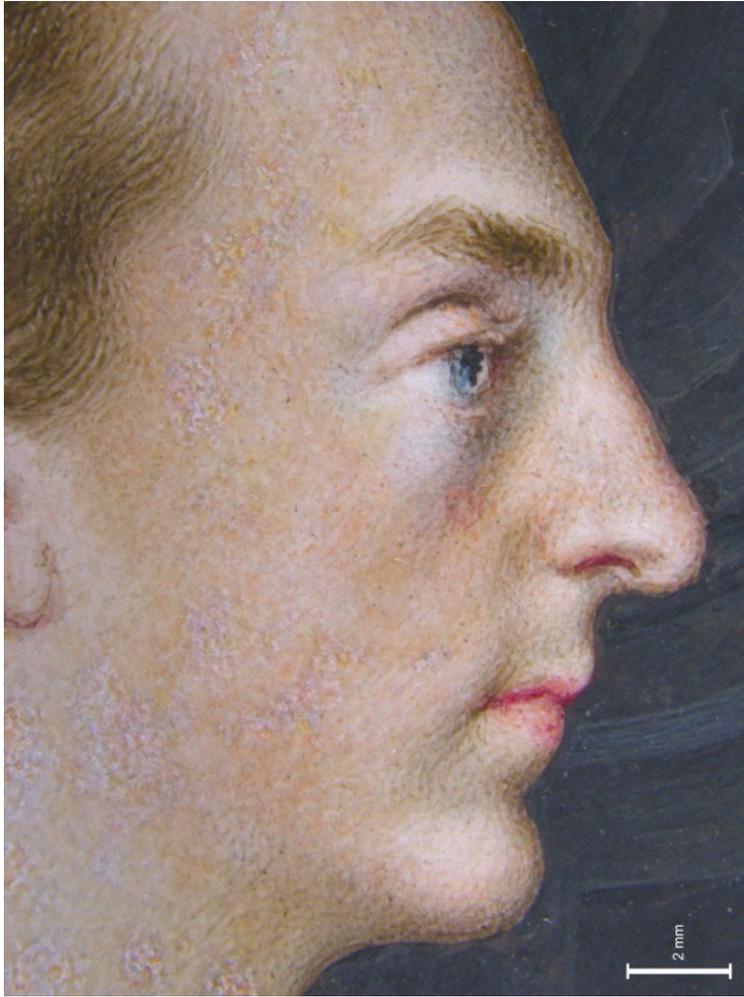


Figure 18.

Isaac Oliver, Henry, Prince of Wales (photo-micrograph), circa 1610, 5.1 × 4.1 cm. Fitzwilliam Museum, Cambridge (FM 3903). Digital image courtesy of Fitzwilliam Museum.



Figure 19.

Studio of Isaac Oliver, Henry, Prince of Wales (photomicrograph), circa 1610, 5.1 × 4.1 cm. National Portrait Gallery, London (NPG 1572). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

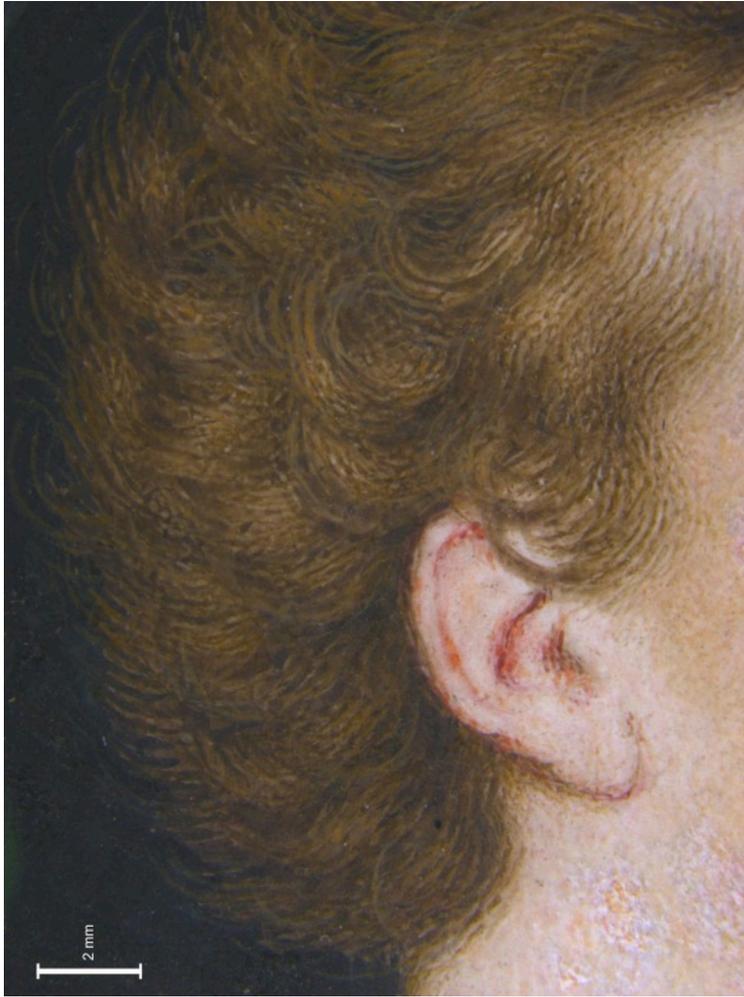


Figure 20.

Isaac Oliver, Henry, Prince of Wales (photo-micrograph), circa 1610, 5.1 × 4.1 cm. Fitzwilliam Museum, Cambridge (FM 3903). Digital image courtesy of Fitzwilliam Museum.

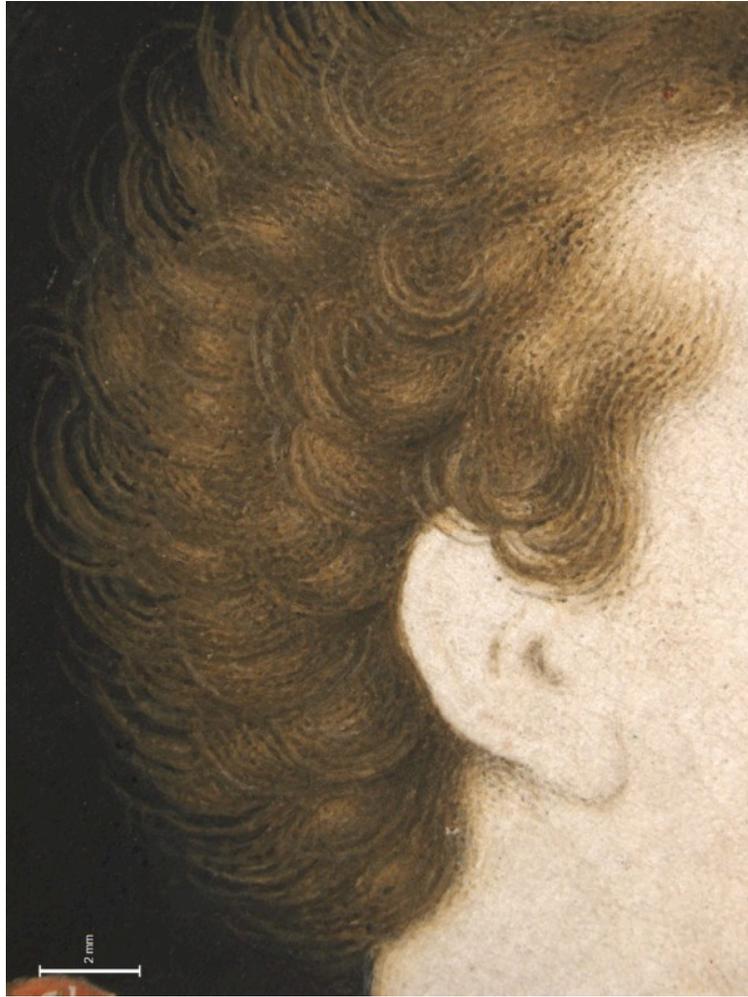


Figure 21.

