

# Investigating Wall Paintings

## Seeing is believing

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**Conservators have made great advances in imaging and recording painted architectural surfaces through new methods of exploiting the responsiveness of materials to different wavelengths. These non-destructive methods can inform conservation works.**

**P**reliminary surveys are an essential step in establishing the conservation requirements for painted architectural surfaces (wall paintings, polychromy, painted panelling and other decorative elements). By combining detailed visual examination with associated documentary research, the conservator can build up a physical history of the site and its decoration, and try to characterise the factors influencing current condition and deterioration.

Despite the obvious benefits of preliminary surveys, often only a minimal amount of time and budget are spent on this part of a project. Additional pressure is placed on the conservator by ever-increasing public enthusiasm for the perceived technological advances in scientific analysis. Sampling and material analysis are now often seen as obligatory even in the preliminary stages of investigation, so that reports can contain 'scientific data' to support proposed conservation works. This rush to analysis encourages the use of invasive sampling before establishing the overview necessary for an appropriate sampling strategy, and it produces only a partial – and often misleading – impression of the painting and its condition.

Clearly it is vital to develop ever more effective and versatile non-destructive examination and recording methods to aid the preliminary survey. Significant benefits have already resulted from the use of portable magnifiers and hand-held video microscopes, and the costs of these tools have now dropped to the point where they are within the reach of even the smaller private conservation firms. However, much of this equipment is limited in one crucial way: it is restricted to visible light. Broadening the investigation to include other wavebands has enormous potential for radical improvements in non-destructive examination.

### Beyond the visible

Conservators are well-versed in using visible light to study painted surfaces – specular, diffuse and raking illumination are all commonly used for examination and assessment. Yet visible light represents only a small portion of the electromagnetic spectrum. To gain insight into the physical and chemical properties of the materials used in paintings (and for that matter, of their conservation), we can use the characteristic interactions of particular materials with other wavelengths, particularly the ultraviolet (UV) and infrared (IR). Recently, digital imaging has made it much easier to record these interactions *in situ*.

The ceiling of the Heaven Room in Bolsover Castle, Derbyshire, with an allegorical painting of the early 17th century. It was suggested that the painting had been extensively over-painted: this was not clear under visible light because of the application of a modern varnish.



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## Ultraviolet illumination

In the early 1850s, British scientist Sir George G Stokes showed that fluorescence – the phenomenon whereby certain materials emit visible light when stimulated by incoming energy – could be readily induced by UV light (rather more energetic than the visible wavelengths), and that the degree and colour of the fluorescence was specific to the material. Many pigments, media and coatings (both organic and inorganic) display these characteristic responses. In particular, waxes, resins and re-touching materials, often difficult to discern in visible light, are extremely obvious in UV. This can instantly reveal much about the degree and extent of previous phases of restoration.

Although dedicated (and expensive) ultraviolet illumination systems are available for conservation, UV lamps can also be purchased to fit standard housings. Conservators can construct very inexpensive units, tailored to suit their own needs.

Imaging UV fluorescence requires some way of cutting out visible light (usually the simple expedient of waiting until nightfall), as well as yellow lens filters for the recording cameras (whether film or digital). This means that exposure times are rather long, and it is necessary to stabilise the camera: no easy feat when using scaffolding, but still perfectly achievable with forethought and care.

The same area recorded under UV illumination clearly shows that re-touching was limited to localised losses and damage (areas appearing darker), while the majority of the ceiling is original. This UV survey was able to reduce the need for sampling of the painting.



## Near-Infrared radiation

**IR THERMOGRAPHY:** Heat is emitted from objects in wavelengths within the IR region. IR thermography records this, and therefore can indicate other aspects of specific physical and chemical composition. It is, of course, best known for its military applications but, as the price of equipment drops, it is becoming more common as a surveying tool. Within historic buildings, IR thermography has been used to reveal concealed alterations to the fabric (such as blocked doors and windows), as well as the effects of heating systems. As a preliminary inspection tool, it can provide clues to localised differences in condition, and can guide further investigations, including material sampling and environmental monitoring.

Early thermography sensors required complex cooling systems, making the cameras cumbersome for portable applications. Now that this has been overcome, there has been an explosion in the market, with numerous hand-held, fast-operating cameras offering ranges of sensitivity and resolution. These units still represent a significant capital outlay, but alternatively short-term rental is available from a number of specialist firms.

**IR REFLECTANCE:** Its longer wavelength means that IR radiation can penetrate quite deeply into the surface of the painting, being reflected back to the eye only when it meets a dense material. Charcoal being one such material, IR reflectance has had some value in revealing carbon black underdrawings for wall paintings.

Until quite recently, *in situ* IR recording was confined to photography under natural light using IR-sensitive film to record both the 'natural' emission of IR and the reflected IR component of the natural light. This methodology unfortunately has been of rather limited success with wall paintings, for a number of technical reasons.

In the 1960s, IR reflectography was developed to look at IR emissions beyond the film sensitivity range, and there are now a number of relatively portable systems that can capture defined wavebands up to the far IR (between 900 and 2500 nm). Interestingly, the charge coupled device (CCD) inside many digital cameras is now sensitive to IR in regions up to almost 1200 nm. With their factory-installed IR filters removed, these can provide a useful low-cost alternative, or perhaps a quick test to see whether more elaborate systems are likely to prove useful.

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### Informed conservation

Taking advantage of – even keeping abreast of – the ever-growing range of tools and equipment available requires a certain amount of determination and enthusiasm on the part of a conservator, but one is well-repaid by the improvements in ease of survey and effectiveness of results. One should not be overwhelmed by the technology, or by the apparent need to produce copious amounts of data. Undoubtedly, the skill lies in the ability to extract the information from the readings: to be able to decipher what has been observed. Establishing the conservation needs of the painting cannot be done with equipment alone, no matter how elaborate. Data is worse than useless without informed interpretation.

But neither should the use of sophisticated technology be thought of as being blinded by science; rather, it is like donning reading glasses to see the small print. Seeing clearly requires facility in both tools and thought, the classic combination of the skilled conservator.



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In visible light, the drapery behind Christ in this late 14th-century wall painting in the Chapter House, Westminster Abbey (*above*), appears undecorated. When recorded in the near-IR region, a floral brocade pattern emerged, with under-drawings, which guided later sampling.

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