

National Gallery Technical Bulletin

VOLUME 34 *Titian's Painting Technique before 1540*



National Gallery Company
London

Distributed by
Yale University Press

This edition of the *Technical Bulletin* has been supported by the American Friends of the National Gallery, London with a generous donation from Mrs Charles Wrightsman

Series editor: Ashok Roy

© National Gallery Company Limited 2013

All rights reserved. No part of this publication may be transmitted in any form or by any means, electronic or mechanical, including photocopy, recording, or any storage and retrieval system, without prior permission in writing from the publisher.

Articles published online on the National Gallery website may be downloaded for private study only.

First published in Great Britain in 2013 by
National Gallery Company Limited
St Vincent House, 30 Orange Street
London WC2H 7HH

www.nationalgallery.co.uk

British Library Cataloguing-in-Publication Data.
A catalogue record is available from the British Library.

ISBN: 978 1 85709 552 4
ISSN: 0140 7430
1035936

Publisher: Jan Green
Project Manager: Claire Young
Editor: Lise Connellan
Design: Libanus Press
Picture Research: Rosalind McKeever
Production: Jane Hyne and Penny Le Tissier
Repro by Alta Image
Printed in the United Kingdom by Butler, Tanner and Dennis

FRONT COVER

Titian, *Bacchus and Ariadne* (NG 35), 1520–3 (detail).

TITLE PAGE

TOP LEFT: Titian, *The Holy Family with a Shepherd* (NG 4), c.1510 (detail).

TOP RIGHT: Titian, *The Music Lesson* (NG 3), c.1535 (detail).

BOTTOM LEFT: Titian, *Portrait of Gerolamo (?) Barbarigo ('The Man with a Quilted Sleeve')* (NG 1944), c.1510 (detail).

BOTTOM RIGHT: Titian, *'The Aldobrandini Madonna'* (NG 635), c.1532 (detail).

Photographic credits

All photographs reproduced in this Bulletin are © The National Gallery, London unless credited otherwise below.

ANTWERP

Koninklijk Museum voor Schone Kunsten, Antwerp, Belgium © Lukas – Art in Flanders VZW/Photo: Hugo Maertens/The Bridgeman Art Library: fig. 27, p. 16. Photo: © The National Gallery, London, Courtesy of the Owner: fig. 26, p. 16.

BERGAMO

Comune di Bergamo - Accademia Carrara: fig. 9, p. 9.

EDINBURGH

© National Galleries of Scotland: fig. 158, p. 82. Photo: © The National Gallery, London, Courtesy of the Owner: fig. 157, p. 82.

FRANKFURT

Städel Museum, Frankfurt am Main, Graphische Sammlung
© U. Edelmann - Städel Museum – ARTOTHEK: figs 33, 34, p. 19.

GLASGOW

Glasgow Museums © CSG CIC Glasgow Museums Collection: figs 68, 70, p. 39; figs 71, 72, p. 40; figs 73, 74, p. 41; fig. 82, p. 43. Photo: © The National Gallery, London, Courtesy of the Owner: fig. 43, p. 24; fig. 69, p. 39; figs 75, 76, p. 41; figs 77, 78, 79, p. 42; figs 80, 81, p. 43.

KINGSTON LACY

The Bankes Collection, Kingston Lacy © National Trust Photographic Library/Derrick E. Witty/The Bridgeman Art Library: fig. 16, p. 12.

OXFORD

Ashmolean Museum, University of Oxford. Photo: © The National Gallery, London, Courtesy of the Owner: fig. 32, p. 18; figs 37, 38, p. 20; fig. 191, p. 100; fig. 192, p. 101; figs 193, 194, 195, p. 102; figs 196, 197, 198; 199, p. 103; figs 200, 201, 202, 203, 204; p. 104; figs 205, 206, 207, 208, p. 105; fig. 211, p. 107; figs 229, 230, 231, p. 117; figs 232, 233, 234, p. 118; figs 235, 236, 237, 238, 239, p. 119; figs 240, 241, p. 120; fig. 243, p. 121.

PADUA

Museo Civico, Padua © 2013. Photo Scala, Florence: fig. 2, p. 6.
Scuola del Santo, Padua © 2013. Photo Scala, Florence: fig. 1, p. 6.

PRAGUE

National Gallery, Prague © 2013. DeAgostini Picture Library/Scala, Florence: fig. 8, p. 9.

PRIVATE COLLECTION

Courtesy of Bonhams: fig. 234, p. 118.

ST PETERSBURG

© The State Hermitage Museum: fig. 51, p. 32. © The State Hermitage Museum/Vladimir Terebenin: fig. 52, p. 33; fig. 53, p. 34; fig. 57, p. 35; fig. 67, p. 37. Photo: © The National Gallery, London, Courtesy of the Owner: figs 54, 55, 56, p. 34; figs 58, 59, p. 35; figs 60, 61, 62, 63, 64, p. 36; figs 65, 66, p. 37.

VENICE

Gallerie dell'Accademia, Venice © Courtesy of the Ministero per i Beni e le Attività Culturali, Soprintendenza Speciale per il Polo Museale Veneziano: figs 41, 42, p. 23. Photo: © The National Gallery, London, Courtesy of the Owner: fig. 29, p. 17.

WARMINSTER

Reproduced by permission of the Marquess of Bath, Longleat House, Warminster, Wiltshire, Great Britain: fig. 83, p. 44; fig. 84, p. 45.

WASHINGTON DC

National Gallery of Art, Washington DC. Photo: © The National Gallery, London, Courtesy of the Owner: fig. 24, p. 14.

Titian's Painting Technique to c.1540

JILL DUNKERTON and MARIKA SPRING, with contributions from RACHEL BILLINGE,
KAMILLA KALININA, RACHEL MORRISON, GABRIELLA MACARO,
DAVID PEGGIE and ASHOK ROY

Titian's painting technique fascinated artists and collectors even in his own lifetime and it was to have an exceptional and continuous influence on the subsequent history of European painting. Over the centuries, however, myths inevitably developed as to how he achieved his atmospheric landscapes, his sumptuous textiles and furs, and above all the vibrant warmth of his depiction of human flesh. Beliefs included the use of brown grounds, monochrome underpaintings, the inclusion of varnishes and other additives to his oil medium and the application of many final touches and multiple glazes.¹ It is now over 40 years since Joyce Plesters carried out her groundbreaking investigation of *Bacchus and Ariadne* (CAT. 8) during its treatment in 1967–9,² followed by important studies by Lorenzo Lazzarini in Venice,³ which demonstrated that Titian actually used a traditional gesso ground, sometimes modified with an *imprimitura* layer, that his paint medium was a straightforward drying oil, and that the paint layer structure as revealed in cross-sections of paint samples is indeed sometimes complex, but that this was either to achieve particular colour effects or can be related to the numerous changes and adjustments that he made in the course of painting.

Since then a great many more paintings by Titian have undergone various forms of technical examination and new scientific methods have been introduced, both for the analysis of microsamples and for exploration beneath the paint surface, in particular developments in infrared examination that dispel another old myth, that Titian created his works entirely in paint, without first drawing his design. *Bacchus and Ariadne*, for instance, has been examined by infrared reflectography for the first time for this issue of the *National Gallery Technical Bulletin*, and the paint samples on which Plesters based her conclusions have been re-examined – expanding, but almost never contradicting her original observations. In the same way, the results of technical examination over many years of the other paintings by Titian in the collection, some of it reported in a variety of separate publications,⁴ but much not previously published, have

been assembled, re-evaluated and updated with some new infrared reflectography and quite extensive new analyses. The material is presented in individual entries on each painting, arranged in roughly chronological order, following this essay, which is a more general survey of aspects of Titian's methods and materials.

The loan in 2012 by The State Hermitage Museum, St Petersburg, of *The Flight into Egypt* (CAT. 1) to the National Gallery for the exhibition *Titian's First Masterpiece: The Flight into Egypt* has, with the generous collaboration of their Laboratory for Technical Analysis, made it possible to include in this *Bulletin* the canvas that is widely accepted as Titian's first surviving large-scale work. This opportunity is particularly valuable as the technique can be compared with that of another much-debated painting, *Christ and the Adulteress* from the Glasgow Museums (CAT. 2), now agreed by most scholars to be by the young Titian. This painting was restored at the National Gallery in the early 1950s and paint samples taken then and in 1980, still held in the National Gallery Scientific Department, have undergone new investigation. The enchanting small canvas from Longleat House showing the *Rest on the Flight into Egypt* (CAT. 3), usually dated close to the Glasgow painting, was lent by the Most Hon. the Marquess of Bath to the 2012 exhibition and the opportunity was taken for X-ray and infrared examination at the Gallery. Although no further analysis was carried out, the X-radiograph, in particular, supplies important new information about the condition and technique.

These three paintings are followed in approximate order of date (always difficult and sometimes controversial in Titian's oeuvre) by the National Gallery's four early canvases, *The Holy Family with a Shepherd* of about 1510 (CAT. 4), the two remarkable portraits *Portrait of Gerolamo (?) Barbarigo* ('The Man with a Quilted Sleeve') and *Portrait of a Lady* ('La Schiavona') (CATS 5 and 6), which are probably close in date, and then *Noli me Tangere* (CAT. 7), painted in about 1514. *Bacchus and Ariadne* (CAT. 8), painted in 1520–3, is the next in the sequence, followed by two little known and more

problematic canvases, the much damaged *Portrait of Girolamo Fracastoro* (CAT. 9), probably painted around 1528, which following cleaning has returned to its old attribution to Titian, and *A Boy with a Bird* (CAT. 10). The reasons for believing that this small painting is a product of Titian's workshop in the late 1520s have already been presented in a recent issue of this *Bulletin* but there is some value in including a summary of those findings for comparison with other works in this new study. To *The Virgin and Child with the Infant Saint John and a Female Saint or Donor* ('*The Aldobrandini Madonna*') (CAT. 11), probably painted in about 1532, there can be added another canvas that may have been painted in this decade, *The Music Lesson* (CAT. 12), recently cleaned and restored after more than a century of obscurity beneath multiple layers of heavily discoloured varnish. The final work, *The Triumph of Love* (CAT. 13), acquired in 2008 by the Ashmolean Museum, Oxford, may date from the mid-1540s, and therefore a little after the approximate division for this volume of the *Bulletin*, but the fact that its cleaning and restoration at the National Gallery is described with other recent treatments in the final part of this *Bulletin* has led to the decision to include it here.

All the paintings have been X-rayed, and the composite X-radiographs of the scanned X-ray plates have been digitally processed to reduce the impact of stretcher bars on the images where appropriate. The majority of the works were examined by digital infrared reflectography using an OSIRIS camera with an indium gallium arsenide (InGaAs) line scan sensor.⁵ Two, the *Portrait of Girolamo Fracastoro* and *The Music Lesson*, also underwent transmitted infrared imaging when their old lining canvases had been removed during the process of relining. Paint samples have been investigated from all but one work. Medium analysis by gas chromatography–mass spectrometry (GC–MS) has been carried out on samples from several works. When suitable samples were available, dyestuffs in red lake pigments have been identified by high performance liquid chromatography (HPLC). Most importantly for the study of Titian's technique, samples have been mounted as cross-sections and the materials and layer structure studied by optical microscopy in both visible and ultraviolet light, supplemented by energy-dispersive X-ray analysis in the scanning electron microscope (SEM–EDX), transmission FTIR analysis and attenuated total reflectance–Fourier transform infrared microspectroscopic imaging (ATR–FTIR). This was greatly aided by the information

from earlier examinations preserved in the files of the Scientific and Conservation Departments, such as the carefully drawn and painted illustrations of cross-sections, as well as detailed descriptions of the paint composition, made by Plesters when some of the paintings were cleaned during the late 1950s and 1960s. Also integrated into the current research are pigment analyses with a laser microspectral analyser, carried out in the late 1970s and early 1980s, supplemented by a few results from X-ray diffraction and some recent analyses by Raman microspectroscopy (specifically for the orange and yellow arsenic sulphide pigments). In addition to the thirteen paintings that form the basis of this study, a few cross-sections have been included from other works by Titian that have been investigated by the National Gallery Scientific Department as part of past and present collaborations with other institutions, including the National Galleries of Scotland, the Koninklijk Museum voor Schone Kunsten, Antwerp, and the Soprintendenza per i beni artistici, Venice.