Studio of Isaac Oliver, Henry, Prince of Wales (photo-micrograph), circa 1610, 5.1 × 4.1 cm. National Portrait Gallery, London (NPG 1572). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

Beyond the head and hair, there are other evident differences that contribute to the visual discrepancies between the two versions. The red toga has fared poorly in the NPG miniature, and the FORS analysis identified radically different colourants from the Fitzwilliam Museum version, in which the toga was painted with vermilion, and modelling was done on top with red lake employed to darken the folds of the garment. In contrast, the NPG toga was painted in red lead first, and while a red lake modelling is likely to have been employed to indicate folds in the fabric in a way comparable with the Fitzwilliam Museum toga, it is now no longer visually extant. Fading will have played a part as it has in the flesh tones, but in addition, flaking has also occurred to a significant degree, causing severe loss of the red lead paint as well. The flaking appears to be worse where the darkest shadows of the toga's folds would have been, indicating that where the red lake modelling

consisted of thicker applications, subsequent paint loss was particularly severe. It is often the case that red lead paint passages fare worse than other paints in miniature. Even in the well-preserved Fitzwilliam Museum miniatures of Ludovic Stuart and Henry, a powdering away of this bright orange-red pigment from lips and corners of the eyes is evident. The extensive use of red lead for the toga of the NPG miniature thus appears to have been a choice contributing to its poor survival in conjunction with the fading of red lake, and it is an irrefutable departure from the material choice of vermilion in the Fitzwilliam Museum toga. In light of Isaac Oliver's evident mastery of his art by the 1610s and his knowledge of the properties of the materials he used, the choice of red lead is perhaps surprising. On the other hand, the deterioration evident today may have happened slowly and well after Oliver's lifetime. It is also the case that he made extensive use of pigments prone to fading, which would most likely have been known by him, a fact which, we must assume, he considered acceptable.

The architectural backdrop of the two miniatures is on first sight more comparable. The NIR images, however, speak of a somewhat differing execution (Figs 22 and 23); it is evident that the use of a carbon black pigment makes the background passages appear dark in both miniatures, but the mottled appearance of the background in the Fitzwilliam Museum miniature suggests an uneven distribution of carbon black, whereas the NPG miniature has an even and fully covering distribution of this pigment, which was modelled subsequently with lead-containing highlights. In the Fitzwilliam Museum miniature, the density of the black pigment reduces in correspondence with protruding features in the architecture. These features, in normal light, appear more bluish. FORS analysis identified indigo in the background of the Fitzwilliam Museum miniature, but not in the NPG version. Indigo, therefore, is responsible for the subtle coolness of the architectural elements in the Fitzwilliam Museum background, and most noticeably so in the lighter surfaces (Figs 24 and 25). Overall, it cannot easily be argued that the unusual feature of an architectural niche in these two portrait miniatures is executed with greater technical acuity in either version, but close comparative scrutiny has shown the two passages to be more different than has been observed previously.

The effects of time and differing environmental conditions have undoubtedly increased the visual difference between these two identical compositions significantly, and while the recent examination has revealed inherent, material differences in some parts, others were most likely so close that a strong argument could be made for attributing them to the same hand. Regardless of what conclusion is drawn on the basis of this further evidence, the findings bring to the fore questions concerning Isaac Oliver's studio practices and collaborations. If the claim that the NPG miniature was executed entirely by a different hand than Oliver's is upheld (and it is a fact that Oliver's monogram is not extant), then it necessitates the existence of

an artist that can mimic his method to utter perfection, which is remarkable in particular when taking into account the minute scale and the complete lack of correction. And if, instead, partial execution by Oliver's own hand is accepted, then the role and skill of other hands in the passages that display material or technical differences deserve further consideration. The expanding, detailed study of miniatures associated with Isaac Oliver will allow for further comparisons between a larger number of works and may enable a better-informed discussion within the scholarly community.



Figure 22.

Isaac Oliver, Henry, Prince of Wales (near-infrared image), circa 1610, 5.3 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3903). Digital image courtesy of Fitzwilliam Museum.



Figure 23.

Studio of Isaac Oliver, Henry, Prince of Wales (near-infrared image), circa 1610, 5.1 × 4.1 cm. National Portrait Gallery, London (NPG 1572). Digital image courtesy of National Portrait Gallery/ Fitzwilliam Museum.



Figure 24.

Isaac Oliver, Henry, Prince of Wales (photo-micrograph), circa 1610, 5.3 × 4 cm. Fitzwilliam Museum, Cambridge (FM 3903). Digital image courtesy of Fitzwilliam Museum.



Figure 25.

Studio of Isaac Oliver, Henry, Prince of Wales (photo-micrograph), circa 1610, 5.1 × 4.1 cm. National Portrait Gallery, London (NPG 1572). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

Key Discoveries: Quicksilver White

*There is also an excellent white to be made of quicksilver which draweth a very fine line; this white the women painters use.*³²

This sentence has puzzled scholars of English sixteenth-century miniature painting for two reasons. First, that there is no well-known white pigment made from quicksilver (i.e. mercury); and second, that the identities and oeuvres of the presumed female painters that Hilliard refers to have so far been elusive.³³ The technical analysis of miniatures attributed to Isaac Oliver in the Fitzwilliam Museum has, however, provided the first surviving example of a miniature painted with a mercury-based white pigment, and its chemical make-up points to a strong link to the apothecaries' medicinal range and a different kind of "women painters" than female limners.

A miniature of an unknown lady in the Fitzwilliam Museum's collection is a depiction of a young, fashionably attired woman, perhaps a little faded and scuffed, but whose attribution to Isaac Oliver has remained firm to this day (Figs 26 and 27).³⁴ The near-infrared (NIR) image, and even more so the UV image of the miniature, provide strong indications that there is a great deal more to this miniature than meets the eye (Fig. 26). A light-grey passage in the otherwise dark background in the infrared image shows that damage has occurred along the edges. Analysis confirmed that this damage has been remedied with French ultramarine rather than the original azurite blue of the background. The fact that French ultramarine was first synthesised in 1826 dates this intervention to the 1830s at the earliest. In other passages, zinc white was identified analytically. As zinc white first occurred in the artists' watercolour range from the mid-1830s, the date of its application as a retouching material cannot pre-date this. The fact that zinc white was found to be present in only some of the retouched areas suggests that the miniature was probably restored on two different occasions. An earlier campaign of retouching includes an extensive repainting with barium white, which was identified throughout the white passages of the costume.

Barium white was introduced as an artist's pigment in the late eighteenth century, but what is particularly interesting about its presence in this miniature is its distribution; it is covering a surprisingly dull, grey rendition of the costume beneath, which is likely to be the reason for the extensive repainting (Fig. 28). High quality lead white, characteristic for its ability to retain its bodied texture, would have been the obvious pigment to choose for the crisp, white lace details in many portrait miniatures, and it is indeed what has generally been found when analysis on miniatures of the sixteenth and seventeenth centuries has been undertaken. However, in this case,

surprisingly small amounts of lead were detected during the analysis of the mottled grey, underlying paint scheme. Instead, a consistent mercury content was evident from the analytical data. This makes very little sense when considering the colour of the passage, as mercury is typically associated with vermilion, a bright red mercury sulphide pigment. Here, however, the mercury signal was associated with a signal for chloride in the XRF spectra, and when Raman spectra were subsequently acquired, they matched reference spectra for calomel, a mercurous chloride mineral known since antiquity and possibly named for its tendency to blacken upon exposure to ammonia (from the Greek *Kalos*, meaning beautiful, and *Melas*, meaning black). Calomel has also had a long-lived medicinal use but appears to be an extremely rare encounter in works of art.³⁵ It is therefore worth considering the route by which it came to be familiar enough to Hilliard to deserve a mention in *The Arte of Limning*.



