

Summary of analytical work undertaken on the St Stephen's Chapel wall painting fragments

Date	Analyst and Summary of results	Comments	Method of analysis	Citation
1800	<p>John Haslam detected the following pigments: vermillion; red ochre "ruddle"; yellow "ochre"; red lead; lead white; a copper green "in all probability verdigrise"; ultramarine.</p> <p>He also confirmed that: the stone was primed with red lead "mixed with an oleaginous matter"; the paint medium is oil; his letter also suggests the presence of varnish: "thick gold leaf was applied over 'ochre' and oil. The gold leaf was afterwards covered with a white or transparent varnish".</p>	<p>This pioneering work is the first recorded analysis of paint samples ever undertaken and provides a remarkably accurate overview of the pigments and binding media employed in the chapel.</p>	chemical	<p>John Haslam's letter, "To Mr. John Thomas Smith, Engraver of the Antiquities of London", in Smith, <i>Antiquities of Westminster</i>, 223-226.</p>
1973	<p>Joyce Plesters, John Mills, Raymond White, and Jo Kirby, Scientific Department, National Gallery, London.</p> <p>Eight samples taken from the <i>Tribulations of Job</i> fragment, revealed the complex</p>	<p>While the presence of a drying oil as the binding medium was confirmed, the identification of egg tempera in the lower red lead-containing (preparatory layers) was tentative.</p>	Optical microscopy on paint cross-sections; micro-chemical and combustion tests;	<p>Joyce Plesters and John Mills, "Preliminary Report on the Examination of a part of the Wall-Paintings from St Stephen's Chapel, Now in the British</p>

	<p>stratigraphy in both the painted areas and in the embossed decoration.</p> <p>In addition to the pigments listed by Haslam: a red lake pigment was identified, which was found to be incorporated in opaque paint layers and also applied as a glaze. Ultramarine, previously identified by Haslam, was also found to have been applied as a glaze.</p> <p>Examination of the paint cross-sections, "revealed a multiplicity of layers both in the painting itself and in the embossed decoration".</p> <p>The preparatory layers on the stone were found to consist of: whitish plaster; followed by orange/red paint layers containing red lead with varying amounts of yellow earth and haematite, followed by paler layers of yellow earth combined with lead white.</p> <p>Analysis of the binding medium using gas chromatography confirmed the presence of a drying oil. The presence of egg tempera in the lower red lead-containing preparatory layers was tentatively suggested.</p>		<p>gas liquid chromatography (GLC).</p>	<p>Museum", unpublished report, Scientific Department, National Gallery, London, October 1973. These results were published (unacknowledged) as, "The Structure, Pigments and Medium of some Samples from the St Stephen's Chapel Wall Paintings in the British Museum", Appendix I, in Peter C. van Geersdaele and Lesley J. Goldsworthy, "The Restoration of Wall Painting Fragments from St Stephen's Chapel, Westminster", <i>The Conservator</i> 2, 11-12.</p>
--	---	--	---	---

1975	<p>Frank. G. Dimes and Martyn Owen, The Geological Museum.</p> <p>The stone support was identified as a compact sandstone from the (Cretaceous) Upper Greensand around Reigate, Merstham, Gatton or Godstone. These are siliceo-calcareous greenish-grey sandstones containing mica and glauconite.</p>	<p>The medieval accounts record that large quantities of this stone were purchased for building. Indeed, the quarries were considered so important that, in the fourteenth century, they were worked exclusively for the crown.</p> <p>Reigate stone is mentioned a number of times in the accounts for St Stephen's Chapel, for example: Hugh de Donnilton, for fourteen pieces of Ryegate stone, at 1s. and 8d. each, for the upper story of the chapel (Smith, <i>Antiquities of Westminster</i>, 190).</p>	Microscopy	Extract from a letter by Mr F.G. Dimes, The Geological Museum, Institute of Geological Sciences, 15 May 1975. Published as Appendix II, van Geersdaele and Goldsworthy, "The Restoration of Wall Painting Fragments from St Stephen's Chapel, Westminster", 12.
1996	<p>Ashok Roy, Scientific Department, National Gallery, London, and Jilleen Nadolny.</p> <p>SEM/EDX analysis of the grey degraded material in Sample 2 (taken in 1973) was identified as tin.</p> <p>Elemental analysis of the inorganic components of the mordant confirmed the presence of lead, silicon, iron, and calcium, suggesting that it contains a mixture of lead white and yellow ochre.</p>	<p>This is the first confirmation that the raised decoration is formed of tin-relief.</p> <p>The purchase of tin foil is recorded a number of times in the accounts for St Stephen's Chapel, for example: John Tynbetere, for twelve dozen leaves, for the same [painting of the chapel] (Smith, <i>Antiquities of Westminster</i>, 218).</p>	Optical Microscopy; Scanning electron microscopy (SEM) with energy dispersive microanalysis (EDX).	Unpublished SEM-EDX analysis, National Gallery London, December 1996.