Titian's origins as a painter

In the absence of contemporary documents concerning Titian's training as a painter, our knowledge of his artistic origins is based on the two early biographies; that included in Lodovico Dolce's *L'Areino o dialogo della pittura* published in 1557⁶ and Vasari's 'Life of Titian' in the second 1568 edition of his *Lives*.⁷ Both were therefore published in his lifetime and both writers had met the painter in his middle age. While the biographies have to be interpreted with care, in many respects they can be shown to be reasonably reliable.⁸ Dolce recounts that Titian was sent, aged nine, from his native Pieve di Cadore to Venice. Vasari claims that he was ten, but given Titian's vagueness and tendency to exaggerate his age in later years, neither is necessarily accurate.⁹ According to Dolce he was sent to the obscure and little-studied artist Sebastiano Zuccato to be given 'i principii dell'arte'. Zuccato was from Treviso, a city on the route down to Venice from Pieve di Cadore and he may well have been a Vecellio family contact.¹⁰ Only one certain work by him is known, a signed panel, probably of about 1490, now in the Museo Correr, Venice,¹¹ which shows a donor kneeling before Saint Sebastian in a deep receding landscape. Zuccato's two sons, Valerio and Francesco, who were much younger than Titian, became well-known mosaicists, and it is generally assumed that



FIG. 1 Titian, *The Miracle of the Jealous Husband*, 1511. Fresco, 340 x 184 cm. Padua, Scuola del Santo.

their father primarily practised that art.¹² However, Valerio Zuccato was also involved in the execution of the frescoes designed by Titian in 1565 for the choir of the church of Santa Maria Nascente in Pieve di Cadore.¹³ This raises the possibility that Valerio's father too was a fresco painter as well as a mosaicist. Even though no work by him in this medium is known, it may be that it has largely disappeared as a result of the loss of almost all external wall paintings in Venice, once extensively decorated in this way – as were the towns and cities of the *terra firma*, although there more survives. While it is possible that Titian spent some of his early years as a

painter on the mainland and learned to paint in fresco there, there is no reason why his first instruction in the craft of painting, both in fresco and in oil on panel and canvas, should not have taken place in Zuccato's workshop. This could have been sufficient for him to qualify to become a member of the Venetian painters' guild.¹⁴

Early training and experience principally as a fresco painter might explain why Titian was taken on to paint the important and highly visible side wall of the Fondaco dei Tedeschi.¹⁵ This was in 1508 or 1509, when he was probably not yet twenty. Everyone who saw the frescoes before they virtually disappeared in the eighteenth century praised Titian's contribution more highly than that of Giorgione on the main façade. On 1 December 1510, the first time Titian is recorded in a document, he was approached to paint frescoes showing miracles of Saint Anthony in the Scuola del Santo in Padua. He was assisted by his brother, Francesco, who must therefore have had a similar training. While the condition of the surviving fragment of Titian's figure of *Judith* from the Fondaco is such that it is difficult to determine details of the technique, the Santo murals are largely executed in true fresco and with considerable speed and confidence.¹⁶ The scene of *The Miracle of the Jealous Husband* (FIG. 1) was divided into only six *giornate*¹⁷ and later frescoes by Titian also demonstrate his proficiency in the medium.¹⁸

A background in fresco painting would also account for the strikingly broad handling of the sky, mountains and distant landscape of *The Flight into Egypt* (CAT. 1), even if it is in oil paint, and also for the light, desaturated tones of the grassy meadow, which does not appear to have lost its deeper green glazes as some have supposed (see p. 37). The group of small-scale panels that are often assigned to the earliest phase of Titian's career – for example, the *cassone* panel of *The Birth of Adonis* (FIG. 2) – are also painted with remarkable confidence, with the abbreviated little figures brushed in quickly over the expansive landscape. Oil painting provided



FIG. 2 Attributed to Titian, *The Birth of Adonis*, c.1505–8. Oil on panel, 35 x 106 cm. Padua, Museo Civico, Inv. 50.



FIG. 3 Cima da Conegliano, *Saint Jerome in a Landscape* (NG 1120), c.1500–10. Oil on wood, 32.1 x 25.4 cm.



FIG. 4 Giorgione, *Il Tramonto (The Sunset)* (NG 6307), 1506–10. Oil on canvas, 73.3 x 91.4 cm.

more opportunity than fresco for altering the design during execution, which Titian took advantage of in *The Flight into Egypt*, with its radical rethinking of the Holy Family figure group, and also in *Christ and the Adulteress* (CAT. 2) with its many alterations to the heads of the figures. There is little sign of the careful planning that went into the execution of a painting in Giovanni Bellini's workshop in the early years of the sixteenth century: for example, the *Madonna of the Meadow* (see FIG. 7) or the altarpiece of the *Baptism of Christ* in the church of Santa Corona, Vicenza, with its careful underdrawing made with the point of the brush (but no longer with the elaborate hatched shading of Bellini's earlier underdrawings) and thin, even paint layers, resulting in a sound technique based on an ordered and logical structure of opaque underpainting followed by more medium-rich glazes.¹⁹

On the evidence of the technique of Titian's earliest paintings, it has to be questioned, therefore, whether he really did abandon Zuccato to continue his basic formal training in the workshops of first Gentile Bellini, then Giovanni Bellini and finally Giorgione, as claimed by Dolce. This progression to ever more 'modern' painters is slightly suspect and it is possible that Dolce was claiming for Titian the training that he thought appropriate, especially as *L'Aretino* was written in part to challenge the supremacy of Michelangelo as promulgated by Vasari. Indeed, it is even possible that, like Michelangelo,²⁰ Titian in later life sought to gloss over his artistic origins. Nevertheless, it is clear that Titian understood and absorbed not only the work of Giovanni Bellini²¹ and Giorgione, but also that of other painters active in Venice in the early years of the century, among them Alvise Vivarini, Cima da Conegliano, Lorenzo Lotto and especially Sebastiano del Piombo. Titian did not

come from an artisanal class, but in common with Michelangelo and also Leonardo, his family, which included several notaries, was engaged mainly in business and local administration.²² Family support may have enabled him to escape some of the restrictions of traditional apprenticeship and training to move more freely among the major workshops of Venice, learning from all of them.

Therefore, in his approach to landscape painting, for example, Titian had much in common with Cima, who like him clearly retained affection for his native hills and mountains, often setting small-scale figures in expansive landscapes rendered with considerable topographical accuracy (FIG. 3). Giorgione's landscapes are, by contrast, more fanciful (FIG. 4), yet Titian understood and adopted their elegiac mood, although not initially with the same degree of sophistication. The palette of his earliest works has similarities with that of Giorgione (FIG. 5), employing rather high-key colours with strong and relatively light highlights. They shared a particular fondness for golden and lemon yellows, based on lead-tin yellow.²³ In his technique and his design skills, however, Giorgione was considerably more refined than the young Titian, who by comparison can appear somewhat awkward. It is possible to believe that Giorgione was trained in the Bellini workshop; even if he made intriguing and possibly significant changes to some works during painting, he usually began with a careful brush drawing. That detected on *Il Tramonto*, *The Adoration of the Kings* and other attributed works²⁴ generally consists of fine brush lines, which are usually quite schematic in their outlining of forms and drapery structures. The paint layers are relatively thin and orderly in their layer structure except where forms overlap or are superimposed.



FIG. 5 Giorgione, *The Adoration of the Kings* (NG 1160), 1506–7. Oil on wood, 29.8 × 81.3 cm.

Evaluation of the role that Giorgione played in Titian's artistic education is not helped by difficulties in attribution, and also dating of his work. Only the *Laura* (Kunsthistorisches Museum, Vienna) has the date 1506. Moreover, we know from early sources that before his early death Giorgione produced few public works other than the Fondaco dei Tedeschi façade.²⁵ The dramatic lighting effects, with important faces sometimes cast into complete shadow, together with the softening of contours and the replacement of precision of detail with a more suggestive handling of paint, are elements that become increasingly apparent in Titian's early works, and could indeed be taken from Giorgione. However, they are also present in the later works of Giovanni Bellini, such as the San Zaccaria Altarpiece, which was certainly accessible and was clearly important for Titian.

The grand altarpieces that Cima painted for Venetian churches in the first decade of the century were

also visible, and elements of Titian's technique, including the extensive use of translucent pigments, often in overlapping layers of opaque and transparent pigment mixtures, appear closer to the technique of Cima's best works than to that of Bellini. Even on a smaller scale the difference is apparent between the deep, richly glazed, and almost enamelled forms of the Virgin's draperies in Cima's *The Virgin and Child with a Goldfinch* (FIG. 6) and the softer, more diffuse shallow relief modelling of Bellini's *Madonna of the Meadow* (FIG. 7).

Another altarpiece that clearly impressed Titian was Albrecht Dürer's *Feast of the Rosegarlands*, painted in 1506 for the German confraternity in San Bartolomeo di Rialto (FIG. 8). The altarpiece, and Dürer's prints, drawings and watercolour studies, inspired Titian's interest in accurate observation of plant and animal life, but he also seems to have been struck by the way that the heavily padded pluvial cloak of the Pope on



FIG. 6 Cima da Conegliano, *The Virgin and Child with a Goldfinch* (NG 634), c.1505. Oil on poplar, 53.3 × 43.8 cm.



FIG. 7 Giovanni Bellini, *Madonna of the Meadow* (NG 599), c.1500. Oil on synthetic panel, transferred from wood, 67.3 × 86.4 cm.

FIG. 8 Albrecht Dürer, *The Feast of the Rosegarlands*, 1506. Oil on panel, 162 × 194.5 cm. Prague, National Gallery, Inv. 0 1552.



the left and the red fur-lined mantle of the Emperor on the right form different fold structures to those of finer fabrics such as the yellow silk of the musician angel. In Titian's earlier works this bulked up, almost inflated, effect can often be seen in draperies, both where appropriate, as in the *Portrait of Gerolamo (?) Barbarigo* (CAT. 5), but also when depicting textiles such as the Virgin's robes in *The Flight into Egypt* or the small Bergamo Madonna (FIG. 9) that one might expect to be more softly draped.

This seeking for volume, rather different from the stiffer triangular fold structures that characterise



FIG. 9 Titian, *Virgin and Child*, c.1509. Oil on panel, 38 × 47 cm. Bergamo, Accademia Carrara, Inv. 644.

Giorgione's drapery painting, is one of several features that bring Titian closer to Sebastiano del Piombo. Sebastiano was slightly older and more experienced than Titian and, until his departure for Rome in 1511, he was arguably at least as important as Giorgione for Titian's development as a painter on canvas and panel. They both worked on canvases for Ca' Loredan of similar dimensions and construction (see CAT. 1, p. 33) and there are resemblances in the way in which they came to prepare their painting surfaces (see p. 13). In the unfinished Kingston Lacy *The Judgement of Solomon* (see FIG. 16) Sebastiano made changes every bit as radical as those discovered in works by Titian. His handling of oil paint could be remarkably bold and free, especially in parts of the organ shutters for San Bartolomeo di Rialto, but also in a small-scale work such as *The Daughter of Herodias* (see FIG. 18). The contrast between the broad brushstrokes of stiff oil paint in her blue dress and sleeve with the evenly modulated flesh tints is heightened by the smooth surface of the panel support.

A surprisingly high proportion of surviving paintings from the first twenty or so years of Titian's career were painted on panel rather than canvas, which is the support that is more generally associated with his work. No panels are included in this study, but they range from his first altarpieces, *Tobias and the Angel*, possibly from about 1508–9 (Gallerie dell'Accademia, Venice),²⁶ and

Saint Mark Enthroned with Saints (Church of Santa Maria della Salute, Venice) to the enormous panels of the *Assumption of the Virgin* for the high altar of the church of the Frari painted in 1515–18 and the destroyed *Death of Saint Peter Martyr* painted for San Giovanni e Paolo in 1527. Many of his smaller Madonnas (FIG. 9) and half-length images of the Virgin and Child with Saints were also on panel, following the tradition of previous generations. Variations in the handling properties of paint when applied to an unyielding surface as opposed to the springy resilience of a stretched canvas, the ways in which panels and canvases age and influence the formation of craquelure in the paint films, and the effects of past conservation treatments, especially relining,²⁷ all mean that works by Titian that may well be close in date can look markedly different depending on their supports.

