Culture and trade through the prism of technical art history: a study of Chinese export paintings

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Introduction

The Victoria and Albert Museum (V&A) has a collection of eighteenth- and nineteenth-century Chinese export paintings produced by artisans from Canton or other Chinese ports. Such pictures, generally sold as souvenirs to Europeans, were intended to satisfy western curiosity about China and its people [1]. They are a valuable resource for researchers into economic and cultural exchange between Britain and China at that time. The Royal Horticultural Society (RHS) owns a collection of early nineteenth-century Chinese botanical watercolours which were commissioned and collected by the Society's representative, John Reeves, as a form of catalogue from which live specimens could be ordered. Unlike most export art, this collection comprises scientific drawings, well documented in the Society's minutes and in Reeves' diary [2].

A holistic approach to non-invasive investigation

There have been relatively few studies involving scientific analysis of Chinese export paintings. A significant problem has been the lack of a wide range of non-invasive instruments to study systematically a diverse collection of materials [3]. With the development of imaging science and technology, it is increasingly possible to conduct effective scientific examinations non-invasively and in situ.

This paper addresses art historical and conservation research questions relating to these paintings through the application of novel imaging technology with complementary non-invasive spectroscopic techniques. Specifically, the light sensitivity of the painting materials is measured with a microfading spectrometer to inform both future display policy and light dosage for scientific imaging. A multispectral imaging system is used to reveal any 'hidden' writing or drawings, and also for measuring the spectral reflectance of the paint for large-scale pigment identification. Raman microscopy and X-ray fluorescence (XRF) are used to confirm pigment identification at selected points. Optical coherence tomography (OCT) images of virtual cross sections are used to provide the best resolution and contrast images of underdrawings [4] and to classify the papers. This is the first time a wide range of complementary scientific techniques have been used to address specific questions such as the nature and provenance of the painting materials; date and provenance of the paintings; the relationship between the painting and/or drawing techniques and the provenance of the material; and the light sensitivity and the state of conservation of the paintings.

Light sensitivity

A portable microfading spectrometer was used to monitor in situ the spectral and colour changes during accelerated light aging at a tiny sub-millimetre sized spot [5] to inform future display and storage strategy. Almost all the colours tested were more stable or as stable as ISO Blue Wool 3, except for a yellow colour in some of the V&A paintings which was found to degrade faster than ISO Blue Wool 1.

Pigment identification

Multispectral imaging provides a series of images from the visible to the near infrared range, giving reflectance spectra for millions of pixels, which can be used for pigment identification [6]. More definitive identification is obtainable by adding point-based non-invasive spectroscopic techniques such as Raman for molecular identification or XRF for elemental identification. Raman microscopy, a non-destructive technique that can be used in situ without the need to take samples, is now routinely used in the scientific analysis of artists' materials on paper substrates [7]. It is also highly specific, providing a unique fingerprint for most materials analysed.

The following two examples demonstrate the complementarity of the techniques used here. The fast rate of light-induced degradation of the yellow paint described above suggested the presence of realgar, although the microfading spectrometer alone was not suitable for identifying the pigment with confidence. Raman spectroscopy unambiguously identified this pigment as a mixture of the intermediate phases between realgar and pararealgar. Realgar is well known to gradually transform into pararealgar when exposed to light.

One limitation of Raman spectroscopy is the inability to identify highly fluorescent material such as organic colorants and binders; for example, the red colorant used for the lips and flower petals in many of the paintings. However, the reflectance spectrum derived from multispectral imaging and fibre optic reflectance spectroscopy of these areas gave the best fit to the spectrum from scale insect dyes such as cochineal lake, amongst a range of red lakes, and was therefore essential to the identification of this type of dye.

Underdrawing technique

Nearly all the RHS paintings showed underdrawing in the near infrared band of the multispectral images, but only a few of the V&A paintings showed underdrawing. Figs. 1b,c show an example of a typical elaborate underdrawing found on many RHS paintings on thick European papers.

Types of paper

OCT can potentially distinguish between European paper and Chinese paper through the different light scattering properties, fibre length and thickness of paper since OCT can image virtual cross-sections

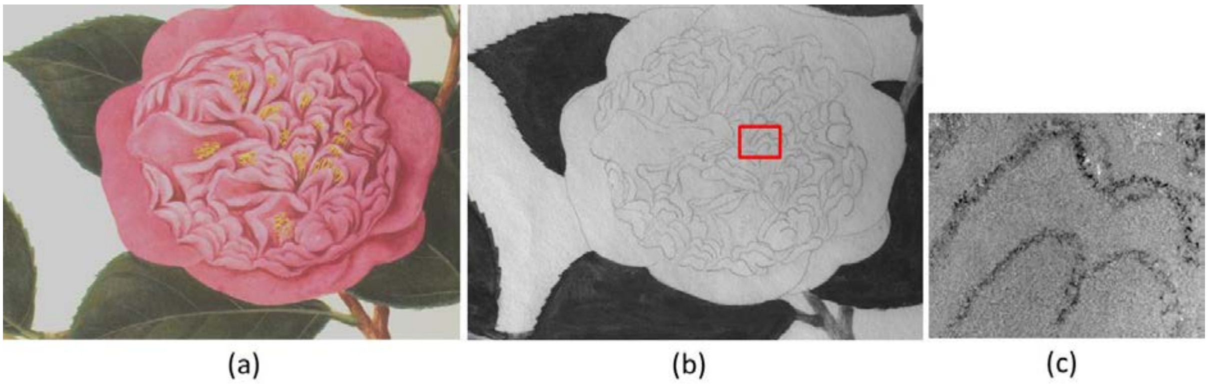

Figure 1 a) Detail from *Camellias* (35617-1001), RHS Reeves collection; colour image derived from the multispectral images for D65 light and 1931 standard 2^{o} observer; b) the near infrared band (880nm) of multispectral images showing elaborate underdrawing likely drawn with a solid substance; c) OCT image of the region marked by the red box in b) showing the underdrawing in high resolution and contrast (image size: 6.2mm x 5.1mm).

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