Figure 26a.

Isaac Oliver, Unknown Lady, circa 1595-1600, 5.2 × 4.1 cm. Fitzwilliam Museum, Cambridge (FM 3868). Digital image courtesy of Fitzwilliam Museum.

Figure 26b.

Isaac Oliver, Unknown Lady (ultraviolet light photograph), circa 1595-1600, 5.2 × 4.1 cm. Fitzwilliam Museum, Cambridge (FM 3868). Digital image courtesy of Fitzwilliam Museum.



Figure 27.

Isaac Oliver, *Unknown Lady* (photomicrograph), circa 1595-1600, 5.2 × 4.1 cm. Fitzwilliam Museum, Cambridge (FM 3868). Digital image courtesy of Fitzwilliam Museum.

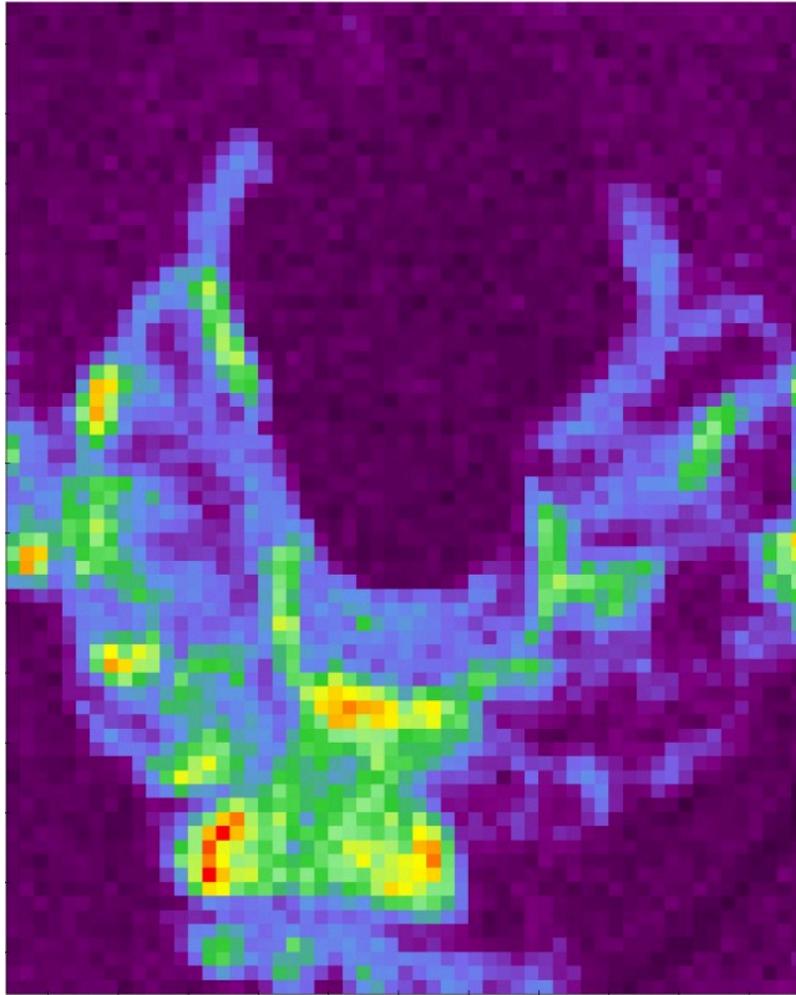


Figure 28.

Isaac Oliver, *Unknown Lady* (elemental map showing barium distribution), circa 1595-1600, 5.2 × 4.1 cm. Fitzwilliam Museum, Cambridge (FM 3868). Digital image courtesy of Bruker Elemental/Fitzwilliam Museum.

Hilliard wrote his treatise at the request of Richard Haydocke, who translated and published Paolo Lomazzo's treatise on painting, carving, and building in 1598, approximately two years before Hilliard drafted *The Arte of Limning*. Haydocke expands on Lomazzo's original manuscript with a section on female cosmetics.³⁶ In a subsection titled "Of sublimate, and the bad effects thereof", Haydocke writes:

Diverse women use sublimate diversely prepared for increase of their beauty. Some bray it with quicksilver in a marble mortar ... and this they call argentatum ... The composition whereof is of salte, quicksilver and vitriol, distilled together in a glassen vessel.

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Haydocke's purpose, being a physician, is to warn against the use of this white powder as make-up. He writes: "such women as use it about their face, have always black teeth, standing far out of their gums like a Spanish mule".

³⁸ Haydocke's sublimate, composed, he writes, of salte (sodium chloride), quicksilver, and vitriol (sulphuric acid) distilled in a glass vessel, is likely to be mercuric chloride (HgCl_2), which is a corrosive, white powder. Mercuric chloride is soluble in water, thus its deleterious effect on the unfortunate females through chemical burns and mercury poisoning is not surprising. In our present context, however, it is important to note that it would have been unsuitable as a pigment applied with a water-soluble paint medium such as gum Arabic, as it would have dissolved in the water-content of the paint and therefore have had no covering power. However, through a salt metathesis reaction, the corrosive sublimate can be turned from mercuric (II) chloride into mercurous (I) chloride, that is, calomel, which is insoluble in water. Haydocke's description leaves little doubt that corrosive sublimate was indeed employed. But taking into consideration the close chemical association between the two forms of mercury chloride, it seems plausible that the product these women employed for their beautification could often have been a mixture of the two. Indeed, evidence of females taking matters into their own hands is extant through the writings of Hannah Woolley, in her book *The Accomplish'd Lady's Delight* printed in 1675. ³⁹ Here, she provides instructions for a process that adds further steps to those reported by Haydocke. She gives the following recipe for a "beauty wash":

Take 4 ounces of Sublimate, and one ounce of Crude Mercury, and beat them together exceeding well in a Wooden Mortar, and wooden Pestle; you must do it at least 6-8 hours, then with often change of cold water, take away the salts from the sublimate, change your water twice every day at least and in 7 or 8 days it will be dulcified, and then it is prepared; lay it on with Oyl of white

Poppy. ⁴⁰

This washing process would remove soluble corrosive sublimate and any remaining sodium salts, leaving behind as the precipitate, insoluble mercurous chloride: calomel.

Returning to Hilliard's treatise, it seems highly probable that his "quicksilver white" pigment is calomel, and that this compound—in more or less purified form—was used by women to wash, paint, or whiten their faces. While Haydocke stresses the negative effects of corrosive sublimate as a cosmetics product, Hannah Woolley's recipe book provides evidence that although corrosive sublimate may have been the starting point, it was also known how to process it further into its "dulcified" cousin, calomel. In the context of the above, Hilliard's quote suggests that he associated the pigment with its cosmetic usage, but whether this was in part to do with his communications with Haydocke or through a different source altogether, cannot be established from his treatise. That he ascribes to it the specific handling properties necessary for the drawing of fine lines should perhaps be seen in the context of the properties of the alternative white, lead white, which had more body than any other pigments on the limner's palette and would therefore resist being applied in thin, consistent lines.