Titian's canvas

Although canvas did not displace panel as the most common painting support in Venice until well into the sixteenth century, when Titian began to paint it had already long been in use, especially for works with particular functions. The greater portability of textile supports meant that in the previous century it was used for works such as banners to be carried in religious processions, large votive canvases showing the doge of the day before the Virgin and Child, and also emblematic paintings featuring the Lion of Saint Mark, sometimes



FIG. 10 NG 3949, Titian, *Portrait of Girolamo Fracastoro* (CAT. 9), detail of the back of the canvas exposed during relining.

with saints. The largest group of surviving canvas paintings, however, consists of the narrative cycles painted to decorate the meeting rooms of the Scuole, Venetian confraternities dedicated to charitable works.

Canvas was readily available in Venice, in part because of its maritime interests and huge shipbuilding industry, and it may be that specialist merchants dealt in canvas for painting as well as for tarpaulins and sails.²⁸ It is not included in the stock of the specialist *vendicolori* (colourmen) who supplied other materials to painters, or at least not those that have been studied to date. Different weaves were available, ranging from plain (also called tabby) weave to twill and more complex variations of twill such as herringbone. Some painters appear to have been quite casual in their choice, so that Carpaccio, for instance, used all three types for the canvases that make up his Saint Ursula cycle painted in the 1490s for the Scuola of that name (now Gallerie dell'Accademia, Venice), and later on Tintoretto was to use lengths of canvas of quite different weaves sewn together to form a single support. Titian, however, seems to have been more particular in his choice of weave and weight. Only two of the works included in this study are on twill-weave canvases: *Portrait of a Lady* ('*La Schiavona*') (CAT. 6) and *The Triumph of Love* (CAT. 13). All the others are tabby (plain) weave. Although Titian did not choose the unusually fine canvas for *Bacchus and Ariadne* (CAT. 8) since it was sent to him by Alfonso d'Este, the thread counts are almost as high for the canvases of the *Portrait of Gerolamo (?) Barbarigo* (CAT. 5), *Noli me Tangere* (CAT. 7) and the later '*Aldobrandini Madonna*' (CAT. 11); all three paintings are notably refined in their execution. The other tabby-weave canvases are coarser, sometimes with barely half the number of warp and weft threads of the finer canvases. These tend to be more strongly textured with slubs and areas with thicker more raised threads as a result of uneven spinning of the linen threads woven to make the canvas (FIG. 10).

Most of the paintings in this study are relatively small and so the canvases consist of single pieces of fabric. The maximum width of a handwoven canvas was usually around or just over a metre (the width that a single weaver could throw the shuttle of the loom) and four of the paintings (CATS 4, 7, 11 and 12) have heights that suggest that the maximum width of canvas was used without any wastage. For larger works lengths of canvas had to be stitched together, a service that may have been offered by the supplier.²⁹

The canvas for *Bacchus and Ariadne* (CAT. 8) consists of two pieces joined vertically, slightly to the right of the centre, which indicates that a full width of a metre or so was used only on the left side. The canvas for *The Flight into Egypt* (CAT. 1) has two horizontal seams and that for *Christ and the Adulteress* (CAT. 2) one, but in both instances the loom width of the canvas was narrower than usual, about 78 cm. Similar narrow linen was also used to make up the support of Sebastiano's *The Judgement of Solomon* (see p. 33).

The canvases were stretched over simple wooden strainers³⁰ – expandable stretchers with keys were not introduced until the late eighteenth century. The canvas edges could be turned around the sides of the strainer for tacking, but it was also common practice in the sixteenth century to hammer the tacks into the edge of the front face of the strainer. The tacks were presumably covered by the frame rebate. Some of the paintings in this study exhibit tack holes surrounded by original paint (FIG. 11), which shows that they were originally stretched in this way, although the tacking margins may later have been turned around the sides of a stretcher.³¹ Often there is a second set of tack holes, which cannot be matched with the cusped distortion of the canvas from the first stretching. The canvas may sometimes have been re-stretched, perhaps after rolling for transport, or a second set of tacks added as the canvas around the first tack holes began to decay and was no longer secured.



FIG. 11 NG 3949, Titian, *Portrait of Girolamo Fracastoro* (CAT. 9), detail of the lower left corner.

Preparing to paint

With one exception (see p. 83), all the canvases in this study for which paint samples were available have been shown to have been first prepared for painting with an application of gesso – that is, calcium sulphate of mineral origin bound in a glue medium (for example, FIG. 12). Earlier Venetian canvas paintings were treated in this way, and it continued to be common practice until late in the sixteenth century, when coloured grounds came to be widely used – even then a little gesso is often found beneath the oil priming.³² In order to avoid cracking and flaking of the gesso, it was not applied as thickly as it might be on a wooden panel. The aim was to fill to some extent the interstices of the canvas weave, but only to cover thinly the tops of the threads. It was not Titian's intention to suppress the texture of the woven fabric. Gesso could be applied with a brush, but in the *Portrait of Girolamo Fracastoro* (FIG. 13) ridges of gesso exposed by the worn condition of the black costume suggest that here it was applied as

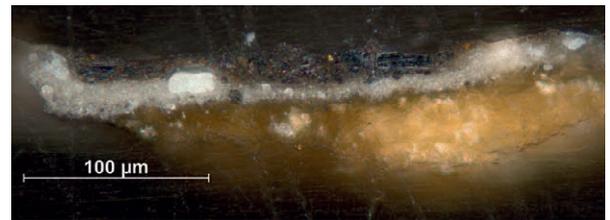


FIG. 12 NG 3949, Titian, *Portrait of Girolamo Fracastoro* (CAT. 9), cross-section of black paint from the arch in the background at the right-hand side of the painting. The uppermost black layer, containing coal black, lies on a mid-grey layer which is in turn directly on the gesso ground.



FIG. 13 NG 3949, Titian, *Portrait of Girolamo Fracastoro* (CAT. 9), photomicrograph showing ridges in the gesso, perhaps as the result of application with a palette knife.

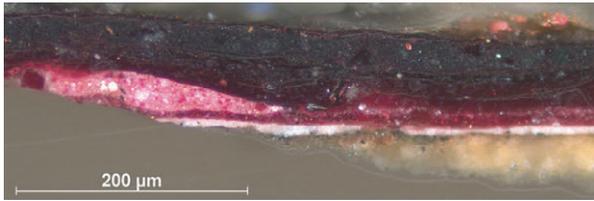


FIG. 14 Cima da Conegliano, *The Incredulity of Saint Thomas* (NG 816), c.1502–4. Oil on synthetic panel, transferred from poplar, 294 × 199.4 cm, paint cross-section from red drapery showing a thin layer based on lead white on top of the gesso. Several red layers based on red lake mixed with more or less lead white lie on top.

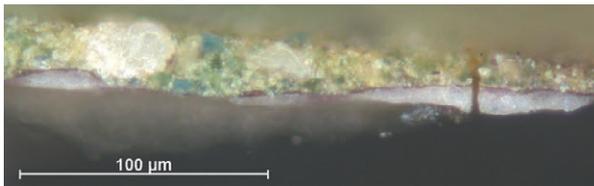


FIG. 15 NG 634, Cima da Conegliano, *The Virgin and Child with a Goldfinch* (FIG. 6), paint cross-section from the green landscape, showing a very thin uneven *imprimitura*.

a stiffer paste with a flexible palette knife. This may have been common practice and would allow rapid and even preparation of the canvas, ensuring that the gesso was pushed into the gaps and depressions of its texture.

A gesso ground is slightly absorbent, so when

painting in oil many painters preferred to seal the surface, sometimes by applying a thin layer of glue, but more often with a priming or *imprimitura* containing drying oil and pigments, usually including at least one that increases the drying rate of the oil, such as lead white. This was common practice in Northern European paintings of the fifteenth century and was also taken up by Italian painters as they adopted the oil medium. Cross-sections of samples from oil paintings by Giovanni Bellini and Cima from the early years of the sixteenth century tend to show a thin layer of lead white over the gesso in some, but not all, samples – as in Cima's *Incredulity of Saint Thomas* (FIG. 14), where there is also a very small amount of black pigment, perhaps stray underdrawing, but also possibly a deliberate addition to tint this layer. It has been suggested for this painting and others that it was applied locally, perhaps only under intensely coloured draperies, or to mask underdrawing, but it seems more likely that often it is so thin that it does not completely cover the gesso.³³ This is demonstrated in a cross-section from *The Virgin and Child with a Goldfinch* by Cima (FIG. 15), in which the lead white layer is notably uneven and discontinuous, either a result of brushing of the priming or perhaps blotting while it was still soft. Indeed, the

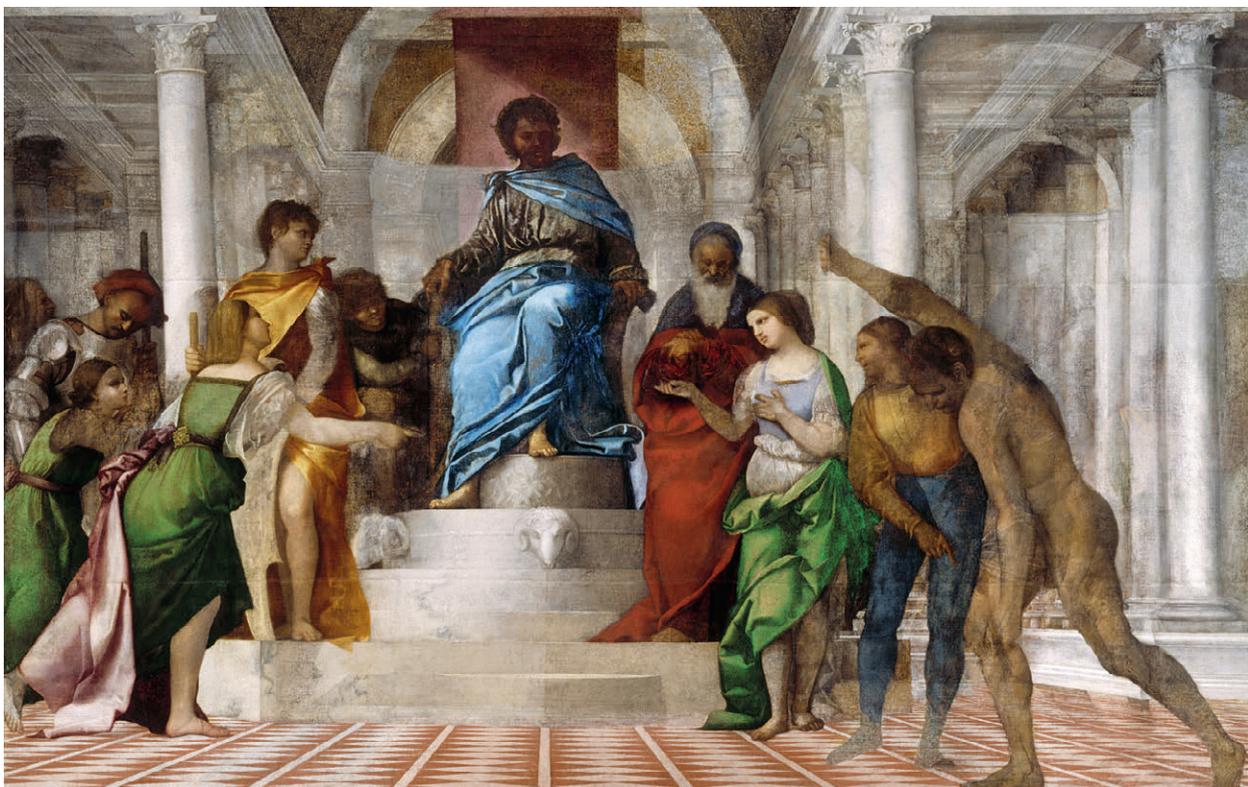


FIG. 16 Sebastiano del Piombo, *The Judgement of Solomon*, c.1506–7. Oil on canvas, 208 × 315 cm. Kingston Lacy, The Bankes Collection.



