National Gallery Technical Bulletin

Volume 12, 1988

National Gallery Publications
The National Gallery London

National Gallery Publications
Published by order of the Trustees

Scientific Adviser, John Mills
Chief Restorer, Martin Wyld
Editor: Ashok Roy

British Library Cataloguing in Publication Data

National Gallery
National Gallery technical bulletin.—
Volume 12, 1988.
1. Painting—Conservation and restoration—Periodicals
I. Title
751.6′05 ND1640

ISSN 0140–7430

ISBN 0 947645 63 2

Designed by James Shurmer

Printed and bound in Great Britain by
William Clowes Limited, Beccles and London

The Fading of the Virgin's Robe in Lorenzo Monaco's 'Coronation of the Virgin'

Aviva Burnstock

When Lorenzo Monaco painted *The Coronation of the Virgin* (No.1897; Fig.1 and Plate15, p.64) in the late 1300s, he coloured the Virgin's robe a deep pinkish mauve. It was never intended that the robe be white, as it appears today. Technical examination reveals that Lorenzo used a fugitive red lake pigment to paint the Virgin's robe which has since faded. This is an example of how a change in a single pigment can significantly alter the appearance of a painting.

Don Lorenzo Monaco was a Camaldolese monk who was active as a painter in Florence between 1391 and about 1422. The National Gallery *Coronation of the Virgin* is the central part of a large altarpiece which includes the *Adoring Saints* (Nos.215 and 216). The panel is made of poplar with a three-arched top. It is similar in style and composition to Lorenzo's *Coronation of the Virgin* in the Uffizi which is signed and dated 1414. There is some evidence that the National Gallery *Coronation* was intended to be displayed in the Camaldolese monastery of S. Benedetto fuori della Porta a Pinti just outside Florence [1].

The painting was divided into three parts at some time after 1792. This is the last time it was seen in one piece in the Florentine Church of Santa Maria degli Angeli. The sale of the two outer parts to private collectors is documented in the early nineteenth century. In 1848 both parts were presented to the National Gallery by William Coningham.

The central part was discovered in about 1840 in a secularized Camaldolese monastery and was bought by the Landi family and then by M. Galli-Dunne. It was bought by the National Gallery (Clarke Fund) in 1902. The three parts were last cleaned in 1947 and assembled to hang together [2]. There is no reference to fading of the Virgin's robe in the condition reports made before this cleaning, or in Martin Davies's catalogue entry for the painting [3].

Fading of lake pigments has been noted in several paintings in the National Gallery and is discussed in detail for a Gainsborough painting on p.44ff. of this *Bulletin*. It is important to identify changes in colour for various reasons. Interpretation of a painting may be based on colour, especially when colour has religious or symbolic significance. Also, use of colour may be characteristic of an artist. In both cases, information about how colours have changed may be relevant to art-historical interpretation.

It is well established that exposure to light is a key factor in the fading of lake pigments [4]. Radiation in the blue and ultra-violet region of the spectrum is known to be the most damaging to paint. This has been shown in accelerated ageing studies using filtered and unfiltered daylight, or daylight lamp sources to induce rapid fading [5–7]. Several authors have noted that the use of ultra-violet blocking filters reduces but does not entirely eliminate fading, indicating that radiation in the other parts of the visible region causes fading to a lesser degree [8–11].

In addition to light, other factors such as gases in the atmosphere [12–14], fluctuations in relative humidity and temperature [15–18], or exposure to cleaning reagents [19] may produce deterioration in paint films and lead to colour change.

The type of binding medium in a paint film may also affect the rate of fading of a fugitive pigment [20–22]. Paint media vary in their ability to protect the pigment from a range of degradative influences. Deterioration of the medium may lead to the exposure of pigment particles on the surface of a paint layer. Alternatively, a chemical reaction occurring between pigment and medium could result in discoloration of the pigment. To summarize, colour change may be due to changes in the pigment (or lake dyestuff), discoloration of medium or a combination of both (for example when smalt is used in oil paint). Another variable which affects fading of lakes is the kind of substrate used as the base [23,24].

There are several accounts in the literature of lake pigments fading in watercolour [25–27], in oil paint [28,29], and a few which report fading in egg tempera [30,31]. Most are observations of colour change in paintings or works on paper. The rate of fading of experimental films containing alizarin lake has been discussed in a number of papers [32–35].