The use of calomel for the expansive but unadorned ruff in the Isaac Oliver miniature, as the only extant example so far identified, cannot be explained without further evidence. However, it is conceivable that the above-mentioned handling properties were taken into account for this unusual choice. Hilliard's and Oliver's ruffs are predominantly executed with a profusion of lace patterning done in lead white. The bodied paint of the lace would have supplemented protruding resin jewels and have contributed to the suggestion of tactile, real materials, which was a signature aspect of Hilliard's aesthetic. In the Oliver miniature, the voluminous ruff instead calls for subtle modelling of light and shade effects, with only the wire-edge requiring a stronger line. Was the limner's choice therefore guided by the knowledge that a white pigment without lead white's body and covering power would be superior for the intended effect? The original appearance of the costume is no longer appreciable due to the extent of the retouching campaigns. However, the visible glimpses of the calomel scheme suggest that the pigment suffered colour changes, potentially through exposure to alkali, which could conceivably have arisen from breakdown products from a cover glass with developing glass disease. But as calomel is also photosensitive, it could simply have suffered unsightly darkening through light exposure severe enough to warrant the extensive overpainting.

More examples of miniatures with calomel paint passages may surface with further analysis in the future, and the use of calomel could thus be proven less rare than it seems at present. A lack of surviving examples should not, however, be taken as proof that the pigment was as rare as it seems. The survival of this miniature may be serendipitous; relatively successful retouching reinstated the calomel passages that had become unsightly. It is quite possible that other miniatures with quicksilver white were less fortunate and were discarded well before our time.

Painting Landscapes

Although Nicholas Hilliard *did* produce a few portrait miniatures with landscape elements framing the sitter, it was Oliver who fully engaged with expansive landscape depictions as a setting for his allegorical or mythological subject matter, and while Hilliard struggled somewhat with perspective, Oliver was better able to suggest the recession towards the far distance that we see in masterfully executed Flemish landscapes around this time.⁴¹ Hilliard's treatise, after all, makes no reference to the painting of landscape and "histories" as part of limning.⁴² Both, however, are discussed in Edward Norgate's work *Miniatura, or the Art of Limning*.⁴³ Notably, Norgate draws examples for both from the work of Isaac Oliver's son Peter, whose landscapes he calls "indeed very excellent" and who provides the prime example for a "history" with his *Entombment*, begun by Isaac and completed by Peter Oliver.⁴⁴ Just as is the case for Hilliard, Edward Norgate (1581-1650), himself a miniature painter as well as a musician, also wrote his book at the request of a contemporary medical practitioner, in this case Sir Théodore Turquet de Mayerne (1573-1655), physician to James I and Charles I and himself the author of a famous manuscript on the art of painting.⁴⁵

Among Oliver's few surviving cabinet miniatures, both the *Allegory of Love* (Fig. 29) and *Elizabeth I and the Three Goddesses* (Fig. 30) are surprisingly small for their ambitious compositions, each measuring approximately 11 cm in height and no more than 17 cm across.⁴⁶ The National Trust portrait of Lord Herbert of Cherbury reclining in a landscape is larger (18.1 x 22.9 cm) and much less complex as a composition, owing little to sixteenth-century Flemish or Dutch print sources or to the Continental tradition of landscape painting. It sits more closely with the contemporary English fashion for the portrayal of the "melancholic" gentleman within a natural or cultivated landscape.⁴⁷



Figure 29.

Isaac Oliver, A Party in the Open Air. Allegory on Conjugal Love (“Allegory of Love”), circa 1590-95, 11.3 × 17.4 cm. Statens Museum for Kunst, Copenhagen (KMS 6938). Digital image courtesy of Statens Museum for Kunst.



Figure 30.

Attributed to Isaac Oliver, Queen Elizabeth I (“Elizabeth I and the Three Goddesses”), circa 1590, 11.5 × 15.7 cm. National Portrait Gallery, London (NPG 6947). Digital image courtesy of National Portrait Gallery/ Fitzwilliam Museum.

Despite the differences in scale, all of these compositions retain a number of technical features, which are commonly associated with portrait miniature painting. Notably, the coarse, mineral green pigments used to depict the landscapes were “floated into” place. Evidence of this application technique is given by raking light photography, which reveals the rounded, thick “cushions” of paint (Figs 31 and 32). The floating-in technique has already been discussed in connection with the azurite blue backgrounds traditionally present in portrait miniatures. The desired intensity of blue can only be achieved by using azurite ground very coarsely which is, however, almost impossible to apply with a traditional painting technique, that is, without the aid of a pre-wetted surface, onto which the coarse pigment is delivered via a loaded brush and in such a manner as to encourage it to float evenly into place.



Figure 31.

Isaac Oliver, *Allegory of Love* (detail of raking light image), circa 1590-95, 11.3 × 17.4 cm. Statens Museum for Kunst, Copenhagen (KMS 6938). Digital image courtesy of Statens Museum for Kunst.



Figure 32.

Isaac Oliver, Sir Edward Herbert, later 1st Lord Herbert of Cherbury (detail of raking light image), circa 1613-14, 18.1 × 22.9 cm. Powis Castle, National Trust (NT 1183954). Digital image courtesy of Hamilton Kerr Institute.

The expanded subject matter provides Oliver with an opportunity to employ a greater range of materials, especially in the extensive landscape passages, including the grass in the foreground as well as the mountains and foliage in the middle- and background. Our scientific investigation revealed that the landscapes in the three cabinet miniatures included in this study, apart from their evident stylistic adherence to a Netherlandish tradition of landscape painting, were all rendered using an unexpectedly broad range of copper-based mineral pigments.⁴⁸ These include the blue copper carbonate azurite, used in the darker passages of the landscapes, in addition to other copper-based pigments throughout the green areas.

Traditionally, and relying only on the elemental information derived from XRF analysis, the assumption has generally tended to be that a brightly coloured green area would be painted with malachite, a copper carbonate mineral. In our case, however, the use of additional analytical methods providing information not only on the individual chemical elements present in a paint passage, but also on the molecular structure of the pigment, allows for a

more reliable identification. We found that while malachite appears to be present most evidently in the slightly darker green passages of the landscapes, the copper sulphate mineral, brochantite, has been used in all of the paler, minty-green passages analysed.⁴⁹ The analytical results suggest that malachite and brochantite were utilised in distinct applications, yielding different shades of green to complement each other's hue, rather than in undiscerning mixes. Highlighted by bright yellows and reds in the luscious foliage, they provide an incredible range of colours. Their juxtaposition and, in some cases, superposition, also contribute to the convincing perspectival effects.

The presence of a copper sulphate mineral, in addition to blue and green copper carbonates, is worthy of further discussion. The chemistry of brochantite is not in itself significant, but the identification of copper sulphates, used as green pigments in European works of art, has often been described in the past as "tentative", or reported as an "unusual" finding. Despite the apparent lack of specific mentions of, or recipes for, green copper sulphates in historical treatises, recent research has demonstrated that pigments in this category—mainly brochantite, but also posnjakite and potentially others—were a staple on the palette of Flemish and Netherlandish artists during the fifteenth and sixteenth centuries. These identifications have largely resulted from the long-term programme of technical examination of Netherlandish school paintings carried out at the National Gallery in London.⁵⁰ More recently, research carried out on hundreds of illuminated manuscripts at the Fitzwilliam Museum has produced statistically significant information on the use of different copper greens in European centres of manuscript production across the Middle Ages and the Renaissance, and up to the beginning of the early modern period. In the context of this discussion, it is significant that while they are rare occurrences in Italy and France, copper sulphates abound in illuminations produced in Flanders and neighbouring regions during the fifteenth and sixteenth centuries.⁵¹

In order to start building a statistically significant database of green pigments used in miniature landscapes, we analysed an unusual miniature landscape in the collection of Burghley House in Lincolnshire (Fig. 33). Its strong visual similarities with the *Allegory* and the National Trust miniature with regards to the landscape features, as well as its dimensions, which match those of traditional portrait miniatures, made its analysis especially appealing. It is presently unattributed, with the general categorisation of "Flemish landscape" attached to it. The analysis undertaken confirms that the choice of pigments and their distribution in the green passages are highly comparable to that of the Oliver landscapes, and of the *Allegory* in particular.