FIG. 17 NG 2493, Sebastiano del Piombo, *The Daughter of Herodias* (FIG. 18), detail of infrared reflectogram.

numerous finger and palm prints noted on works by Bellini and Cima indicate that some form of *imprimatura* was applied across the whole surface and then blotted in the way later described by Vasari.³⁴

From the few samples available from paintings by Giorgione it seems that he may have followed Bellini's and Cima's practice in applying a thin layer of lead white to at least some areas when working on panel, as for example on the Castelfranco Altarpiece,³⁵ but samples from paintings on canvas, including *La Tempesta*, *La Vecchia*³⁶ and *Il Tramonto* (FIG. 4), do not show any such layer. Sebastiano's *The Judgement of Solomon* (FIG. 16), begun possibly as early as 1505,³⁷ was also painted directly on the gesso ground, as were the first two canvases by Titian included in this study. However, the group of four paintings from the National Gallery that date from around 1510 to 1514 (CATS 4–7) all include a priming of relatively substantial thickness (averaging around 30 μm) with an essentially similar and distinctive composition. It may not be a coincidence that the same type of priming is also present on Sebastiano's *The Daughter of Herodias* (FIG. 18), one of



FIG. 18 Sebastiano del Piombo, *The Daughter of Herodias* (NG 2493), 1510. Oil on wood, 54.9 × 44.5 cm.

his Venetian works, signed and dated 1510. In cross-sections from these paintings (FIGS 19–23) this layer can be seen to contain mainly lead white, some of it in the form of large flakes, together with a very fine grained black identifiable from its microscopic characteristics as lamp black, a pigment prepared by collecting the soot produced in the flame when burning various materials, such as oils, resins, fats and waxes.³⁸ Although listed among the black pigments used by artists in sixteenth-century treatises on painting by Lomazzo (1584), Borghini (1584) and Armenini (1586),³⁹ it has not been found as frequently as other blacks during the broad surveys of painting technique in Italy in the sixteenth century that have been conducted over many

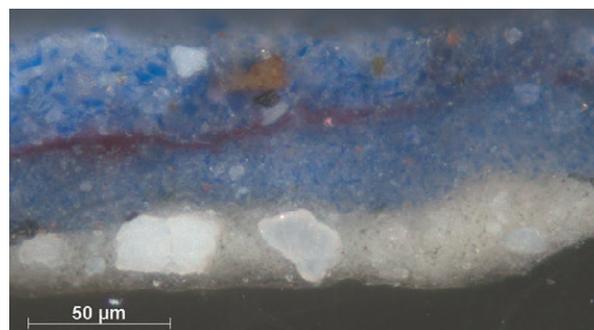


FIG. 19 NG 2493, Sebastiano del Piombo, *The Daughter of Herodias* (FIG. 18), paint cross-section from the blue dress.



FIG. 20 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), paint cross-section from the Virgin's blue mantle.



FIG. 21 NG 1944, Titian, *Portrait of Gerolamo (?) Barbarigo* (CAT. 5), paint cross-section from the grey background.



FIG. 22 NG 270, Titian, *Noli me Tangere* (CAT. 7), paint cross-section from a brown leaf on the tree.



FIG. 23 NG 5385, Titian, *Portrait of a Lady ('La Schiavona')* (CAT. 6), paint cross-section from the grey background.

years at the National Gallery. In the study published in 1998 on the composition of grounds and primings in almost 140 sixteenth-century Italian paintings, there were quite a large number that were off-white in colour, but only two where lamp black was used to tint the white – both by Sebastiano.⁴⁰

Lamp black has a distinctive appearance in samples, but because of its small particle size it can be difficult to see under the microscope, especially when only a small amount is present. As a result, in earlier studies the *imprimatura* in several of these paintings was reported as being white.⁴¹ In fact, in these paintings the surface was off-white, tending to pale grey. In three of the works it was left exposed either at the edge, or in gaps where painted forms do not quite meet, showing that in the *Portrait of Gerolamo (?) Barbarigo* it is very pale and only just off-white (FIG. 104, p. 54), while in the *Portrait of a Lady ('La Schiavona')* it is a slightly warmer off-white hue (FIG. 114, p. 60). In *The Holy Family with a Shepherd* (CAT. 4), and also in the Sebastiano mentioned above, sufficient black pigment is present for the streaks from its brushed application to register quite strongly in an infrared reflectogram (FIG. 17). The presence of these unpainted areas of priming also made it possible to analyse the medium without interference from any overlying paint layers, which indicated that in every case the binder was heat-bodied linseed oil.

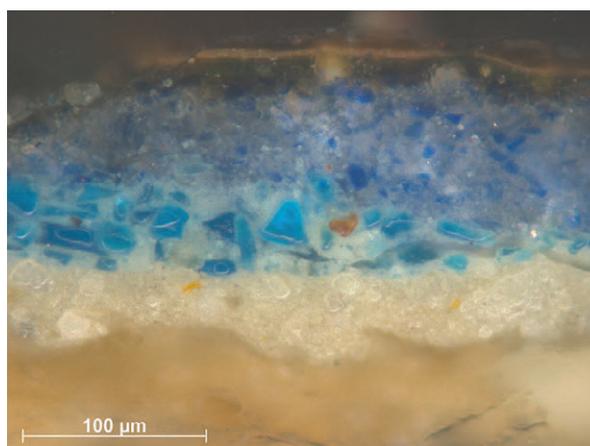


FIG. 24 Giovanni Bellini (finished by Titian), *The Feast of the Gods*, 1514/29. Oil on canvas, 170.2 x 188 cm. Washington, DC, National Gallery of Art, Inv. 1942.9.1, paint cross-section from the sky.

Although difficult to see under visible light, SEM-EDX analysis revealed that the primings on the four early National Gallery paintings consistently contain in addition some dolomite (calcium magnesium carbonate) – mostly as small particles, although one larger particle with the characteristic square shape of this mineral can be seen in FIG. 22. This seems to be present as a component of an earth pigment since a small amount of yellow iron oxide is also present.

The more rounded translucent globules in the primings of the two portraits (FIGS 21 and 23) are not

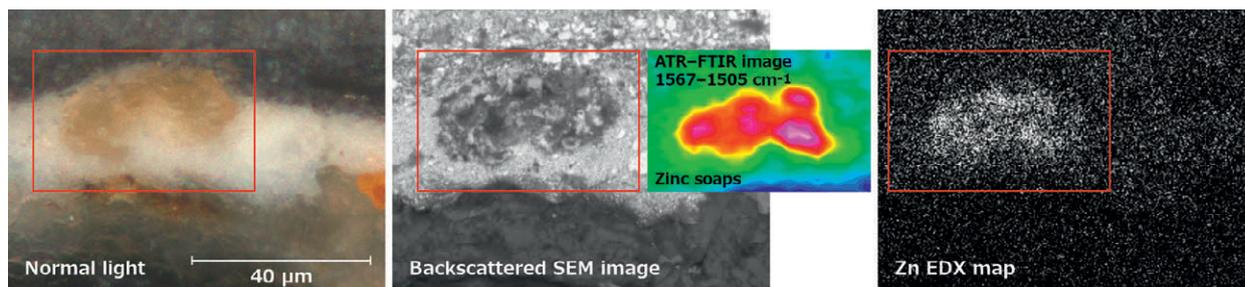
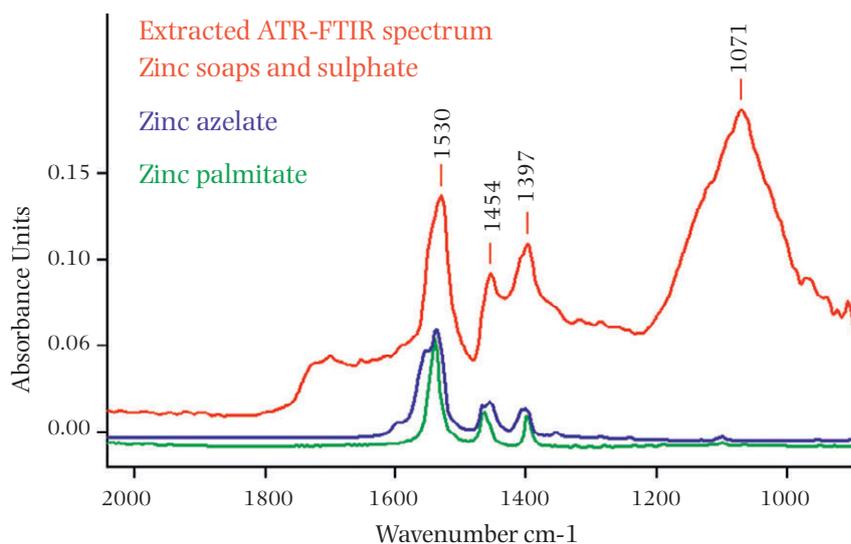


FIG. 25 NG 1944, Titian, *Portrait of Gerolamo (?) Barbarigo* (CAT. 5), ATR-FTIR imaging of one of the translucent zinc-containing globules in the priming.



dolomite but instead proved when analysed by EDX to contain zinc. ATR-FTIR imaging showed this was present in the form of zinc sulphate (FIG. 25), as well as zinc soaps formed over time as the sulphate has reacted with the fatty acids in the oil medium.⁴² Zinc sulphate (white vitriol, white copperas) is occasionally mentioned as a drier for oil paint in documentary sources. What seems to be the same material was also found during this study in the paint layers of *The Flight into Egypt* (CAT. 1) and *Christ and the Adulteress* (CAT. 2) (these have no priming), and this is therefore discussed in more detail below.

Priming layers containing lead white and a small amount of lamp black have also been reported on several other works by Titian that date from the second decade of the century, and it seems to have been part of his regular practice around this time.⁴³ That on *Jacopo Pesaro being presented by Pope Alexander VI to Saint Peter* (FIGS 26 and 27) contains slightly more black pigment than the National Gallery paintings. In the X-radiograph it is apparent that the priming was applied with broad diagonal sweeps, most probably with a palette knife.⁴⁴ In the past it has been suggested that

the painting was begun as early as 1506, by Giovanni Bellini, or by Titian in Bellini's workshop, and then later finished by Titian. The composition of the priming is consistent with a later date in the 1510s, which has recently become more widely accepted.⁴⁵ As already mentioned above, very similar primings were used by other artists working in Venice, among them even Giovanni Bellini, notably on *The Feast of the Gods*, one of his last works, later to be reworked by Titian (FIG. 24), and the first of the four works for the Camerino in Alfonso d'Este's ducal residence at Ferrara.⁴⁶ Titian also chose to use this type of priming on another painting for the Camerino, *The Bacchanal of the Andrians* (Museo Nacional del Prado, Madrid), but *The Worship of Venus* (Museo Nacional del Prado, Madrid) has a priming of pure lead white,⁴⁷ while *Bacchus and Ariadne* (CAT. 8) has no priming and was painted directly on the gesso.

It seems, therefore, that towards the end of the decade and into the 1520s Titian became less consistent in the preparation of his painting surfaces and so, in common with *Bacchus and Ariadne*, some other panels and canvases, including the *Assunta* altarpiece, also

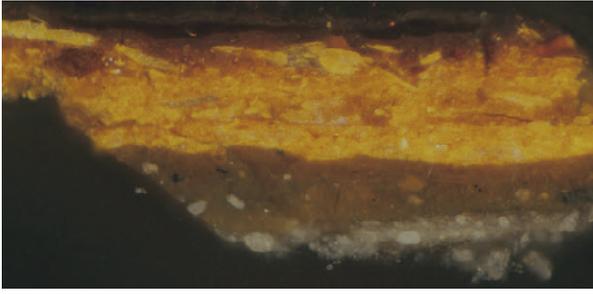


FIG. 26 Titian, *Jacopo Pesaro being presented by Pope Alexander VI to Saint Peter* (FIG. 27), paint cross-section from Saint Peter's orange cloak.

have no overall priming.⁴⁸ Outside Venice, several painters were beginning to work on more strongly coloured painting surfaces, not just pale grey. Dosso Dossi in Ferrara and Giulio Romano in Mantua often painted on very dark grey, almost black preparations, while Correggio, who supplied works to Mantua in the 1520s,

prepared some of his canvases with a warm red-brown priming, as did Moretto in Brescia.⁴⁹ Since Titian was producing works for all these cities in this decade, and may therefore have been aware of the painting practices being employed there, it is perhaps not surprising that he too began to experiment with darker painting surfaces. The *Venus Anadyomene* (FIG. 158, p. 82), painted perhaps towards the end of the 1520s, has a red-brown ground, apparently without a first application of gesso (FIG. 157), as does *A Boy with a Bird* (CAT. 10, p. 82, FIG. 156), which seems to be a product of Titian's workshop, even if not necessarily by Titian himself. Variations in the preparation layers continue into the 1530s, with '*The Aldobrandini Madonna*' (CAT. 11) having over the gesso a relatively dark grey-brown *imprimitura* containing lead white, earths and manganese black, these last two sometimes together in large agglomerates (FIG. 172, p. 90). A rather similar composition occurs in the priming of Titian's celebrated



FIG. 27 Titian, *Jacopo Pesaro being presented by Pope Alexander VI to Saint Peter*, c.1512–14. Oil on canvas, 147.5 x 189 cm. Antwerp, Koninklijk Museum voor Schone Kunsten, Inv. 357.