The extent to which a colour has changed is sometimes recognized if the original colour is preserved on part of the painting. Those parts of the paint which are protected from light, such as the painted edges hidden by the frame rebate, areas covered by mordant gilding or other equally opaque or reflective layers will retain more of the original colour than exposed areas.

In *The Coronation of the Virgin*, Lorenzo Monaco has applied a mordant containing lead white in a pattern along the sleeve and hem edges and in rosettes on the front of the Virgin's robe. The gold adhering to the mordant is in good condition and the opaque reflective surface protects the original paint of the robe beneath. The technique used by Lorenzo here is largely the same as that described by Cennino Cennini [36], whose treatise on painting technique was written in about 1390. The technique of mordant gilding to decorate drapery was often used by painters in the fourteenth- and early fifteenth-centuries in Italy.

Wide horizontal cracks in the paint surface of the whole panel provided an opportunity to take small samples of paint from the edge of the mordant gilding for examination under the microscope in cross-section (see Plates 16, 17 and 18a–f, p.64). By making cross-

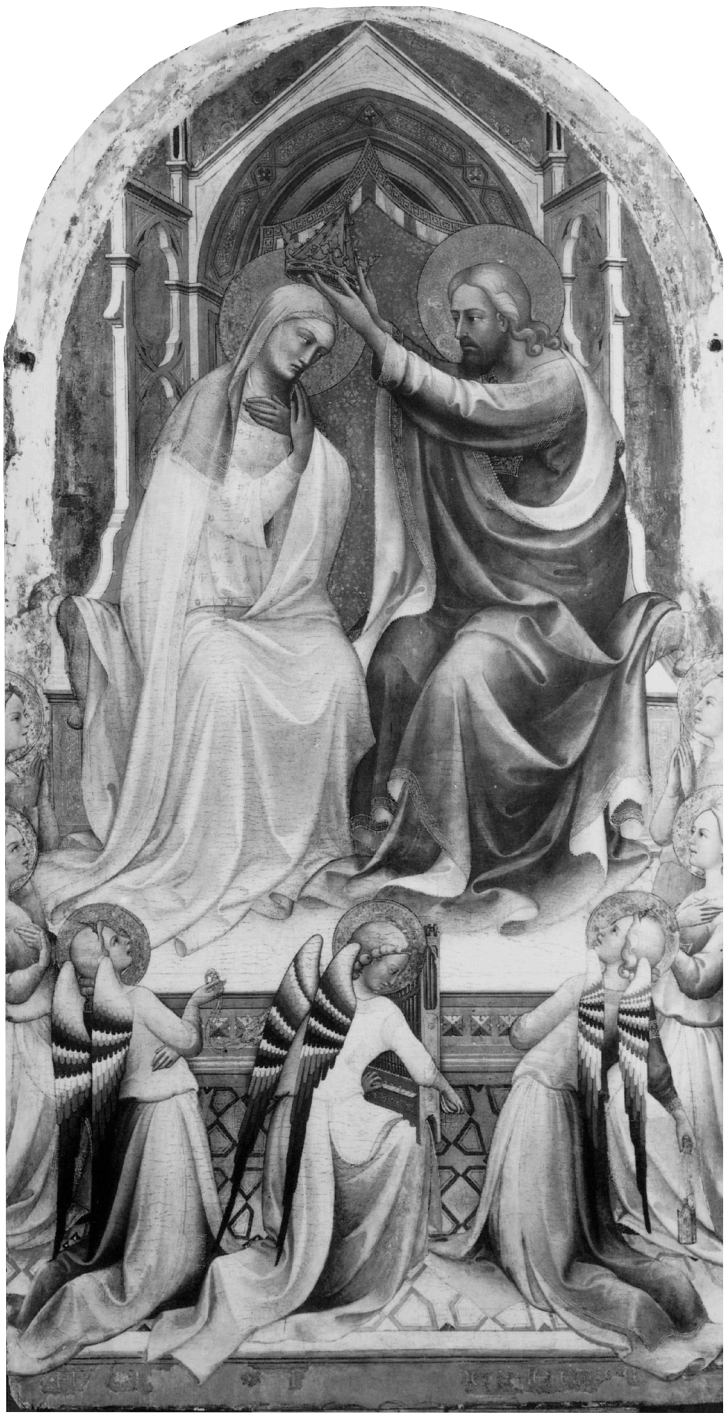

Figure 1
Lorenzo Monaco, *The Coronation of the Virgin* (No. 1897), centre panel, 217.2 × 115.6 cm.

sections, paint beneath the mordant gilding on the Virgin's robe could be compared with the unprotected paint of the robe.