Figure 33a.

Flemish School, A landscape, seventeenth century, 5 × 4 cm. Burghley House, Stamford, Lincolnshire (MIN0102). Digital image courtesy of Burghley House/Fitzwilliam Museum.



Figure 33b.

Flemish School, A landscape (near-infrared image), seventeenth century, 5 × 4 cm. Burghley House, Stamford, Lincolnshire (MIN0102). Digital image courtesy of Burghley House/Fitzwilliam Museum.

also worth briefly discussing the blue-grey architectural features, which appear in all four of the landscapes analysed (Figs 34, 35, 36 and 37). In three of them, these take the form of minute shapes receding into the far distance before further mountain ranges.⁵² In the National Portrait Gallery miniature, the buildings are much closer to the viewer, resulting in a much more “contained” landscape.

In both the *Allegory* and the Flemish landscape, these blue-grey architectural features were painted using smalt, a pigment made from ground cobalt-blue glass and famously traded in great quantities in Antwerp during the second half of the sixteenth and throughout the seventeenth century. In the *Allegory*, in particular, smalt is present only in the very pale blue-grey buildings, not in the brighter blue areas, which instead contain azurite. Smalt is known to degrade when bound in oil, resulting in a loss of blue colour and an overall darkening of the paint layers. In water-based binders, smalt is less prone to degradation, but still sensitive to environmental conditions.⁵³ It is therefore possible/likely that the landscape in this miniature was bluer originally, having subsequently lost much of its colour due to the chemical processes affecting the smalt—processes that appear not to have affected the small Flemish landscape as substantially. In the other two landscapes, the architectural elements were painted using azurite blue instead and have retained their colour beautifully.⁵⁴

It
is

The material evidence discussed here, with regards to Oliver's choice of green and blue pigments for his landscapes, is a useful addition to the growing body of comparable analytical data available from research on contemporary illuminated manuscripts and easel paintings. It provides an opportunity to start comparing the use of smalt and of copper green pigments, across European artistic centres at the turn of the seventeenth century. It also establishes a solid ground on which to build further object-based explorations of limning practice in England among artists of the generation following Oliver's, including his own son Peter's, and for further comparisons with Norgate's mid-seventeenth-century writings.



Figure 34.

Isaac Oliver, *Allegory of Love* (photo-micrograph), circa 1590-95, 11.3 × 17.4 cm. Statens Museum for Kunst, Copenhagen (KMS 6938). Digital image courtesy of Statens Museum for Kunst.



Figure 35.

Flemish School, A landscape (detail of visible image), seventeenth century, 5 × 4 cm. Burghley House, Stamford, Lincolnshire (MIN0102). Digital image courtesy of Burghley House/Fitzwilliam Museum.



Figure 36.

Isaac Oliver, Sir Edward Herbert, later 1st Lord Herbert of Cherbury (detail of visible image), circa 1613-14, 18.1 × 22.9 cm. Powis Castle, National Trust (NT 1183954). Digital image courtesy of Hamilton Kerr Institute.



Figure 37.

Attributed to Isaac Oliver, Elizabeth I and the Three Goddesses (photo-micrograph), circa 1590, 11.5 × 15.7 cm. National Portrait Gallery, London (NPG 6947). Digital image courtesy of National Portrait Gallery/Fitzwilliam Museum.

A Cosmopolitan Artist

The Oliver family's close relationship with Dutch members of the immigrant community in London is evident through the will of the young Peter Matheusen (d. 1588), the likely son of Jacob Matheusen (d. 1570), a painter from Breda denized in 1562, who lived in the Old Bailey district just a stone's throw from the Oliver family's home in Fleet Lane. Peter Matheusen was a cousin of Adrian Vanson, the court portrait painter to James VI of Scotland, and Matheusen left to Vanson "three picture of the counterfaytings of my late ffather and mother and also of me and also the Arte concerning Lymning".⁵⁵ He also bequeathed £3 each to Isaac Oliver and his mother Epiphane, in addition to his "books of Artes and that whiche concerneth the same arte to my fellows Isac Olivyer and Rouland".⁵⁶ While Rowland Lockey's eight-year association with Nicholas Hilliard is documented to have commenced in 1581 and finished prior to 1592, no apprentices or pupils in the arte of limning are named in the sparse surviving sources on Hilliard's workshop.⁵⁷ However, it is tempting to read Peter Matheusen's reference to his fellows Isaac Oliver and Rowland, coupled with the date of his will and his evident possession of the "Arte concerning Lymning", as likely indications that the connection between the three of them was tutelage by Hilliard.

Isaac Oliver's general stylistic debt to contemporary continental art production is widely recognised by scholars.⁵⁸ Our increasing understanding of the artist's material choices, as revealed by in-depth technical and scientific analysis of a selection of representative works, points to a distinctive use of copper greens and a routine employment of the blue glass-based pigment smalt. Both are quintessentially "Flemish" material choices, strengthening the claim that Oliver's milieu was strongly rooted in the Dutch tradition, both stylistically *and* materially. Growing insight into the materiality of Oliver's art and that of his contemporaries gained through comprehensive analytical means has the potential to further clarify these connections.