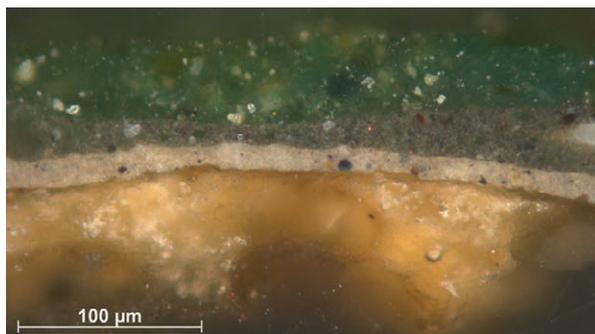


FIG. 28 NG 3, Titian, *The Music Lesson* (CAT. 12), paint cross-section from the green skirt of the figure at the left, showing the beige priming on top of gesso.

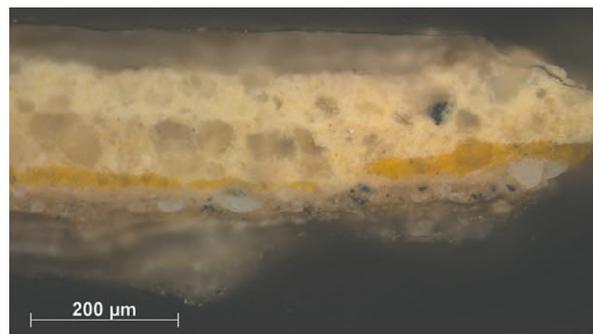


FIG. 29 Titian, *The Presentation of the Virgin in the Temple* (FIG. 41), paint cross-section showing the beige priming on top of gesso.

'*La Bella*' painted in 1536 for Francesco Maria della Rovere, Duke of Urbino.⁵⁰ A couple of years earlier Titian had begun his huge canvas of *The Presentation of the Virgin in the Temple* for the boardroom of the Scuola of Santa Maria della Carità, now part of the Gallerie dell'Accademia in Venice (see FIG. 41). Here the paint samples include a lighter grey-brown priming (FIG. 29), very like that of *The Music Lesson* (FIG. 28). The medium of the priming in *The Music Lesson* is heat-bodied walnut oil, rather than the heat-bodied linseed oil found in the primings of the only three earlier paintings where it has been possible to analyse the binder, although with so few comparative results it is not clear whether this is significant. The last painting in this study, *The Triumph of Love* (CAT. 13), was painted directly on the gesso, which is indicative of a tendency that marks Titian's production in the later part of his career.

Titian's underdrawing

Titian was traditionally believed to have started working on his canvases and panels directly with paint and colour, without first drawing his composition on the support, but his paintings have proved to be surprisingly rewarding candidates for investigation by infrared reflectography, with at least some lines of underdrawing having been revealed on almost all the works studied in this *Bulletin*. It should be stressed, however, that the drawing seen by infrared imaging is generally only part of a more extensive underdrawing, much of which may be obscured because of the thickness of the overlying paint layers and the particular pigments that they

contain. Confirmation that Titian began his paintings by first sketching in all the principal elements of the composition is supplied by those examples where most of the underdrawing has been made visible, either by infrared reflectography, as in the case of *The Triumph of Love* (CAT. 13), or by drastic interventions on the painting support such as the transfer of the paint film of the so-called *Allegory of Alfonso d'Avalos* (Musée du Louvre, Paris), which left the underdrawing exposed on the separated canvas.⁵¹ Titian's initial underdrawing seems usually to have been executed using a brush and a liquid medium containing a carbon black, essentially a black paint, hence its visibility in infrared. On one canvas, *The Music Lesson* (CAT. 12), there is also evidence of lines drawn with red lake paint. These were visible during restoration in areas of damage; similar drawing using materials that cannot be detected by infrared may exist on other works.

No evidence was found in the paintings in this study for any form of mechanical method of transfer of cartoons to the painting support. A few of Titian's drawings on paper are squared for enlargement, however, and infrared examination has revealed a grid presumed to have been for this purpose on the standing nude in *Le Concert Champêtre* (Musée du Louvre, Paris).⁵² Careful schematic underdrawings that were probably transferred to the painting surface by means of tracings have been found on workshop replicas and variations: for example, those derived from '*The Aldobrandini Madonna*' (CAT. 11).⁵³ For new inventions, however, Titian seems always to have worked freehand, placing his figures by eye, as demonstrated by the repeated repositioning of Cupid in *The Triumph of Love*. This empirical approach was developed further during painting.

In the few cross-sections from paintings in this study that include particles of underdrawing, they are on top of the *imprimitura* if one is present, which can sometimes result in the lines being interrupted where they pass over the ridges of the brushstrokes, so that they have a broken quality that can be mistaken for drawing in a dry medium. When working on a small scale, as in *Noli me Tangere* (CAT. 7), or when precision was needed for a complex pose such as that of Bacchus in *Bacchus and Ariadne* (CAT. 8), the lines can be quite fine, drawn with the point of the brush. More typical of Titian's underdrawing technique, however, is the broad, fluid line that he used to outline forms such as the cheetahs (FIG. 31). Often these were made with such brevity that a shape or a detail is indicated with just a few short strokes or curves, as, for instance, in the sleeve in the *Portrait of Gerolamo (?) Barbarigo* (CAT. 5, FIG. 102, p. 52). His underdrawing style remains remarkably consistent, so that the bubbling curls of the shepherd's head (in its first position) in the early *Holy Family with a Shepherd* (FIG. 30) reappear in the first sketching in of Cupid in *The Triumph of Love* (FIG. 32), painted more than 30 years later. This technique with its bold, heavy lines, also discovered on other early works,⁵⁴ is quite unlike the fine brush underdrawings found on early sixteenth-century works, whether on panel or canvas, by other Venetian painters such as Giovanni Bellini, Cima, Giorgione and Sebastiano.⁵⁵ The broader approach used for *sinopie* in wall paintings comes to

mind, but the style of some of Titian's few surviving drawings on paper is also comparable. The well-known studies for the Saint Sebastian in the Averoldi Polyptych, begun in 1519, show a heavy, emphatic contouring of the figure with black (FIG. 33), while in the profile head, above the separate studies of the saint's feet on the *verso* (FIG. 34), the short thick curve around the jawbone is very like some of the more abbreviated marks in the underdrawings.



FIG. 30 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail of infrared reflectogram (FIG. 87).

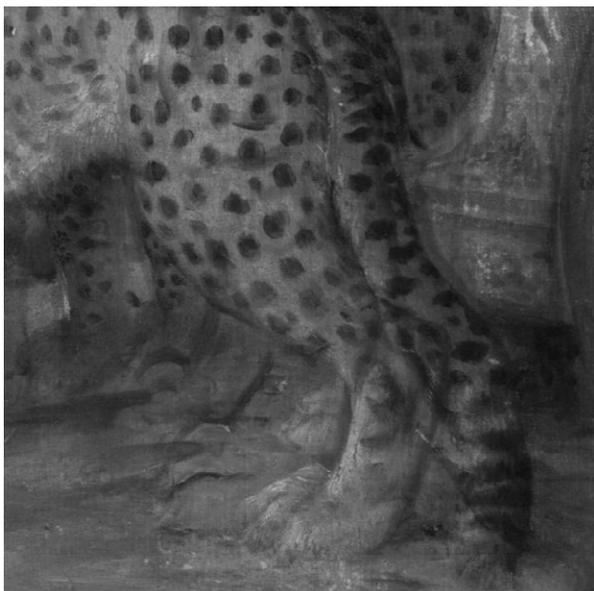


FIG. 31 NG 35, Titian, *Bacchus and Ariadne* (CAT. 8), detail of infrared reflectogram.



FIG. 32 Titian, *The Triumph of Love* (CAT. 13), detail of infrared reflectogram.



FIGS 33 and 34 Titian, *Studies for Saint Sebastian from the Averoldi Polyptych (recto and verso)*, c.1520. Pen and brush in grey-brown ink on light blue paper, 18 × 11.5 cm. Frankfurt, Städel Museum, Graphische Sammlung, Inv. 5516.

Pentimenti

For Titian the underdrawing was only a rough guide and he did not hesitate to disregard it in the development of a painting. He often made changes to the initial drawing, and even then it was not necessarily followed in the execution: for example, when Titian came to paint the shepherd in *The Holy Family* (FIGS 35 and 36), he decided to move this figure to the left so that the face goes over elements of the landscape, as is clearly visible in both X-ray and infrared images. Elsewhere – for instance, the head of the Virgin in the same picture – he began to paint following the guidelines of the underdrawing and then reconsidered the design (see p. 48). Even when painting a figure such as Bacchus, almost certainly planned with preliminary studies, Titian made adjustments to contours that result in overlapping colours, as seen in many of the cross-sections: several other examples appear in this study (for example, FIGS 76, 135, 140).

When modifying his compositions during the painting process, Titian sometimes redrew elements using a black liquid medium, probably the same used for the preliminary drawing, but over the first paint layers. These lines can show in infrared, often appearing more black – for example, the lines defining the edge of the Magdalen's sleeve in *Noli me Tangere* (CAT. 7, p. 65) – or their location in the layer structure can be seen in cross-sections, as is the case with the revised edge of the oculus in *The Triumph of Love* (FIG. 233, p. 118). X-radiographs show that other adjustments were indicated with strokes of X-ray-opaque paint. Damage to the upper paint layers of *The Triumph of Love* revealed that there these corrections were made with lead white (FIGS 37 and 38). Similar marks appear in the X-radiograph of the early *Holy Family*: for example, the light stroke and zigzag of paint across the top of the shepherd's head and the curved lines around his buttocks (FIG. 36). X-ray images also show extensive alterations to the arrangement of the draperies of Joseph in this painting



FIG. 35 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail of infrared reflectogram (FIG. 87).



FIG. 36 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail of X-radiograph (FIG. 85).



FIG. 37 Titian, *The Triumph of Love* (CAT. 13), detail of X-radiograph.

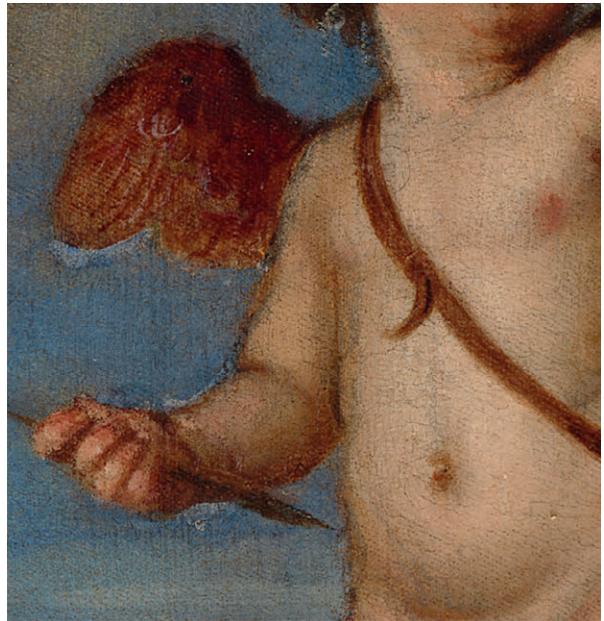


FIG. 38 Titian, *The Triumph of Love* (CAT. 13), detail.

and to those of the Virgin in *'The Aldobrandini Madonna'* (CAT. 11, pp. 87–8). The presence of underlayers of different, and sometimes unexpected, colours in some cross-sections from draperies might suggest that Titian frequently changed his mind about their colour, but often they can be shown to be related to overlapping contours or to have been part of a sequence to produce a particular final effect. Occasionally, however, they do seem to be an indication that the drapery colour has been reconsidered, for example in *Bacchus and Ariadne* (CAT. 8, p. 74), where the blue paint of the skirt of the bacchante with cymbals lies over pinkish-red.⁵⁶

Some of the most significant pentimenti in the paintings included here are to the heads of figures. These can be quite small adjustments to heighten the interaction between figures: for example, the shepherd's engagement with the Holy Family group, Ariadne's eyes meeting those of Bacchus, the forward movement of the head of the female saint in *'The Aldobrandini Madonna'* and the music master in *The Music Lesson*. The more radical revisions of the heads in *Christ and the Adulteress*, especially that of Christ himself (see CAT. 2, p. 38), and of the recorder player in *The Music Lesson* (see CAT. 12, p. 97) transform the relationships between the figures and, in the latter case, with the viewer as well.