Where the gold leaf covers the paint of the robe, the red lake mixed with lead white and natural ultramarine is beautifully preserved (Plate 18a, p.64). Where there is no gold or mordant, the red has faded. Particles in the upper part of the paint which received the most light have discoloured more than those lower in the layer. Plate 16 (p.64) shows a detail of an area of mordant gilding from a rosette on the front of the Virgin's robe where beneath the gold the red lake particles retain their colour. Plate 18b (p.64) shows a cross-section taken from an ungilded (and therefore exposed) part of the drapery, where the red has almost disappeared from the mixture of red lake, lead white and ultramarine, leaving yellowish and semi-transparent particles.

On close examination it was found that some of the cracks in the Virgin's robe had been inpainted with a red lake (Plate 18c, p.64). The restorer's paint, which retains its colour, must have been applied to disguise the cracks before the red in the original paint had faded. The other area of surviving red lake is the glaze of Christ's underdress. A sample of this red was taken from near the hem (Plate 18d, p.64) for comparison with the lake in the Virgin's robe and the repaint in the cracks.

Examination of the lake pigment dyestuffs was carried out using transmission spectrophotometry [37]. This technique has the advantage of being able to measure colour in single pigment particles within the layer structure of a painting. Thin cross-sections were made from the paint of the glaze of Christ's robe and from the Virgin's robe for transmittance measurements. Comparison of the transmittance spectrum of one of the least faded particles of the Virgin's robe with that of a pigment particle in the thin cross-section from Christ's underdress suggests that the same lake pigment was used in the execution of both garments (Fig.2). The spectrum shape is characteristic of an insect dyestuff and corresponds most closely to a standard sample of lac pigment of a similar thickness (Fig.3). Originating in India, the secretion of lac insects contains water soluble laccaic acids which can be made into lake pigments [38]. Lac lakes were widely available to painters in Italy in Lorenzo's lifetime, usually precipitated onto a base of hydrated alumina [39]. Aluminium from the substrate was confirmed in a sample using EDX analysis.

A transmittance spectrum of a thin cross-section of the restorer's paint in the cracks was recorded (Fig.4). Comparison with the spectrum from the Virgin's robe in Fig.2 reveals that the pigments are different. The spectrum of the colorant material found in the crack paint is similar to that of a standard sample of cochineal (Fig.4). Carminic acid, the colouring material of the cochineal lake, was extracted from the dried bodies of the scale insect *Dactylopius coccus*, a species which was brought to Europe from Mexico at the beginning of the sixteenth century [40].

Two possible reasons could be advanced to explain why the retouchings in the cracks of the Virgin's robe have retained their colour whilst the original paint has faded. Firstly, the lake dyestuff of the retouchings is cochineal, which may fade differently from the lac lake of the original. Secondly, the later paint may be bound with a different medium from the original, making the dyestuff less vulnerable to deterioration. Unfortunately the sample of the retouching paint was insufficient for medium analysis using gas-chromatography. The only possibility remaining was to use staining tests. Whilst these tests give an indication of the kind of medium present they are difficult to interpret. Staining tests on a cross-section indicated that the repaint did not contain egg medium. In contrast, the paint layer of the Virgin's robe was found by staining with amido black to contain egg. These tests indicate that the original paint and later paint are bound in different media. More research is required to determine the relative stability of particular lake pigments in different media. In the present case, the

examination of the Virgin's robe suggests that lac lake in egg tempera fades more quickly than cochineal lake in another medium.

It remained uncertain why the lac lake has faded in the Virgin's robe and not where it is used for Christ's underdress. The answer was provided by examination of a sample of Christ's underdress. From the cross-section (Plate 18d, p.64), it can be seen that Christ's robe is painted in two layers. On the white gesso ground (gypsum combined with anhydrite) is a layer of opaque pink underpaint, about 25 μ thick, consisting of a mixture of lead white and red lake pigment. The underpaint is glazed almost uniformly with a relatively thick (30 μ) layer of lac lake containing particles of iron oxide [41]. When the same sample was prepared as a thin section (Plate 18e, p.64) and viewed in transmitted light it was revealed that the upper 10 μ of the glaze layer had become semi-transparent in a manner similar to that of the individual particles in the Virgin's robe. The presence of iron oxide particles in the glaze renders the paint less transparent than a pure lake glaze and thus affords it some protection from photochemical deterioration. The particles of red iron oxide are more stable than the red lake dyestuff and retain their colour whilst the lake in the same layer fades. The red glaze on Christ's underdress is thicker than the relatively thin paint of the Virgin's robe. In addition, the Virgin's robe is painted in a single layer while the solid red glaze of Christ's underdress has a pink underpaint. The red lake in the pink underpaint is well protected by the upper layer which has sustained the damage by light.