Footnotes

- ¹ (NT 1183954).
- ² See Christine Slottved Kimbriel and Paola Ricciardi, "A Closer Look at the Cabinet Miniature of Lord Herbert of Cherbury", National Trust Collections, 29 May 2018, <http://www.nationaltrustcollections.org.uk/article/a-closer-look-at-the-cabinet-miniature-of-lord-herbert-of-cherbury>, accessed 10 September 2020.
- ³ The pilot project was funded by the Cambridge Humanities Research Grants Scheme.
- ⁴ Jim Murrell, *The Way Howe to Lymne: Tudor Miniatures Observed* (London: Victoria and Albert Museum, 1983).
- ⁵ The list of relevant, easily accessible publications is exceptionally short and is largely limited to the following: Alan Derbyshire and Robert Withnall, "Pigment Analysis of Portrait Miniatures Using Raman Microscopy", *Journal of Raman Spectroscopy* 30 (1999): 185-188; Alan Derbyshire, Nick Frayling, and Timea Tallian, "Sixteenth-Century Portrait Miniatures: Key Methodologies for a Holistic Approach", in Mark Clarke, Joyce H. Townsend, and Ad Stijnman (eds), *Art of the Past: Sources and Reconstructions* (London: Archetype Publications, 2005), 91-93; Diana Mancini, Aurélie Tournié, Maria-Cristina Caggiani, and Philippe Colombari, "Testing of Raman Spectroscopy as a Non-Invasive Tool for the Investigation of Glass-Protected Miniature Portraits", *Journal of Raman Spectroscopy* 43, no. 2 (2012): 294-302, doi:[10.1002/jrs.3010](https://doi.org/10.1002/jrs.3010); Lucia Burgio, Anna Cesaratto, and Alan Derbyshire, "Comparison of English Portrait Miniatures Using Raman Microscopy and Other Techniques", *Journal of Raman Spectroscopy* 43, no. 11 (2012): 1713-1717, doi:[10.1002/jrs.4133](https://doi.org/10.1002/jrs.4133); Alfredina Veiga, José Mirão, António J. Candeias, Paulo Simões Rodrigues, Dora Martins Teixeira, Vânia S.F. Muralha, and Jorge Ginja Teixeira, "Pigments Analysis of Portuguese Portrait Miniatures of 17th and 18th Centuries by Raman Microscopy and SEM-EDS", *Journal of Raman Spectroscopy* 45, no. 10 (2014): 947-957, doi:[10.1002/jrs.4570](https://doi.org/10.1002/jrs.4570); Alfredina Veiga, Dora Martins Teixeira, António J. Candeias, José Mirão, Aan Manhita, Catarina Miguel, Paulo Rodrigues, and Jorge Ginja Teixeira, "Micro-Analytical Study of Two 17th Century Gilded Miniature Portraits on Copper", *Microchemical Journal* 123 (2015): 51-61, doi:[10.1016/j.microc.2015.05.015](https://doi.org/10.1016/j.microc.2015.05.015); and Janka Hradilová, David Hradil, Michal Pech, Petr Bezdička, Vilem Neděla, Eva Tihlaříková, and Piotr Targowski, "Complementary Use of X-Ray Based Imaging and Analytical Methods in the Investigation of Miniature Portraits", *Microchemical Journal* 153 (2020), 104371, doi:[10.1016/j.microc.2019.104371](https://doi.org/10.1016/j.microc.2019.104371).
- ⁶ A common recommendation is to keep laser power well below 1 mW, see, for example, Lucia Burgio, "Analysis of Pigments on Manuscripts by Raman Spectroscopy: Advantages and Limitations", in Sarah Neate, David Howell, Richard Ovenden, and A.M. Pollard (eds), *The Technological Study of Books and Manuscripts as Artefacts: Research Questions and Analytical Solutions* (London: Archaeopress, 2011), 67-76.
- ⁷ Very little research has been carried out on the possibility of undertaking scientific analysis of miniatures without removing their cover glasses. See, for example, Derbyshire and Withnall, "Pigment Analysis of Portrait Miniatures Using Raman Microscopy"; and Mancini *et al.*, "Testing of Raman Spectroscopy as a Non-Invasive Tool".
- ⁸ See "MINIARE: Manuscript Illumination: Non-Invasive Analysis, Research and Expertise", The Fitzwilliam Museum, Cambridge, <https://www.fitzmuseum.cam.ac.uk/research/miniare>.
- ⁹ Additional analyses by means of Raman spectroscopy were carried out on selected objects, either by commission to the V&A's Senior Objects Scientist, Dr Lucia Burgio, or by borrowing a portable spectrometer. The latter allowed the analyses to be performed on site at the Fitzwilliam Museum, with the drawback of not having the same high spatial resolution available in a bench-top instrument such as the one in use at the V&A.
- ¹⁰ The miniatures belonging to the National Portrait Gallery and Burghley House were analysed in their respective host institutions. The Statens Museum for Kunst (SMK) miniature was analysed at the Centre for Art Technological Research in Copenhagen, in collaboration with the local scientists and using the Centre's own equipment.
- ¹¹ A recent comprehensive review of the analytical methods used to analyse illuminated manuscript can be usefully read with an eye to the technical study of miniatures, see Paola Ricciardi and Catherine Schmidt Patterson, "Science of the Book: Analytical Methods for the Study of Illuminated Manuscripts", in Stella Panayotova (ed.), *A Handbook of the Art and Science of Illuminated Manuscripts* (London and Turnhout: Harvey Miller/Brepols, 2020), 51-87.
- ¹² Nicholas Hilliard, *The Arte of Limning*, edited by R.K.R. Thornton and T.G.S. Cain (Manchester: Carcanet Press, 1992), 77.

- 13 Hilliard, *The Arte of Limning*, 79.
- 14 Isaac Oliver, *Sir Edward Herbert, later 1st Lord Herbert of Cherbury (1581/2-1648)*, circa 1613–1614, National Trust, Powis Castle and Garden, Powys, Wales (NT 1183954), <http://www.nationaltrustcollections.org.uk/object/1183954>.
- 15 In the full-length portrait of *Sir Edward Herbert, later 1st Baron Herbert of Cherbury*, painted circa 1603 by a follower of William Larkin, in which he is depicted in the robes of the Knights of the Order of the Bath, his sword strap is lying across his chest. National Trust, Powis Castle and Garden, Powys, Wales (NT1180912) <http://www.nationaltrustcollections.org.uk/object/1180912>.
- 16 Isaac Oliver, *Ludovic Stuart, 2nd Duke of Lennox and Duke of Richmond*, 1603, Fitzwilliam Museum, Cambridge (FM 3869).
- 17 The floating-in technique is explained further below, in the “Painting landscapes” section.
- 18 (NPG 3063).
- 19 Edward Norgate, *Miniatura or the Art of Limning*, edited by Jeffrey M. Muller and Jim Murrell (New Haven, CT: Published for the Paul Mellon Centre for Studies in British Art by Yale University Press, 1997).
- 20 Hilliard, *The Arte of Limning*, 77.
- 21 Francois Boucher, *A History of Costume in the West* (London: Thames and Hudson, 1987), 242 and 252.
- 22 This has been proposed most recently by Catharine MacLeod in the *Elizabethan Treasures* exhibition catalogue entry for the NPG 3063 version; see Catharine MacLeod, *Elizabethan Treasures: Miniatures by Hilliard and Oliver* (London: National Portrait Gallery, 2019), 156–157. A likely example of such a pattern is the portrait of Robert Devereux in the collection of the Yale Center for British Art (circa 1596, B1974.2.75), see <http://collections.britishart.yale.edu/yufind/Record/1665673>.
- 23 MacLeod, *Elizabethan Treasures*, 156–157.
- 24 The pigments employed in these altered passages include natural ultramarine in the Garter ribbon, azurite, and natural ultramarine in the background, lead white and bone black. These pigments would have been available to Isaac Oliver himself, as well as to his seventeenth-century contemporaries, but could equally have been employed at a later stage.
- 25 Ludovic Stuart married Frances Howard in 1621, four years after Isaac Oliver’s death. It is worth noting also that the miniature has a table-book leaf backing. Peter Oliver is thought to have been the first to introduce this support, but only subsequent to his father’s death.
- 26 A follower of Anthony van Dyck, *Portrait of Frances Howard, Duchess of Richmond*, oil on canvas, 201 x 130 cm, Sold in Sotheby’s sale 2009, <http://www.sothebys.com/en/auctions/ecatalogue/2009/early-british-paintings-109682/lot.3.html>, accessed 19 March 2020.
- 27 Cornelius Johnson, *Frances Howard, Duchess of Richmond and Lennox*, 1635, oil on canvas, Gilcrease Museum, Tulsa, Oklahoma (0176.1020).
- 28 <https://www.npg.org.uk/collections/search/portrait/mw03090/Henry-Prince-of-Wales>, accessed 19 March 2020.
- 29 Roy Strong, *Tudor and Jacobean Portraits* (London: National Portrait Gallery Publications, 1969), 161.
- 30 Jill Finsten, *Isaac Oliver: Art at the Courts of Elizabeth I and James I*, Vol. 2 (New York: Garland Publishing, 1981), catalogue no. 66, 104–105.
- 31 Turbid medium effect arises when a lightly coloured substance with sufficient turbidity sits over something dark. The filtering of the light through these substances results in a blue tinge to the light reflected back to the onlooker, such as the blue cast from fair skin over red blood. While an artist of slow-drying paint (e.g. oil paint) can achieve this effect by applying a thin layer of white over a dark underlayer, a miniaturist cannot work larger passages of smooth paint one over the another. Instead, (s)he relies on the skilful application of minute strokes over and adjacent to each other in order to achieve the same visual effect. In addition, the success of the illusion relies on a viewing distance at which the eye stops perceiving each individual brush stroke and instead perceives a visually blended totality.
- 32 Hilliard, *The Arte of Limning*, 71.
- 33 R.K.R Thornton and T.G.S. Cain proposed that Hilliard may be referring to Levina Teerlinc; see Hilliard, *The Arte of Limning*, 71.
- 34 Fitzwilliam Museum FM 3868.
- 35 So far, it has only been identified in a handful of objects, of which only two are of European origin, including the Fitzwilliam Museum miniature discussed here. See Mila Crippa, Stefano Legnaioli, Christine Kimbriel, and Paola Ricciardi, “New Evidence for the Intentional Use of Calomel as a White Pigment”, *Journal of Raman Spectroscopy* 51 (2020), doi:10.1002/jrs.5876.
- 36 As Sammern has observed, “Together with William Harvey (1578–1657) and Sir Théodore Turquet de Mayerne (1573–1655), Haydocke belonged to a generation of English physicians that shared a common interest and engagement in medicine, empiricism and art.” Face-painting was first called an art by Ovid and has been linked with painting in its literal sense since then, as both arts are comparable in terms of brushwork and painting materials. Haydocke was the first to link the two, from a theoretical and practical point of view, in English art writing. For more details, see Romana Sammern, “Red, White and Black: Colors of Beauty, Tints of Health and Cosmetic Materials in Early Modern English Art Writing”, in Tawrin Baker, Sven Dupré, Sachiko Kusukawa, and Karin Leonhard (eds), *Early Modern Color Worlds* (Leiden: Brill, 2015), 109–139.