		SEM/EDX analysis was not available when samples were examined at the National Gallery in 1973.		
2000	<p>Jilleen Nadolny, Courtauld Institute of Art.</p> <p>Research into the ground layer/s and tin relief decoration.</p> <p>Samples 1, 2, and 4 (taken in 1973) were re-examined and analysed in more detail.</p>	<p>Nadolny characterised at least ten different patterns of relief decoration on the fragments. She characterised the inorganic components of the fill-mass of the relief ornament as: red lead, lead white, and chalk with some ochre. She also determined that the gold leaf was adhered to the tin- relief decoration with a double layer of mordant. Nadolny also studied the medieval accounts in relation to the materials employed for the relief decoration and the workshop practice involved in their production.</p>	Optical Microscopy; SEM/EDX analysis	<p>Jilleen M. Nadolny, "The Techniques and Use of Gilded Relief Decoration by Northern European Painters, c.1200-1500", 2 vols, unpublished PhD thesis, Courtauld Institute of Art, June 2000.</p>
2003	<p>Catherine Higgitt, Marika Spring, and David Saunders, National Gallery London</p> <p>Sample 3 (taken in 1973) was re-examined to identify the paint medium, in the light of the previous suggestion of the presence of egg tempera.</p> <p>FTIR analysis confirmed the presence of lead white and oil as well as lead soaps of fatty acids, resulting from a reaction</p>	<p>A reaction between the original oil medium and red lead pigment had caused analysts in 1973 to incorrectly conclude that egg tempera may be present in the lower red lead-containing preparatory layers.</p> <p>FTIR and SEM-EDX analysis were not available when the samples</p>	Fourier transform infrared (FTIR) microscopy, optical microscopy, and SEM-EDX.	<p>Catherine Higgitt, Matthew Spring, and David Saunders, "Pigment-Medium Interactions in Oil-Paint Films Containing Red and Lead or Lead-Tin Yellow", <i>National Gallery Technical Bulletin</i> 24 (2003), 82.</p>

	<p>between the original oil medium and the red lead pigment. No proteinaceous material was identified and it was concluded that there was no egg binder in the red lead priming layer as had previously been thought.</p> <p>Oil was identified as the binding medium for the preparatory layers as well as the paint layers.</p>	<p>were examined in 1973 at the National Gallery.</p>		
2006	<p>Marika Spring and Catherine Higgitt, National Gallery London.</p> <p>The analysis undertaken in 2003 was extended to include a number of other similar examples in which the presence of lead soaps caused a proteinaceous binder to be erroneously identified.</p>		<p>FTIR microscopy, optical microscopy, and SEM-EDX.</p>	<p>Marika Spring and Catherine Higgitt, "Analyses Reconsidered: The Importance of the Pigment Content of Paint in the Interpretation of the Results of Examination of Binding Media", in J. Nadolny (ed.), <i>Medieval Painting in Northern Europe: Techniques, Analysis, Art History</i> (London: Archetype Publications, 2006), 223-229.</p>
2015 – 2016	<p>Helen Howard and Catherine Higgitt, National Gallery London, with David Saunders and Lloyd de Beer, British Museum</p>	<p>The presence of a preparatory drawing was documented for the first time. Different hands within the workshop were determined and alterations</p>	<p>New digital infrared (IR), ultraviolet (UV) and high-resolution visible images acquired.</p>	<p>Unpublished reports, Scientific Department, National Gallery 2017. Presentation, "Recent Imaging and Scientific</p>

		<p>made during the course of painting documented. A small number of new samples were taken to determine: the type of dyestuff present in the red lake pigment; the presence of an original varnish; details of the paint stratigraphy and pigment alterations documented.</p>	<p>Digital microscopy undertaken. New samples were examined and 1973 National Gallery samples re-examined using: SEM-EDX; pyrolysis gas chromatography-mass spectrometry (PyGC-MS); high performance liquid chromatography (HPLC); and attenuated total reflectance (ATR) - FTIR.</p>	<p>Analysis of the Wall Painting Fragments”, Helen Howard, Catherine Higgitt, David Saunders, and Lloyd de Beer at conference: St Stephen’s Chapel, Westminster: “Visual and Political Culture 1292–1941”, Portcullis House, Westminster 19–20 September 2016.</p>
--	--	---	---	--