It is clear from the thin cross-section that the red glaze of Christ's underdress has faded only to a certain depth, about 10 μ below the surface. The larger particles of lake in the glaze have retained their colour, while smaller particles have either faded to a yellowish colour or

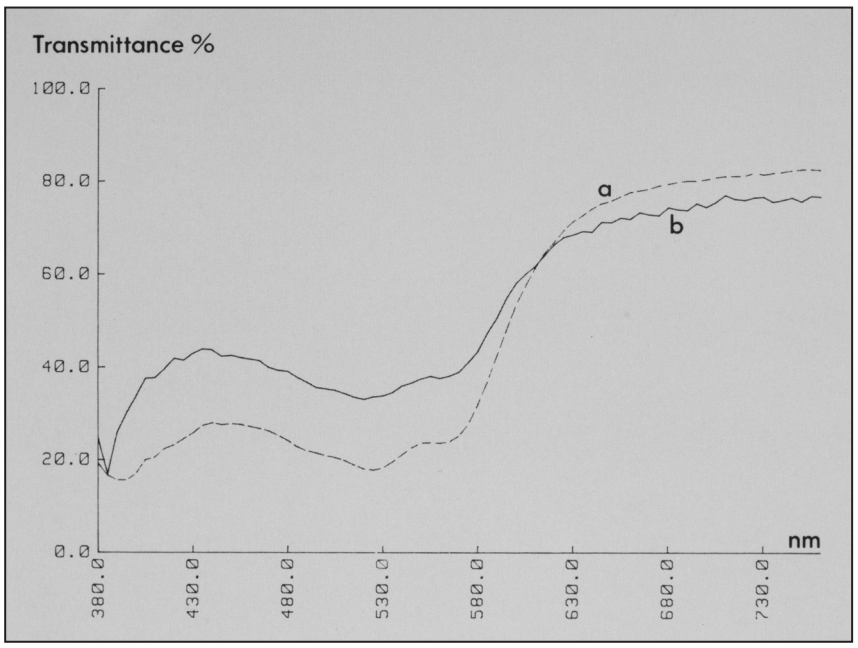

Figure 2 Transmittance spectra comparing an unfaded particle of red lake from the Virgin's robe **(a)**, with a particle of red lake from Christ's underdress **(b)**.

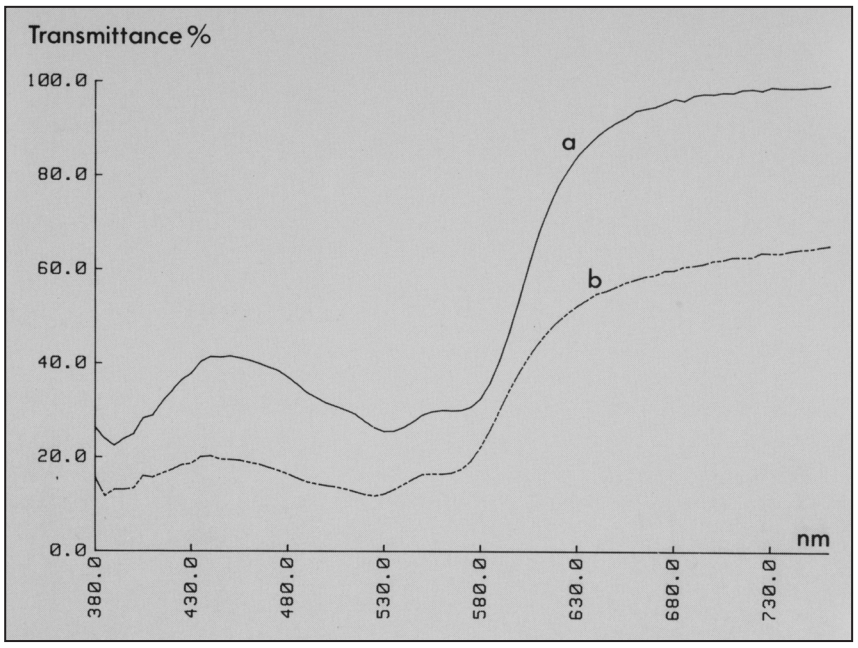

Figure 3 Transmittance spectra for a reference standard of lac lake **(a)**, compared with a particle of red lake from Christ's underdress **(b)**.

become transparent. In the underpaint where the red lake is mixed with white, the red remains unfaded.