- 37 Richard Haydocke, *Giovanni Paolo Lomazzo: A Tracte Containing the Artes of Curious Paintinge Carvinge and Buildinge* (Oxford: Ioseph Barnes, 1598), <https://archive.org/details/tractecontaining00loma>, The Third Booke, 130.
- 38 Haydocke, *Giovanni Paolo Lomazzo*, The Third Booke, 130. Haydocke's recommendations about the use and effects of sublimate are by no means unique. They also appear almost verbatim in a recipe for a white "minerall fucus for the face", in Hugh Platt's *Delightes for Ladies, to adorne their persons, tables, closets, and distillatories: with beauties, banquetts, perfumes & waters*, 2nd edn (London: Humfrey Lownes, 1609), n. 14.
- 39 Hannah Woolley, *The Accomplish'd Lady's Delight in preserving, physick, beautifying, and cookery containing I. the art of preserving and candying fruits & flowers ... II. the physical cabinet, or, excellent receipts in physick and chirurgery: together with some rare beautifying waters, to adorn and add loveliness to the face and body: and also some new and excellent secrets and experiments in the art of angling, 3. the compleat cooks guide, or, directions for dressing all sorts of flesh, fowl, and fish, both in the English and French mode ...* (London, printed for B. Harris, 1675), <http://name.umdl.umich.edu/A66834.0001.001>.
- 40 Woolley, *The Accomplish'd Lady's Delight*, Section II, recipe 58.
- 41 Examples of Hilliard's work with landscape elements include portraits of George Clifford, 3rd Earl of Northumberland (circa 1590, National Maritime Museum, Greenwich, MNT0193) and Henry Percy, 9th Earl of Northumberland (1590-1595, Rijksmuseum, Amsterdam, RP-T-1981-2), as well as the famous depiction of a melancholic Young Man Among Roses (circa 1587, Victoria and Albert Museum, London, P.163-1910).
- 42 In this context, "histories" refers to mythological, biblical, or allegorical scenes.
- 43 Norgate, *Miniatura or the Art of Limning*, 82-95.
- 44 Angers, Musée des Beaux-Arts (MBA J 415 (J1881)).
- 45 Sir Theodore de Mayerne, *Pictoria, sculptoria et quae subalternarum artium* (the "Mayerne manuscript"), 1620-1646, British Library, London, Sloane MS 2052.
- 46 The *Allegory of Love* measures 11 x 17 cm; *Elizabeth I and the Three Goddesses* measures 11.5 x 15.7 cm.
- 47 MacLeod, *Elizabethan Treasures*, 166-175.
- 48 Norgate acknowledges that landscape painting is "an Art soe new in England" and its name "a borrowed one, and that from a people that are noc great Lenders but upon good Securitie, the Duch". He adds: "For to sav truth the Art is theirs, and the best in that kind that ever I saw speake Dutch"; Norgate, *Miniatura or the Art of Limning*, 82.
- 49 Another large miniature with landscape features, attributed to the studio of Nicholas Hilliard, was analysed at the National Portrait Gallery (NPG 6241). It was found to contain neither brochantite nor malachite in the green passages, which have instead been executed largely using atacamite, a copper chloride.
- 50 Marika Spring, "New Insights into the Materials of Fifteenth- and Sixteenth-Century Netherlandish Paintings in the National Gallery, London", *Heritage Science* 5 (2017): 40, doi:[10.1186/s40494-017-0152-3](https://doi.org/10.1186/s40494-017-0152-3).
- 51 See Giulia Bertolotti and Paola Ricciardi, "Painting Materials in Sixteenth-Century Flemish Illumination, with a Focus on the Use of Copper Sulphates: Simon Bening as a Case Study", in Stella Panayotova and Paola Ricciardi (eds), *Manuscripts in the Making: Art and Science*, Vol. 2 (London and Turnhout: Harvey Miller/Brepols, 2018), 118-131, and references therein.
- 52 These images beautifully evoke Norgate's exhortation to the painter of landscapes: "And in all your work avoid hardnes, but expresse your remote Mountaines and grounds with a certaine airie Morhidezza, or softnes, which is another remarkable grace and ornament to your worke"; Norgate, *Miniatura or the Art of Limning*, 88.
- 53 Monica Ganio, Nathan Daly, Catharine Schmidt Patterson, Samuel M. Webb, and Karen Trentelman, "Tracking Smalt Degradation: The Role of Potassium and Cobalt Structural Changes and Distribution in the Glass Matrix on Discoloration" (PowerPoint presentation), TECHNART conference, Bruges, Belgium, May 2019.
- 54 Smalt does, however, appear in *Elizabeth I and the Three Goddesses*, in the shadowed portions of the white drapery folded below Venus.
- 55 According to Town, this was likely to have been one of the various editions of the anonymous *A Very Proper Treatise, wherin is briefly set forth the Art of Limning*, which were published in London between 1573 and 1588; Edward Town, "A Biographical Dictionary of London Painters 1547-1625", *The Volume of the Walpole Society* 76 (2014), 140-141.
- 56 The Rouland mentioned in Peter Matheusen's will is presumed to be fellow-artist Rowland Lockey (circa 1565-1616); see Town, "A Biographical Dictionary of London Painters 1547-1625", 140-141.
- 57 The only exception is a William Franke, apprenticed to Hilliard, who sought to be made free of the Goldsmith's Company during Hilliard's stay in France in the 1570s; see Mary Edmond, *Hilliard & Oliver: The Lives and Works of Two Great Miniaturists* (London: Robert Hale, 1983), 67.
- 58 See, for example, Graham Reynolds, *English Portrait Miniatures*, Revised edn (Cambridge: Cambridge University Press, 1988), 21-29; MacLeod, *Elizabethan Treasures*, 203-205; and Dominique Cordellier, "La mise au tombeau d'Isaac Oliver au musée d'Angers", *Revue du Louvre* 33, no. 3 (1983): 178-187.

