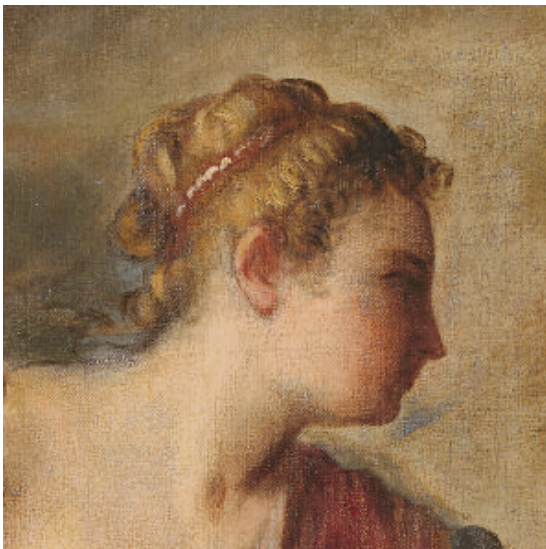


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Titian's Painting Technique from 1540



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FRONT COVER

Titian, *Diana and Actaeon* (NG 6611; NGS 2839), 1556–9 (detail).

TITLE PAGE

TOP LEFT: Titian, *The Vendramin Family, venerating a Relic of the True Cross* (NG 4452), 1540–5 (detail).

TOP RIGHT: Titian, *Diana and Actaeon* (NG 6611; NGS 2839),
1556–9 (detail).

BOTTOM LEFT: Titian, *The Death of Actaeon* (NG 6420),
c.1559–76 (detail).

BOTTOM RIGHT: Titian, *The Tribute Money* (NG 224),
1567–8 (detail).

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Notes

Titian after 1540: Technique and Style in his Later Works

- 1 Penny 2008.
- 2 For a detailed biography see Hale 2012 and for briefer accounts of Titian's life see, for example, C. Hope, 'Titian's Life and Times' in London 2003, pp. 11–28, and Penny 2008, pp. 201–5.
- 3 Madrid 2003, p. 226.
- 4 The very damaged panel of the *Mater Dolorosa* belonging to the Roman Catholic Diocese of Brooklyn, New York, is clearly related to the paintings for Charles V and must have been painted at around the same time. Her mantle now appears red but this colour seems likely to have been an underpainting for a blue pigment, now almost completely lost.
- 5 C. Garrido, '“El emperador Carlos V a caballo en Mühlberg”: studio técnico' in Madrid 2001, pp. 117–34, esp. pp. 126–7.
- 6 The surface texture of *The Martyrdom of Saint Lawrence* (FIG. 11) now in the Church of the Gesuiti, Venice, suggests a twill weave. Although the paint film was transferred from canvas to canvas in 1881–2, the texture of the original canvas seems to be that which is now visible. See A. Roso and N. Pisano, 'Un Restauro Difficile' in Alba 2012, p. 17. Another twill weave appears on the *Portrait of Doge Andrea Gritti* painted probably posthumously in the late 1540s (National Gallery of Art, Washington DC). Here the surface texture of the painting has survived intact since the canvas has never been lined.
- 7 For Tintoretto's canvases see J. Dunkerton, 'Tintoretto's Painting Technique' in Madrid 2007, pp. 139–58, esp. pp. 151–2. For the canvases used by Veronese for his works in the National Gallery see Penny and Spring 1995 and Penny, Roy and Spring 1996.
- 8 The distinctive canvas weave is clearly visible, especially in the clouds above the Saint, in the high-resolution image available on the National Gallery of Art website: <http://www.nga.gov/content/ngaweb/Collection/art-object-page.43725.html>.
- 9 Crowe and Cavalcaselle 1877, vol. II, p. 534. See also Checa and Muñoz 2003, pp. 17 and 87.
- 10 Notable examples include *Venus with a Mirror and Two Cupids* (National Gallery of Art, Washington DC), painted over an abandoned double portrait and even retaining and adapting some of the sitter's drapery for Venus' cloak (Vienna and Venice 2007–8, pp. 246–8 [German edition only]); the *Portrait of Jacopo Strada* (Kunsthistorisches Museum, Vienna), with underneath a smaller-scale figure perhaps holding a shield (Vienna and Venice 2007–8, pp. 169–72 [English edition], pp. 199–202 [German edition]); *The Virgin and Child* (Gallerie dell'Accademia, Venice) painted over a female saint in prayer (Vienna and Venice 2007–8, pp. 272–5 [English edition], pp. 316–18 [German edition]); the Prado *Ecce Homo* of about 1565–70, painted over a portrait (Madrid 2003, pp. 296 and 415); part of the Escorial *Saint Jerome* (Madrid 2003, pp. 286 and 411) and both the Prado and the Hermitage versions of *Christ on the Way to Calvary*, painted over an *Ecce Homo* and a *Christ blessing* respectively (Madrid 2003, pp. 268 and 403).
- 11 The face and pointing hand of Christ are the only parts easily distinguished in the confusion of the X-radiograph. Initially it was thought that the *Saint Sebastian* was first conceived as a half-length figure and subsequently extended (Vienna and Venice 2007–8, pp. 304–7 [English edition], pp. 350–3 [German edition]).
- 12 FTIR analysis is needed to identify the type of calcium sulphate present, and a suitable sample was only available for a few of the works in this study, so it is not necessarily the case that CATS 3 and 8 are alone in having anhydrite as the main component of the gesso. In addition, a mixture of gypsum and anhydrite would be difficult to detect by FTIR and may have been missed.
- 13 Very few of the cross-sections included the gesso ground layer so it was not always possible in the other paintings to confirm by SEM–EDX analysis whether these impurities were present. In CAT. 3 some celestine (strontium sulphate) was also identified.
- 14 For example, on the canvases for the portraits of *Charles V on Horseback* (FIG. 1) and *Charles V Seated* (Alte Pinakothek, Munich); see C. Garrido, '“El emperador Carlos V a caballo en Mühlberg”: studio técnico' in Madrid 2001, p. 127, and von Sonnenburg 1999, p. 103. Two portraits associated with Titian's time in Augsburg (but not always accepted as autograph) – *Johann Friedrich von Sachsen* (Kunsthistorisches Museum, Vienna) and *Antoine Perrenot de Granvelle* (Nelson-Atkins Museum of Art, Kansas City) – appear to have been prepared with oil primings alone, without any chalk or gesso ground; see Wald 1999.
- 15 Penny, Roy and Spring 1996, p. 48; Penny 2008, p. 126.
- 16 In some paint cross-sections from Titian's later works (including some presented in this study) thin layers of brownish paint have been observed over the initial gesso layer. They have sometimes been described as *imprimature*, but since they generally vary considerably in composition and colour from sample to sample when taken from the same work, they are perhaps more likely to represent a first lay-in or underpainting – indeed not unlike the process described by Marco Boschini: see Boschini 1660 (Pallucchini ed. 1966), pp. 711–12. Examples include the Escorial *Martyrdom of Saint Lawrence* (see Checa and Muñoz 2003) and the *Portrait of Jacopo Strada* (see Vienna and Venice 2007–8, pp. 169–72 [English edition], pp. 199–202 [German edition]).
- 17 J. Dunkerton, 'Tintoretto's Painting Technique' in Madrid 2007, p. 148.
- 18 Dunkerton and Spring, forthcoming.
- 19 The figure of Saint Theodore in the drawing of a *Landscape with Saint Theodore overcoming the Dragon* in the Morgan Library and Museum, New York, clearly derives from that of Actaeon in *Diana and Actaeon* since it repeats his pose in the final position, although he carries a spear or lance, as did Actaeon in the first version of this figure. The drawing was most likely made for the etching while *Diana and Actaeon* was still on the easel.
- 20 See Wethey 1987, pp. 29–31, for discussion of later drawings that may have been connected with the preparation of paintings. More studies survive for the works made before 1530.
- 21 L. Puppi, 'Il “Martirio di San Lorenzo”' in Alba 2012, p. 11.
- 22 The legs of this figure in the painting, especially his left thigh, have been badly affected by the large losses in the