As might be expected, there are fewer alterations in the portraits. Titian seems to have been able to capture a likeness, or the illusion of a likeness, without hesitation, and the heads in the two male portraits are confidently and directly painted. The only changes are a few minor adjustments to the costume in the case of the *Portrait of Girolamo Fracastoro* (CAT. 9). However, the extraordinary portrait known as *'La Schiavona'* (CAT. 6), perhaps not a commissioned portrait in the strictest sense, underwent extensive alteration, including major changes in the position of the subject's arms and to her setting, with the elimination of a circular window opening and the introduction of the raised stepped parapet.

Generally the alterations in paintings in this study were made directly over the underlying colours, even in the case of *The Flight into Egypt* (CAT. 1), where the subject of the painting was effectively changed, or *A Boy with a Bird* (CAT. 10), painted over another picture. In some instances the paint underneath had evidently not yet dried fully, and so cracks and other drying defects have developed in the superimposed paint, as in the faun over the chariot wheel in *Bacchus and Ariadne* (CAT. 8) and several areas of *Christ and the Adulteress* (CAT. 2). In *Noli me Tangere* (CAT. 7),

however, there is a broadly applied layer of X-ray-opaque paint that covers much of the upper half of the canvas, which perhaps served to cancel the hill and farm buildings that were initially on the left side of the landscape, before they were moved to the right side of the composition, so that they did not show through the light-coloured paint of the sky.

Paint handling, levels of finish and workshop participation

The adaptability of the oil medium allowed Titian not only to change and correct his compositions as he painted, but also to manipulate his paint in widely different ways, depending on the scale, function and viewing distance of the work. His choice of brushes, whether made from stiff hog bristle or the softer more flexible tail hairs of various animals, was also important – those manufactured in Venice were particularly prized for their quality.⁵⁷ The importance of the patron and the price being paid are also another factor. In a study such as this, when works are inspected from close to and small details illustrated, misleading and sometimes confusing impressions can be formed as to how Titian painted at any particular moment in his career. Moreover, different modes of painting can appear in the same picture. *The Holy Family with a Shepherd* (CAT. 4) was clearly a work to which Titian gave considerable attention, making many alterations and painting conspicuous details such as the plants in the foreground with great care, yet the ox and ass that loom out of the dark rocks on the left are painted in such a direct and summary way that, when examined individually, they appear rough and almost clumsy (FIG. 39). His experience in painting murals meant that Titian knew not to waste effort on detail that would not register in the relatively low light levels in which these works were mostly seen.

On the other hand, in a work such as *Bacchus and Ariadne* (CAT. 8), for an important client and designed for a relatively small and well-illuminated room, Titian was able to demonstrate to the full his powers of observation and his descriptive ability with the brush, above all in his painting of the plants and animals. Here his rendering of the long silky fur of the satyr is so convincing that one might believe that he had indeed set eyes on such a creature (FIG. 40). The lion in *The Triumph of Love* (CAT. 13) is given the defensive pose



FIG. 39 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail.



FIG. 40 NG 35, Titian, *Bacchus and Ariadne* (CAT. 8), detail.

of a small barking dog, perhaps for deliberate humorous effect, but his mouth, with his wide pink tongue and fearsome teeth, indicated with a few quick strokes of lead white, is completely convincing.

This small canvas is, of course, the latest of the works under discussion, painted when Titian was beginning to move towards what is often called his late style. However, the same economy of technique appears in many earlier works. The bold execution of figures such as God the Father high up on the *Assunta* altarpiece, with unblended highlights applied with a stiff impasto (still prominent since the painting is on panel), followed only a few years after the delicate refinement of *Noli me Tangere*. *The Presentation of the Virgin in the Temple* (FIG. 41), commissioned in 1534 but not finished until 1538, was painted in the same decade as ‘*The Aldobrandini Madonna*’ (CAT. 11), as well as other relatively highly finished works for the Dukes of Mantua and Urbino. The large canvas, set up above the panelling and doorways of the *albergo*, is painted in a rapid direct technique, using mainly opaque pigment mixtures. The handling of

the heads, including the several portraits, is closer to Titian’s *Santo* frescoes than to his paintings on panel or canvas. The feather in the hat of the figure leaning out of a window in the centre of the *Presentation* (FIG. 42) consists of no more than four or five wet-in-wet strokes of lead white paint, and yet it reads perfectly in the context for which it was painted.

It might be thought that for the execution of a canvas as large as the *Presentation* Titian would need the assistance of workshop members (attempts have been made to identify their possible contributions), yet he must have been a man of considerable physical energy, able to apply paint with great speed, creating a figure in less time than it would take to instruct another painter. Moreover, the modification of works throughout the painting process would not have made for easy delegation. Nevertheless, while the actual application of paint may sometimes have been rapid, for more highly finished works such as *Bacchus and Ariadne* time was needed for the build up of paint layers – the four layers of red lake glaze on Bacchus’ cloak, for instance – each one



FIG. 41 Titian, *The Presentation of the Virgin in the Temple*, 1534–8. Oil on canvas, 335 x 775 cm. Venice, Gallerie dell'Accademia, Inv. 626.



FIG. 42 Titian, *The Presentation of the Virgin in the Temple* (FIG. 41), detail.

needing to be dry before the next was applied. This may partly account for the delays and procrastination for which Titian became known, as well as over-commitment and the desire to have time to work through design problems.

The role of Titian's workshop in the production of his paintings in this first part of his career has been less studied than for the second half, when his fame had spread across Europe.⁵⁸ From early on, his workshop generated replicas and variants on successful compositions, to which Titian himself may have contributed to varying degrees.⁵⁹ *'The Aldobrandini Madonna'* (CAT. 11) is a good example of a prime version of a composition from which further paintings were developed (see p. 86). One would expect these workshop products to be painted with similar materials and techniques to those seen in Titian's own paintings, but with perhaps less expensive pigments and fewer of the adjustments that characterise his particular creative method. Titian also needed to have assistants in constant attendance to prepare his materials for painting.

Titian's paint: medium and pigments

One of the most important tasks for Titian's workshop assistants was the grinding of pigments with drying oils to make paints of the consistency and quality that he required. It was established as early as the 1970s that both linseed and walnut oils were used for this purpose in Titian's paintings in the National Gallery, through analysis by gas chromatography (GC).⁶⁰ Samples from two paintings, *Bacchus and Ariadne* (CAT. 8) and *The Vendramin Family* (NG 4452), and a third from Titian's workshop, *Venus and Adonis* (NG 34), were examined at that time.⁶¹ Since then the binding medium has been analysed by gas chromatography–mass spectrometry (GC–MS) in a wider range of samples, from ten of the thirteen paintings in this survey.⁶² This has given a clearer view of the colours for which the less rapidly yellowing walnut oil was chosen and those for which linseed oil was considered adequate, as well as an indication of whether there had been any pre-treatment of the oil that might modify its handling and drying properties. In every sample there was evidence that the oil had been heat-bodied, at least to some extent: that is, the oil had been heated so that it became thicker and would dry more rapidly.⁶³

In five of the paintings – *The Flight into Egypt* (CAT. 1), *Portrait of Gerolamo (?) Barbarigo* (CAT. 5), *Noli me Tangere* (CAT. 7), *Bacchus and Ariadne* (CAT. 8) and *The Triumph of Love* (CAT. 13) – only linseed oil was identified, but this probably reflects the number and locations of the samples available. For instance, for two of these (CATS 8 and 13) reliable results were obtained from only one sample, and in neither the *Portrait of Gerolamo (?) Barbarigo* nor *Noli me Tangere* was it possible to sample

the white drapery where one might expect that Titian would choose to use walnut oil. In the other five paintings, both linseed and walnut oil were found, and it appears that Titian used walnut oil more often than previous studies might suggest, generally for lighter passages of paint: for example, the shepherd's white breeches in *The Holy Family with a Shepherd* (CAT. 4), and the lighter areas of the architecture in the *Portrait of Girolamo Fracastoro* (CAT. 9). It also appears in the white drapery and flesh paint in *A Boy with a Bird* (CAT. 10). More unexpected perhaps, was that walnut oil was used not only for the light pink underlayer of the dress in 'La Schiavona' (CAT. 6) but also for the translucent dark purple paint applied as the final modelling of the folds. Similarly, in *The Music Lesson* (CAT. 12), one of the later paintings in this group, walnut oil was identified in the music master's purple-blue cloak and the red lake glaze on the viol player's tunic, and even in the priming, as well as more conventionally for the white drapery of the woman's sleeve. However, linseed oil was still chosen for areas where the yellowing of the oil may have been a less important consideration, such as the brown background, the young boy's brown sleeve and the woman's green drapery.

As already mentioned above, zinc was found by EDX analysis in translucent globules in the primings on the two early portraits. It was also detected in one sample from *The Flight into Egypt* (CAT. 1, p. 35), in pale pink underpaint; in *Christ and the Adulteress* (CAT. 2, p. 42), in the Adulteress's dress, again in pale pink; and in some quantity in the darkest orange flesh tints and the vermilion of the Pharisee's robe, as well as the brown underpaint beneath it based on earth pigments (FIG. 43); and in *The Holy Family* (CAT. 4), in Joseph's

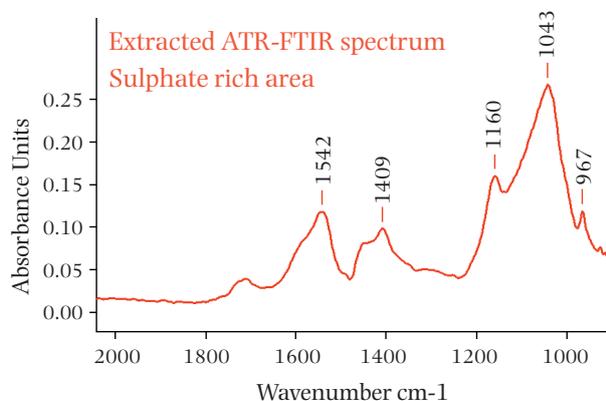
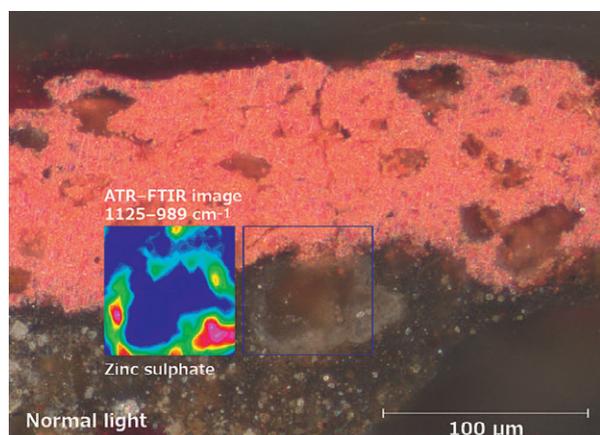


FIG. 43 Titian, *Christ and the Adulteress* (CAT. 2), paint cross-section from the red robe of the Pharisee, ATR–FTIR imaging of one of the translucent zinc-containing globules in the underpaint.