Bibliography

- Bertolotti, G. and Ricciardi, P. (2018) "Painting Materials in Sixteenth-Century Flemish Illumination, with a Focus on the Use of Copper Sulphates: Simon Bening as a Case Study". In Stella Panayotova and Paola Ricciardi (eds), *Manuscripts in the Making: Art and Science*, Vol. 2. London and Turnhout: Harvey Miller/Brepols, 118-131.
- Boucher, F. (1987) *A History of Costume in the West*. London: Thames and Hudson.
- Burgio, L. (2011) "Analysis of Pigments on Manuscripts by Raman Spectroscopy: Advantages and Limitations". In Sarah Neate, David Howell, Richard Ovenden, and A.M. Pollard (eds), *The Technological Study of Books and Manuscripts as Artefacts: Research Questions and Analytical Solutions*. London: Archaeopress, 67-76.
- Burgio, L., Cesaratto, A., and Derbyshire, A. (2012) "Comparison of English Portrait Miniatures Using Raman Microscopy and Other Techniques". *Journal of Raman Spectroscopy* 43, no. 11: 1713-1721. doi:10.1002/jrs.4133.
- Cordellier, D. (1983) "La mise au tombeau d'Isaac Oliver au musée d'Angers". *Revue du Louvre* 33, no. 3: 178-187.
- Crippa, M., Legnaioli, S., Kimbrieli, C.S., and Ricciardi, P. (2020) "New Evidence for the Intentional Use of Calomel as a White Pigment". *Journal of Raman Spectroscopy* 51. doi:10.1002/jrs.5876.
- de Mayerne, T. (1620-1646) *Pictoria, sculptoria et quae subalternarum artium* (the "Mayerne manuscript"). British Library, London, Sloane MS 2052.
- Derbyshire, A., Frayling, N., and Tallian, T. (2005) "Sixteenth-Century Portrait Miniatures: Key Methodologies for a Holistic Approach". In Mark Clarke, Joyce H. Townsend, and Ad Stijnman (eds), *Art of the Past: Sources and Reconstructions*. London: Archetype Publications, 91-93.
- Derbyshire, A. and Withnall, R. (1999) "Pigment Analysis of Portrait Miniatures Using Raman Microscopy". *Journal of Raman Spectroscopy* 30: 185-188.
- Edmond, M. (1983) *Hilliard & Oliver: The Lives and Works of Two Great Miniaturists*. London: Robert Hale.
- Finsten, J. (1981) *Isaac Oliver: Art at the Courts of Elizabeth I and James I*, Vol. 2. New York: Garland Publishing.
- Ganio, M., Daly, N., Schmidt Patterson, C., Webb, S.M., and Trentelman, K. (2019) "Tracking Smalt Degradation: The Role of Potassium and Cobalt Structural Changes and Distribution in the Glass Matrix on Discoloration". PowerPoint presentation, TECHNART conference, Bruges, Belgium, May.
- Haydocke, R. (1598) *Giovanni Paolo Lomazzo: A Tracte Containing the Artes of Curious Paintinge Carvinge and Buildinge*. Oxford: Joseph Barnes, <https://archive.org/details/tractecontaining00loma>.
- Haydocke, R. (1970 [1598]) *Giovanni Paolo Lomazzo: A Tracte Containing the Artes of Curious Paintinge Carvinge and Buildinge*, reprint. Farnborough: Gregg International Publishers Limited.
- Hilliard, N. (1992) *The Arte of Limning*. Edited by R.K.R. Thornton and T.G.S. Cain. Manchester: Carcanet Press.
- Hradilová, J., Hradil, D., Pech, M., Bezdička, P., Neděla, V., Tihlaříková, E., and Targowski, P. (2020) "Complementary Use of X-Ray Based Imaging and Analytical Methods in the Investigation of Miniature Portraits". *Microchemical Journal* 153: 104371. doi:10.1016/j.microc.2019.104371.
- Kimbrieli, C.S. and Ricciardi, P. (2018) "A Closer Look at the Cabinet Miniature of Lord Herbert of Cherbury". National Trust Collections, 29 May, <http://www.nationaltrustcollections.org.uk/article/a-closer-look-at-the-cabinet-miniature-of-lord-herbert-of-cherbury>. Accessed 10 September 2020.
- MacLeod, C. (ed.) (2019) *Elizabethan Treasures: Miniatures by Hilliard and Oliver*. London: National Portrait Gallery.
- Mancini, D., Tournié, A., Caggiani, M.-C., and Colombari, Ph. (2012) "Testing of Raman Spectroscopy as a Non-Invasive Tool for the Investigation of Glass-Protected Miniature Portraits". *Journal of Raman Spectroscopy* 43, no. 2: 294-302, doi:10.1002/jrs.3010.
- Murrell, J. (1983) *The Way Howe to Lymne: Tudor Miniatures Observed*. London: Victoria and Albert Museum.
- Norgate, E. (1997) *Miniatura or the Art of Limning*. Edited by Jeffrey M. Muller and Jim Murrell. New Haven, CT: Published for the Paul Mellon Centre for Studies in British Art by Yale University Press.
- Platt, H. (1609) *Delightes for Ladies, to adorne their persons, tables, closets, and distillatories: with beauties, banquets, perfumes & waters*, 2nd edn. London: Humfrey Lownes.
- Reynolds, G. (1988) *English Portrait Miniatures*, Revised edn. Cambridge: Cambridge University Press.
- Ricciardi, P. and Schmidt Patterson, C. (2020) "Science of the Book: Analytical Methods for the Study of Illuminated Manuscripts". In Stella Panayotova (ed.), *A Handbook of the Art and Science of Illuminated Manuscripts*. London and Turnhout: Harvey Miller/Brepols, 51-87.
- Sammern, R. (2015) "Red, White and Black: Colors of Beauty, Tints of Health and Cosmetic Materials in Early Modern English Art Writing". In Tawrin Baker, Sven Dupré, Sachiko Kusakawa, and Karin Leonhard (eds), *Early Modern Color Worlds*. Leiden: Brill, 109-139.
- Spring, M. (2017) "New Insights into the Materials of Fifteenth- and Sixteenth-Century Netherlandish Paintings in the National Gallery, London". *Heritage Science* 5: 40, doi:10.1186/s40494-017-0152-3.
- Strong, R. (1969) *Tudor and Jacobean Portraits*. London: National Portrait Gallery Publications.
- Town, E. (2014) "A Biographical Dictionary of London Painters 1547-1625". *The Volume of the Walpole Society* 76: 1-235, <https://www.jstor.org/stable/pdf/24855803.pdf>.

Veiga, A., Mirão, J., Candeias, A.J., Simões Rodrigues, P., Martins Teixeira, D., Muralha, V.S.F., and Ginja Teixeira, J. (2014) "Pigments Analysis of Portuguese Portrait Miniatures of 17th and 18th Centuries by Raman Microscopy and SEM-EDS". *Journal of Raman Spectroscopy* 45, no. 10: 947-957. doi:[10.1002/jrs.4570](https://doi.org/10.1002/jrs.4570).

Veiga, A., Martins Teixeira, D., Candeias, A.J., Mirão, J., Manhita, A., Miguel, C., Rodrigues, P., and Ginja Teixeira, J. (2015) "Micro-Analytical Study of Two 17th Century Gilded Miniature Portraits on Copper". *Microchemical Journal* 123: 51-61. doi:[10.1016/j.microc.2015.05.015](https://doi.org/10.1016/j.microc.2015.05.015).

Woolley, H. (1675) *The Accomplish'd lady's delight in preserving, physick, beautifying, and cookery containing I. the art of preserving and candying fruits & flowers ..., II. the physical cabinet, or, excellent receipts in physick and chirurgery: together with some rare beautifying waters, to adorn and add loveliness to the face and body : and also some new and excellent secrets and experiments in the art of angling, 3. the compleat cooks guide, or, directions for dressing all sorts of flesh, fowl, and fish, both in the English and French mode ...* London: printed for B. Harris, <http://name.umd.umich.edu/A66834.0001.001>.

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