Samples from the Virgin's robe show that some of the red particles lower down in the paint layer have not faded as much as those closer to the paint surface. The thickness of the paint layer of the Virgin's robe is between 15 and 20 μ. Where it is thinner, almost all the lake in the mixture has faded (Plate 18f, p.64), whilst in the thicker parts some red remains in the lower 10 μ of the layer. Fig.5 shows the transmittance spectra of three particles in a thin cross-section from the robe. The sequence of curves is characteristic of a loss of colour from a lake type pigment. The same has occurred in the glaze on Christ's underdress, where the larger red particles are less faded than the smaller ones. Johnstone-Feller [42] has shown experimentally that mixtures of alizarin lake mixed with white fade to a greater depth the fewer lake particles there are in the mixture. A faster rate of fading of the smaller particles of lake has been observed in test samples by several authors [43,44].

Deterioration is greatest at the surface of the paint which is most exposed to light. It has been pointed out both by Johnston-Feller [45] and in the article on Gainsborough in this *Bulletin* (p.54) that differences in the absorption of light by the underlayers of paint affect the total amount of light which reaches the upper paint layer. The pink underpaint of Christ's underdress absorbs more light than the white paint of the Virgin's robe, and the white ground beneath. The light which penetrates the paint of the Virgin's robe is reflected back through the paint layer. The potential of the light to cause fading of the lake is increased when there is white in the paint layer and underlayer, which is the case for the Virgin's robe.

Another factor for the mechanism of fading of lake pigments has been suggested by Madeleine Hours [46]

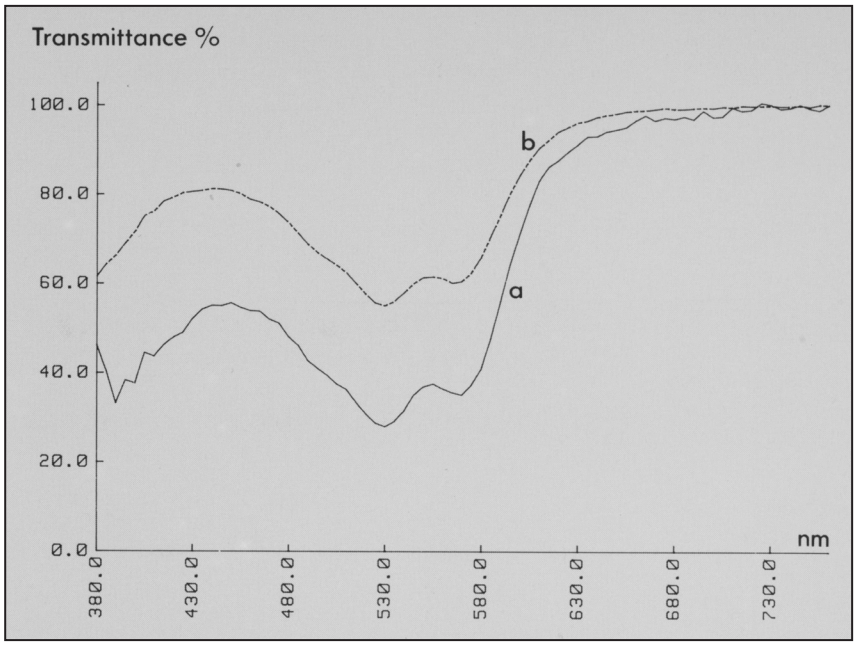

Figure 4 Transmittance spectrum of a sample of the restorer's red paint in the cracks of the Virgins' robe **(a)**, compared with a curve obtained from a standard sample of cochineal lake **(b)**.