orange cloak, painted with realgar.⁶⁴ In an earlier study it was concluded that the zinc in the two early portraits was related to the presence of a zinc-rich earth pigment,⁶⁵ partly because in the samples examined some iron oxide happened to be present, but also because the use of this type of earth had already been suggested by other studies of Italian paintings by XRF.⁶⁶ Analysis of a wider range of samples, however, has shown that in fact in these paintings by Titian the zinc is also found where there is certainly no earth pigment – for example, in the vermilion paint in *Christ and the Adulteress*. ATR–FTIR imaging has proved that in these paintings at least it is present in the form of zinc sulphate, usually together with zinc soaps that must have formed over time by reaction with the oil medium (FIG. 43). In each case in some areas of the sample a little potassium was detected by EDX in addition to zinc and sulphur, and the FTIR spectrum suggested that another slightly different zinc sulphate was also present.⁶⁷

Zinc sulphate, known as white vitriol or white copperas, is colourless and therefore not a pigment but a paint additive. Various types of vitriol are mentioned in the inventories of the Venetian *vendecolori* for a number of purposes in other branches of the arts.⁶⁸ They are usually distinguished only by their place of origin – Roman, Hungarian, German – but sometimes by their colour from which it is possible to deduce whether the reference is to the iron, copper or zinc variety. Zinc vitriol is occasionally mentioned as a drier for oil in documentary sources on painting technique, mostly in those from Northern Europe,⁶⁹ but also in an Italian source, the Marciana manuscript, where it is an ingredient in a recipe for a mordant for gilding that is said to dry rapidly.⁷⁰ Our understanding of the use of this material by artists is still at an early stage, based mainly on the few scattered (but increasing) reported occurrences of zinc in several paintings by Northern European artists of this period, always in paint composed of red lake,⁷¹ and in a small number of Italian paintings, where again it is mainly associated with red paint, but also occasionally with arsenic sulphide pigments.⁷² Titian does not fully conform to this pattern, since no zinc was found in any of the red glazes in the paintings by him, but it was present in orange areas containing realgar, where it might be expected that a drier would be needed. In the other areas in which Titian used this material – the primings and underpaint – it was not with slow-drying pigments, but it still might have been desirable for these layers to dry even more quickly to allow further paint

to be applied on top. In fact, in *Christ and the Adulteress* in particular, the areas in which zinc sulphate has been used show marked paint defects, as can happen if too much drier is incorporated. The rather fragmentary view that we have at present means that it is not yet possible to draw firm inferences about this material as part of Titian's practice – but so far it does appear to be present only in his earliest paintings and does not seem to arise from his own experimentation since it has been found in paintings by other artists that are earlier in date, and in addition was evidently not a practice confined to Venice.⁷³

As well as manipulating the properties of his paint by choosing different oils or additives, Titian achieved a great variety of textures and effects by his choice of brushes and also with adjustments to the amount of drying oil in the paint. This is particularly evident in passages painted with lead white. Large expanses of white fabric, such as the sleeves of the shepherd in *The Holy Family* (FIG. 44), are broadly painted with the folds shaded with the addition of a small amount of black pigment. The direction of the brushstrokes helps to describe the structure and volume of the drapery. Christ's shroud in *Noli me Tangere* is painted in this way, but for the gauzy fabric of his loincloth (FIG. 45)

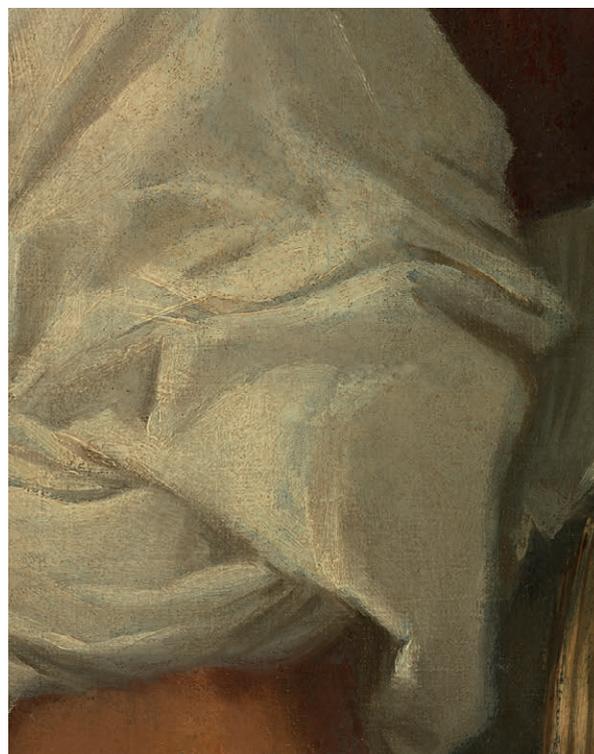


FIG. 44 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail.

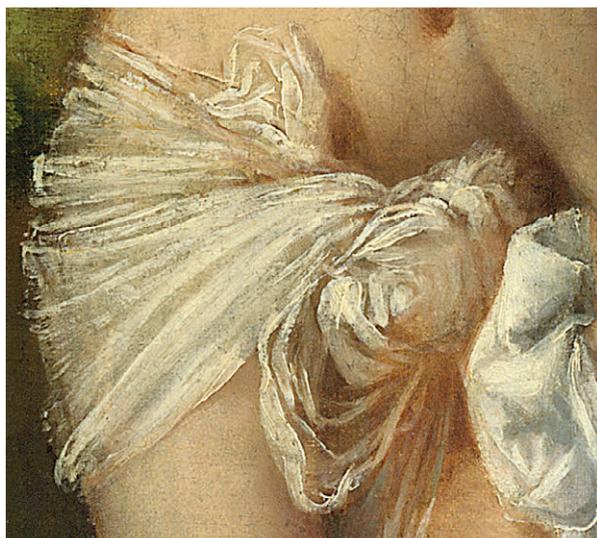


FIG. 45 NG 270, Titian, *Noli me Tangere* (CAT. 7), detail.

Titian probably added a little more medium to make a paint that flowed easily from the brush, allowing him to obtain a more translucent effect. Conversely, when a brush loaded with stiff lead white paint is quickly dragged over underlying colours that are already dry, a vibrating 'broken' brushstroke results; for example, the long white hairs of the lynx fur in the *Portrait of Girolamo Fracastoro* (FIG. 46). As well as using lead white to lighten mixtures of other pigments, in the first half of his career Titian frequently included areas of white drapery in order to set off the richness of his colours and especially the warmth of his flesh tints. Indeed, the absence of white in the draperies of *'The Aldobrandini Madonna'* (CAT. 11) adds to its colouristic distinction. Venice was a well-known centre for the manufacture of the finest lead white – Matthioli in the 1540s notes that Venetian ceruse is the best and it was also being exported to elsewhere in Europe.⁷⁴ The quality of the pigment would have depended on the manufacturing conditions, as well as any subsequent washing and refining, and it may be that the reputation of Venetian lead white derived from careful control of these processes, rather than from any fundamental difference in method of manufacture.⁷⁵ The pigment is often composed of both hydrocerussite (basic lead carbonate) and cerussite (neutral lead carbonate) – indeed these have been found together in some of the paintings studied here.⁷⁶ It has been suggested that the particle size and distribution might influence the properties of lead white oil paint, as it can be quite variable (not only in works from Venice but also elsewhere),⁷⁷ seen



FIG. 46 NG 3949, Titian, *Portrait of Girolamo Fracastoro* (CAT. 9), detail.

most clearly in some of the priming layers in samples illustrated in FIGS 19, 22, 24, where some large flakes or agglomerates are surrounded by a matrix of small dispersed particles.

The city contained so many painters of all descriptions that it could support several *vendecolori* who supplied pigments and other materials.⁷⁸ These specialised apothecaries seem to have appeared in Venice earlier than elsewhere in Italy.⁷⁹ As a major centre for the import and export of goods both to and from the East and West, a wide range of pigments from elsewhere in Europe and beyond would have been available in Venice, in addition to the pigments manufactured there (among which were vermilion, minium and verdigris, as well as the already-mentioned lead white). The range and quality of pigments was such that painters journeyed or sent representatives from as far afield as Rome in order to procure the best colours. This was especially the case for ultramarine, as Venice became the principal European point of entry for the mineral, lapis lazuli, from which different grades of the pigment were extracted. Ultramarine has been found in all except one of the paintings in this study,⁸⁰ used particularly lavishly in *'The Aldobrandini Madonna'* (FIG. 47) and in *Bacchus and Ariadne*, as might be expected given the illustrious patron of the latter. The colour and intensity of the pigment must have depended on the quality of the lapis lazuli stone that was the starting material for the pigment, but different grades (with an increasing proportion of associated colourless minerals) were produced during the extraction process, and in the

paintings some variations can be recognised between the ultramarine used, for example, in the sky paint and that in draperies – in terms of particle size and intensity of colour – which suggests that Titian did reserve the very best pigment for certain elements of the composition. The high quality of that used in the draperies is evident both from the deep colour on the painting itself as well as in the particles seen in paint samples, and the low proportion of associated colourless impurities (CAT. 11, p. 90, FIG. 171, for example).⁸¹ Despite this, the paint has suffered from some blanching in several places, such as in the Virgin's cloak in both *The Holy Family* (CAT. 4) and *'The Aldobrandini Madonna'* (CAT. 11), which has reduced the contrast in the modelling of the folds and made the draperies appear rather flat.

Titian used ultramarine rather more sparingly in *The Flight into Egypt* (CAT. 1), and its rather small particle size in the sky and in the very thin final glaze on Joseph's purple drapery (painted mainly with azurite mixed with red lake) suggests a relatively low grade. Only azurite was identified in the sample from the Virgin's drapery, although it may be that at least a very thin ultramarine layer for some of the final modelling is present in other areas. Azurite would have been cheaper than ultramarine, but studies of pigment prices indicate that it was still considerably more expensive than other pigments.⁸² Titian used it quite extensively in mixtures for purples (see below), and also in *Bacchus and Ariadne* (CAT. 8) to underpaint the sky and distant landscape. In other works the cheaper blue indigo was used instead in underpaint: for example, in the sky of both the earliest painting in this study, *The Flight into Egypt*, and the latest, *The Triumph of Love* (CAT. 13), and in the Virgin's cloak in *The Holy Family*, as well as in the stockings of the figure leading the ass in *The Flight into Egypt*. Lorenzo Lazzarini reports this same practice on the *Assunta* (1518) and the *Pala Pesaro* (1519–26).⁸³

In some paintings produced in Florence and Rome in this period, rose pink underpaint has been observed in the ultramarine blue draperies, probably to achieve particular chromatic effects.⁸⁴ Titian perhaps had similar reasons for what appears to be his general practice in purple draperies, where the first underpaint layer is usually a pink based on red lake and white, with very little if any blue pigment. Joseph's purple robe in the earliest work studied here – *The Flight into Egypt* – is typical: on top of a first pink layer, cross-sections show a purple paint of azurite, red lake and lead white, followed by further modelling in ultramarine and red lake.



FIG. 47 NG 635, Titian, *'The Aldobrandini Madonna'* (CAT. 11), detail.

Essentially the same sequence of layers was used for Joseph's robe in *The Holy Family*, but without any ultramarine, giving a more plum-coloured purple (FIG. 48). In the music master's cloak in *The Music Lesson* the upper layers in the highlights include rather little red lake giving yet another shade that tends towards a purple-blue. In *Bacchus and Ariadne* the nymph in the background wears a rather more delicate pale lilac made only from ultramarine, red lake and lead white. The effort that Titian put into achieving subtle differences in the purple hues he created is perhaps most evident in the particularly complex structure of the dress in *'La Schiavona'*, where on top of the usual pink layer there is some modelling in blue paint (ultramarine and white), followed by a translucent red lake glaze and then even more modelling in a purple mixture of ultramarine and red lake, giving a drapery with a rich deep purple-red colour.

In the red draperies, too, Titian has paid attention to variations in hue, using a paint based on rather pure and



FIG. 48 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail.

crystalline vermilion, a pigment that was manufactured in Venice, for scarlet-red colours such as the robe of the Pharisee in *Christ and the Adulteress*, the shepherd's jerkin in *The Holy Family* and Ariadne's sash in *Bacchus and Ariadne*. The rather aggressive orange-red of vermilion has been toned down with thin red lake glazes for the final modelling, and, in the case of the Pharisee and the shepherd, the use of a dark brown underlayer. The cooler pinkish reds, such as that in the Virgin's dress in *The Holy Family* (FIG. 49), or the drapery around Bacchus, are instead only red lake and lead white. For the latter, the strong relief of the folds was made by first undermodelling in mixtures grading to very light highlights that are almost pure white, as was quite typical of Titian, and then glazing with red lake applied particularly thickly in the shadows. Titian must have returned to this drapery again and again, since a cross-section

viewed under ultraviolet light shows a final glaze applied in no less than four layers – well separated and therefore not wet-in-wet – but with each layer being extremely thin, building up to a total thickness that another artist might have applied in one session (CAT. 8, FIGS 136, 137). Interestingly, although colourless powdered glass has been found as an additive in red lake glazes in many other paintings of this period, it was not found in any of those by Titian studied here, but it may not have been necessary when applying the paint so thinly.⁸⁵

Red lake pigments were among the more expensive of those on the artist's palette in the sixteenth century. Where the use of fine colours is indicated in contracts as a guarantee of high quality, in addition to the blues that are always specified, the use of a fine lake pigment is sometimes mentioned.⁸⁶ These pigments are of particular interest in Venetian paintings due to the importance of the textile and dyeing industry in Venice and its position as a point of entry into Europe for the dyestuffs that were imported from the East, as well as being a centre of trade for those from elsewhere in Europe. In the first half of the sixteenth century the dyestuffs would have included those from plants such as madder, brazilwood and sappanwood, as well as those derived from the scale insects lac, kermes and cochineal, which in this period would have been the Old World (such as Polish and Armenian) varieties.⁸⁷ New World cochineal from Mexico (*Dactylopius coccus* Costa), which was much richer in dyestuff than the Old World insects, is thought to have first arrived in Spain in 1523 and by the 1540s was being adopted by Italian dyers, its use being officially sanctioned by the guilds in Venice in 1550.⁸⁸ Titian's long career therefore spans a particularly interesting period in the history of the dyeing industry. These dyestuffs produced a range of colours, from the more orange red scarlet of madder to the much more purple red of kermes and particularly cochineal. The industry had long been closely regulated in Venice as elsewhere in Italy, with stipulations about what dyestuffs could be used for particular qualities of materials, the most expensive colourants such as kermes and the Old World cochineal insects being used for silk. This meant that the hue of the red became closely associated with perceptions of quality.⁸⁹

The manufacture of red lake pigments was inextricably linked with the dyeing industry, not least because textile shearings were commonly used as a source of the dyestuff, as indicated in recipes for lakes named 'lacca di cimatura' (shearings lake).⁹⁰ As with the textiles, the use

of the different red dyestuffs gave pigments in a range of hues, and it might be expected from Titian's interest in colour that he would make his choice on this basis, but there is evidence that the cost of the dyestuff in the pigment, and the association of certain hues with expensive textiles, would also have influenced what was considered a good quality lake. Other factors such as permanence were an additional consideration – brazilwood lakes, for example, although giving a rather beautiful crimson colour, tend to fade rather quickly.

There have been rather few analyses of the dyestuffs in these pigments in Titian's paintings, but during this study it has been possible to carry out HPLC analysis on red lakes in five of the works: *Christ and the Adulteress*, *The Holy Family*, 'La Schiavona' and *Noli me Tangere*, all very early works from before 1514,⁹¹ as well as the later *Music Lesson*. In each case the major dyestuff was identified as kermes from the scale insect *Kermes vermilio* Planchon, and in all except one painting (where there was only one layer of red lake applied over vermilion), a second dyestuff, a pseudopurpurin-rich madder, from *Rubia tinctorum* L. was also detected.⁹² In *The Music Lesson* there was an indication of yet another dyestuff, a small amount of soluble redwood such as sappanwood or brazilwood. The characteristic orange-pink fluorescence of the pseudopurpurin-rich madder under ultraviolet light could be seen in some of the red lake pigment particles in the samples, making it possible to say that the kermes and madder dyestuffs are present in two different lake pigments, and that rather than using them in different areas because of their different hues, Titian has used the more expensive kermes lake in upper layers, with madder lake reserved for the underpaint, as has been found to be standard practice by artists all over Europe at this time.⁹³

It is only with a greater number of analyses of red lakes in paintings from the second half of Titian's career that it will be possible to place the results from the early paintings in context, but the few dyestuff analyses that exist do suggest some differences. For example in *The Vendramin Family* (NG 4452), begun in the 1540s but completed in the following decade, again a kermes lake was the major component of the extensive areas of rich translucent red in the draperies, but in addition a small amount of dyestuff derived from cochineal was identified,⁹⁴ and in the *Death of Actaeon* (NG 6420), from about 1559–75, the red lake proved to be based only on cochineal.⁹⁵ For a view of practice in Venice more generally in this later period we can add the more numer-



FIG. 49 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail.

ous results from paintings by Veronese and Tintoretto, which have proved so far to contain cochineal lakes, with a few instances of lac, rather than kermes lakes.⁹⁶ Although it is difficult to distinguish by analysis between Old World and New World cochineal,⁹⁷ and the Old World variety would have been available for dyeing and therefore lake-making throughout the sixteenth century, only a few lake pigments in Venetian paintings from before the middle of the sixteenth century have been identified as cochineal (Old World). It seems more than a coincidence that there is a shift towards cochineal lakes in paintings in the second half of the sixteenth century,⁹⁸ at the same time as the far more efficient New World cochineal was being used more and more for dyeing cloth.

The lead-tin yellow used in these paintings was consistently of a rather pale colour, most evident in the drapery on the ground in *Bacchus and Ariadne*, painted

entirely in this pigment (FIG. 147). Whether used in this way, or in mixtures in the greens and oranges, SEM–EDX analysis indicated that the pigment was rather inhomogeneous in composition, including not only yellow lead-tin oxide particles but also colourless tin oxide, and, especially where used alone, there has been extensive lead soap formation in the paint. What must be lead-tin yellow can be found in treatises on painting technique under a variety of names – Borghini lists, in 1584, ‘giallolino di vetro’, ‘giallolino di Fiandra’ and ‘giallolino di Venezia’. The first of these is likely to be lead-tin yellow of the ‘type II’ form, which was not found in these early paintings by Titian, but the other two could be lead-tin yellow ‘type I’ of varying origin and perhaps also shade, probably made to different recipes.⁹⁹ The raw ingredients would have been either lead oxide or red lead and tin oxide, which were then heated in a furnace to a high temperature to give yellow lead-tin oxide. The white tin oxide present in the pigment in Titian’s paintings must indicate either an excess of that ingredient, or incomplete roasting, and it is conceivable that both the proportions of the raw materials and the temperature or time of heating were deliberately adjusted to give paler or more golden hues.¹⁰⁰

The golden yellow of the tunic of the man in the centre of the composition in *Christ and the Adulteress* and of Joseph’s cloak in *The Flight into Egypt* are both painted predominantly with lead-tin yellow, with orange shadows and half-shadows made with a mixture of lead-tin yellow and red earth. Joseph’s cloak in *The Holy Family*, however, is orange (FIG. 48), reflecting what seems to be a shift in taste towards draperies of this colour painted with realgar, which became so common later in the century that it is seen as very characteristic of Venetian technique.¹⁰¹ Tintoretto and Veronese used orpiment and realgar rather more extensively but Titian, at least in these early paintings (and in common with his contemporaries), has in fact used realgar only in the brightest highlights and, mixed with earth pigments, in the lightest midtones, with the shadows and the underpaint instead being a darker orange mixture based on red and yellow earths (CAT. 4, FIG. 96).¹⁰² The orange drapery of the bacchante with cymbals in *Bacchus and Ariadne*, the only other painting here that includes arsenic sulphide pigments, is painted in the same way (CAT. 8, FIGS 141 and 142). Raman micro-spectroscopy has now more precisely identified the pigment composition, and every particle analysed was found to consist predominantly of pararealgar (a yellow



FIG. 50 NG 4, Titian, *The Holy Family with a Shepherd* (CAT. 4), detail.

polymorph of arsenic II sulphide), with a little realgar, which is consistent with the fact that their colour is more yellow than orange.¹⁰³ Although it is possible to find pararealgar as a component of the mineral, it can also form as a light-induced deterioration product and here the friable crusty appearance of the paint, and the appearance of the cross-section, suggest that the pigment has degraded and that the highlights that are now rather bright once blended better with the rest of the drapery.¹⁰⁴

The composition of the yellow earth pigment that is part of the mixture in the underpaint of the orange drapery in *Bacchus and Ariadne* is typical of that in most of the paintings in this study, containing a relatively small amount of yellow iron oxide, with some iron-containing silicates and, most notably, a large amount of colourless dolomite, which would give a pigment with a high transparency.¹⁰⁵ Its properties are most easily seen in the yellow border around the bottom of the Adulteress’s dress in the Glasgow painting, where it has been used alone. This same yellow earth, perhaps from the same source, is also a component of the green mixtures (with verdigris and lead-tin yellow) in many areas of the foliage paint, and of the distinctive yellow-brown

and orange-brown paint that Titian uses in his trees, together with red earth and small amounts of other pigments. A yellow-brown shade of this mixture forms the base colour of the canopy of the tree in *Noli me Tangere* and, perhaps partly because of its translucency, it has been thought in the past to be a discoloured green 'copper resinate' paint (CAT. 7, FIG. 125). In fact the foliage on this tree is built up in different shades of brownish paint mixed from yellow and red earths with some verdigris, sometimes with indigo and lead-tin yellow in addition, which may have darkened slightly but was never intended to be a strong green. Only the leaves at the very top of the canopy that catch the light are a brighter colour, painted instead with verdigris, lead-tin yellow and white. These multi-component mixtures in the darker areas give a softer more realistic effect and by describing more precisely how Titian painted the tree we are closer to understanding his original intentions.

Given that the thirteen paintings studied here span nearly thirty years – the extent of a normal career for most Renaissance artists – they demonstrate a remarkable degree of consistency in their materials and the ways that they were used. In spite of his increasing status, both socially and as an artist, Titian remained a practical craftsman. Expensive pigments such as ultramarine, azurite and red lakes from kermes were used in ways that show them to their greatest beauty and advantage, especially when working for princely clients such as Alfonso d'Este, but he was far from profligate with his materials. Colour effects were built up with complex sequences and cheaper pigments used to underpaint the most expensive ones. Titian's fame as a colourist rests in part on the quality of his pigments but also in the juxtaposition of different colour areas, something that he seems to have been able to plan with a remarkable degree of certainty for a painter who made so many adjustments to other elements of his designs. Colours are used to both contrast and complement one another: for example, the orange and blue of the bacchante in *Bacchus and Ariadne*. Sometimes they are pure, and instantly recognisable, as in the areas of ultramarine, but equally important and characteristic is

the remarkable variety, even in this small sample, of different hues of pink, deep red and purple of every cast – distinctions that meant so much to his Venetian con-temporaries with their detailed knowledge of the commercial and social value of textiles dyed with these colours.¹⁰⁶ Many of these colour choices were to persist into the second part of Titian's exceptionally long career and, while he was to continue to use many of the same materials, some were also to change as different pigments from new sources were introduced into the artists' palette.¹⁰⁷ At the same time, Titian's handling of his materials in the earlier phase of his career as described here – areas of contained colour, ordered and logical in structure, although with occasional passages of flamboyance – was gradually to evolve, becoming more free and arriving eventually at the dissolving contours and flickering interlaced brushwork of his very last works.

Acknowledgements

This study has drawn on much analytical work carried out by former colleagues in the Scientific Department, notably Raymond White, Catherine Higgitt and Jilleen Nadolny. We are especially grateful to Jo Kirby for her contribution, which included valuable advice on references to historical aspects of pigment trade and manufacture. Elke Oberthaler and Nicholas Penny also read the text and made important comments and suggestions. Janet Ambers at the British Museum kindly carried out Raman analyses. Maria Dolores Gayo and Maite Jover generously re-examined samples from the two Camerino paintings in the Prado. The conservation department at the National Galleries of Scotland made samples from their early Titians available to us. We are also grateful to Irina Artemieva (The State Hermitage Museum, St Petersburg), Matteo Ceriana (Director of the Gallerie dell'Accademia, Venice), Erika Bianchini and Giulio Bono who led the team of restorers on *The Presentation of the Virgin in the Temple*, and Enrico Fiorin, who carried out scientific investigation on that painting.