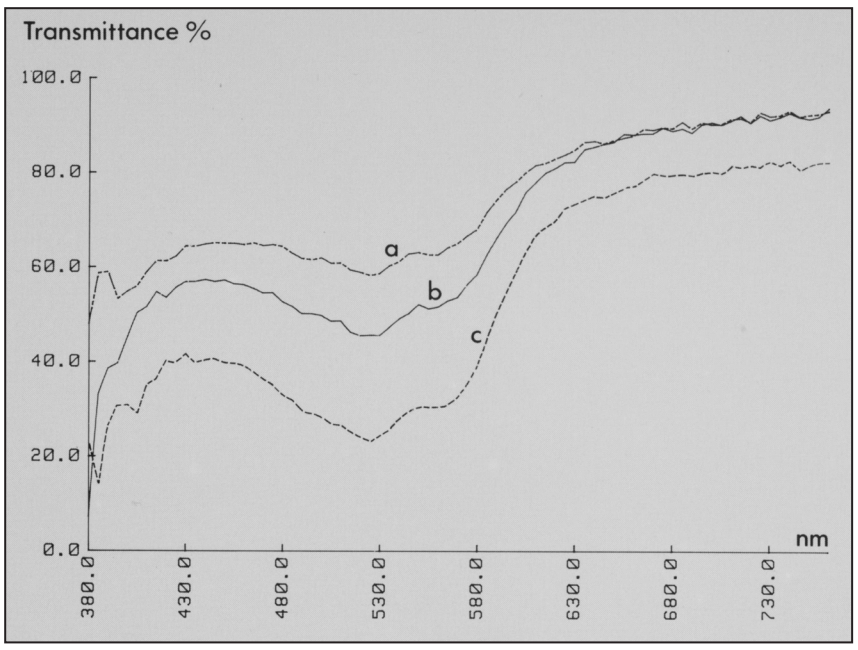

Figure 5 Transmittance spectra of three particles of lake pigment from the Virgin's robe showing progressive degrees of fading. The most faded is **(a)**, the least faded **(c)**.

who proposed that the dyestuff of the lake may diffuse from the inert base and be reabsorbed by lead white if it is present in the paint mixture. The secondary complex formed is susceptible to bleaching. This may explain the enhanced fading of the Virgin's robe, which does contain lead white. However, there is no visible evidence in the cross-sections for the migration of dyestuff in the transition stage from lake to lead white particles. Indeed, the existence of partially faded lake particles is evidence against this theory.

Similar fading has been recognized in two fifteenth-century paintings at the Courtauld Institute of Art (Gambier-Parry Collection). Another version of *The Coronation of the Virgin* (Fig.6) by Lorenzo Monaco was examined in 1985 and found to contain unfaded red lake under a recent damage to the mordant gilding on the Virgin's robe [47]. Removal of the frame on *The Crucifixion* by Bernardo Daddi revealed a red lake background of a much deeper colour than the painted area exposed to the light [48].

These examples of fading of red lake paint in tempera paintings suggest that the phenomenon may be more common in paintings of this age than is generally recognized. Two other Early Italian panel paintings in the National Gallery depicting the *Coronation*, one ascribed to Agnolo Gaddi (No.586) and the other in the style of Orcagna (No.569) exhibit pale pink or white robes of Christ and the Virgin which may have faded. No technical examination has been made of these paintings for comparison with the Lorenzo Monaco discussed here and the possibility of fading remains unsubstantiated.

Red lake retouching in the cracks of the Virgin's robe indicate that it was still red when the restoration was done. There is no record of this restoration, which must have been carried out between the early 1500s, when cochineal lake became available in Europe and 1947, the most recent cleaning. That much of the fading of the Virgin's robe has occurred relatively recently is supported by evidence of fading in recent condition reports on other paintings. *The Crucifixion* by Bernardo Daddi from the Gambier-Parry Collection [49] has an area of unfaded lake which was protected by a frame of nineteenth-century origin. The unfaded lake lies directly beneath the spiral columns of the frame. Earlier frames are unlikely to have covered the protected part of the picture precisely. If this is the case it is clear that a significant amount of fading has occurred since the nineteenth century. Similarly, the fragmentary *Head of an Angel* by Gherado de Giovanni (1445–95) in the same collection [50] has unfaded red under the rebate of the frame which was put on after the picture was cut down from the original, probably in the nineteenth century. These examples suggest that a great deal of fading has

Figure 6 Lorenzo Monaco, *The Coronation of the Virgin*, panel 208 × 179 cm. London, Gambier-Parry Collection, Courtauld Institute Galleries.

occurred over the last century in paintings which are more than 500 years old.

The acceleration of fading with time has been shown experimentally by Johnston-Feller [51] for a lake mixed with white, or used as a glaze on a white background. The red glaze fades slowly when freshly applied on a white ground. When deterioration of the glaze layer starts to allow transmission of light in the ultra-violet and infra-red parts of the spectrum, the rate of fading increases rapidly. Once the destructive wavelengths of light start to be absorbed, internal reflection back through the glaze layer increases the rate of fading further. Lake pigment mixed with white unprotected by a glaze is vulnerable to internal reflection from the beginning and as a result fades more quickly.

Predictions from accelerated ageing studies of lake pigment in synthetic media relate closely to the observed deterioration which has occurred in tempera paintings of the late fourteenth- and fifteenth-centuries. This suggests that lake pigments used in other media may fade in a similar way. The discovery that Lorenzo's Virgin's robe has faded may have more significance when examining other paintings. The implication is that the fading of lake pigments in paintings may be more common than is appreciated.

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Plate 15 Lorenzo Monaco, *The Coronation of the Virgin* (No.1897), centre panel.

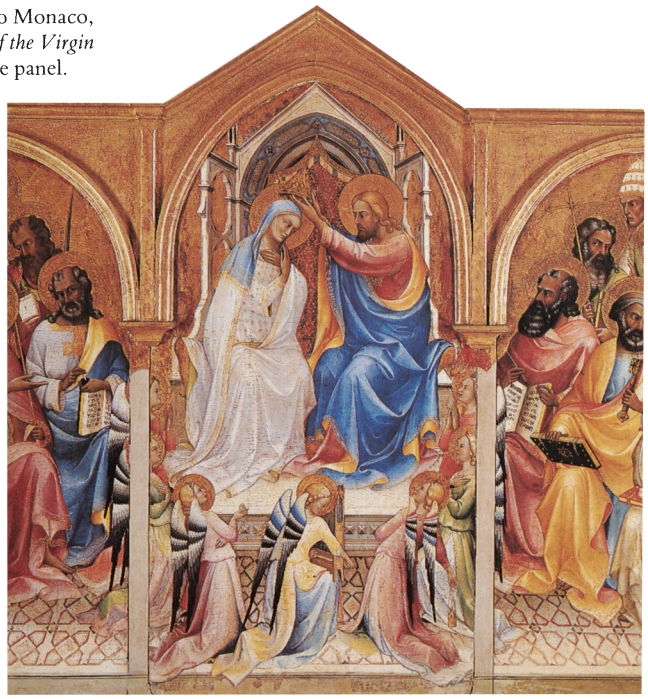

Plate 16 (Above) Lorenzo Monaco (No.1897), detail of the Virgin's robe.

Plate 17 (Right) Lorenzo Monaco (No.1897), detail of Christ's robe.

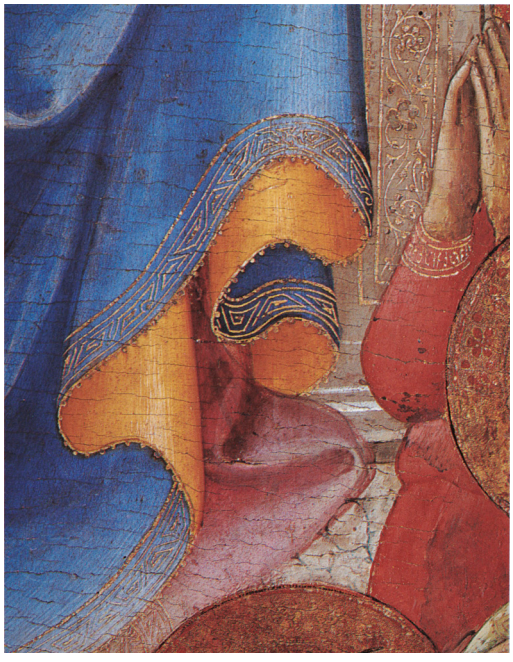

Plate 18 (Far right) Lorenzo Monaco (No.1897), paint cross-sections. Full caption on facing page.

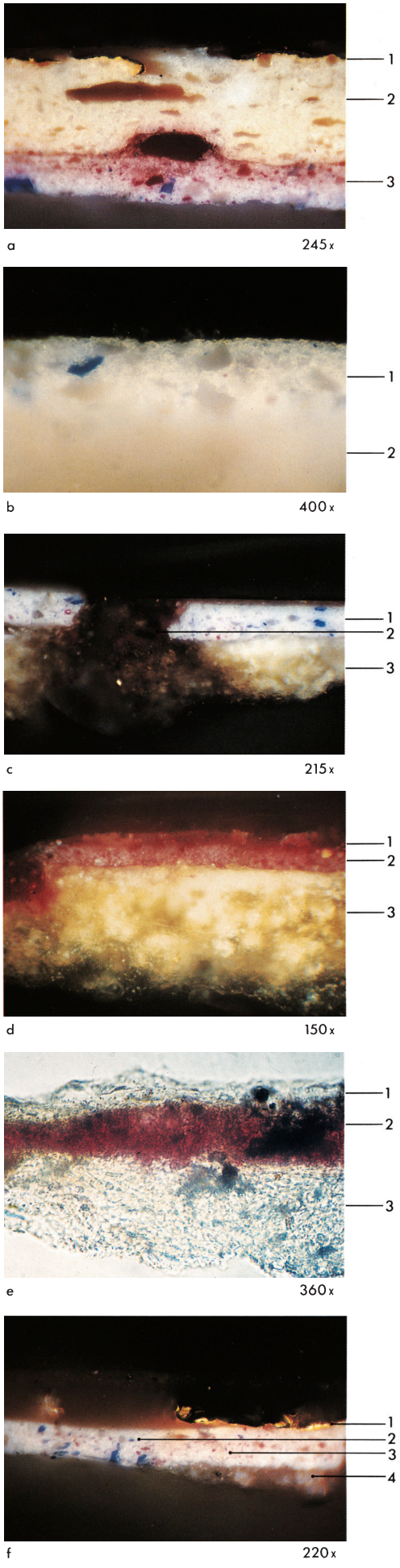

Plate 18 Lorenzo Monaco, *The Coronation of the Virgin* (No.1897). Photomicrographs of paint cross-sections, photographed in reflected light (*a*, *b*, *c*, *d* and *f*) and transmitted light (*e*) under the microscope at 600× (*a*, *b*) and 220× (*c*, *d*, *e*, *f*). Actual magnifications on the printed page shown opposite.

(a) Mordant gilding from the Virgin's robe.

1. Gold leaf.

2. Mordant, containing lead white.

3. Paint of robe, containing a mixture of red lake, ultramarine and lead white. Ground missing from this sample.

(b) White paint from a fold in the drapery near the Virgin's knee.

1. Lead white, ultramarine and translucent particles of faded red lake.

2. Gesso ground.

(c) Paint of Virgin's robe, with crack inpainted with red lake.

1. Upper paint layer of robe, containing lead white, ultramarine and red lake.

2. Cochineal lake; restorer's paint in crack.

3. Gesso ground.

(d) Red of Christ's underdress.

1. Thin glaze of red lake containing some iron oxide particles.

2. Pink underpaint; red lake and lead white.

3. Gesso ground.

(e) Thin cross-section of the red of Christ's underdress.

1. Uppermost part of red lake glaze which has completely faded.

2. Lower part of glaze layer and pink underpaint, where red lake remains relatively unfaded.

3. Gesso ground.

(f) Paint from the Virgin's robe taken from the edge of the mordant gilding. Paint in the right half of the cross-section is protected from light by a thin layer of gold leaf.

1. Gold leaf.

2. Paint of the robe protected from light; red lake particles retain their colour.

3. Paint of robe exposed to light, where red lake particles have faded in the upper part of the layer.

4. Gesso ground.

portrait of William Congreve from the National Portrait Gallery (no.3199) has faded red lake which had been preserved under the rebate of the frame. The paint medium has been analysed by Raymond White and found to be linseed oil.

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48. 'The Crucifixion' by Bernardo Daddi, examination report, Courtauld Institute of Art (1986), personal communication by Caroline Villers.

49. *ibid.*

50. Courtauld Institute of Art condition report on the 'Head of an Angel' (fragment) by Gherado de Giovanni, Gambier-Parry Collection. Personal communication by Robert Bruce-Gardner, Courtauld Institute of Art, February 1988.

51. Johnston-Feller, R. (1986), *op. cit.*, pp.40–3.