- lower part of the picture and were extensively reconstructed in the recent restoration. See A. Roso and N. Pisano, 'Un Restauro Difficile' in Alba 2012, pp. 32–3.
- 23 Vienna and Venice 2007–8, pp. 238–41 (German edition only). The question as to whether Titian's workshop made painted replicas, perhaps as *ricordi*, has been much debated. Occasionally candidates for such a type of painting have been proposed, but they can usually be shown to be later copies. This is certainly the case with the small-scale version of Titian's *The Trinity* (*La Gloria*) in the National Gallery (NG 4222), which is clearly derived from Cornelis Cort's engraving published in 1566 but appears subsequently to have been corrected with some knowledge of the original painting (see Penny 2008, pp. 304–11). This and the fact that the National Gallery painting has a red-brown ground, similar to the grounds often seen on paintings by El Greco, suggest that it may have been produced in Spain in the late sixteenth or early seventeenth centuries. It is therefore not included in this study.
- 24 The overlaying of traced outlines of the various versions demonstrates the likely use of cartoons based on tracings of the first versions in the case of the 'Venus with a musician' series, and also the two versions of *The Entombment* (see M. Falomir, 'Titian's Replicas and Variants' in London 2003, pp. 60–8, and Madrid 2003, pp. 248–51 and 260–3). For a similar study of the versions and replicas of Titian's *Danaë* composition see R. Wald, 'Titian's Vienna "Danae"'. Observations on execution and replication in Titian's studio' in Vienna and Venice 2007–8, pp. 124–33 (English edition), pp. 122–31 (German edition).
- 25 Falomir, Joannides and Mora 2014, pp. 16–51 (in Spanish) and 60–74 (in English).
- 26 Reproduced (although on a rather small scale) in Falomir, Joannides and Mora 2014, pp. 27 and 44.
- 27 For examples of works attributed to Orazio, Marco and Cesare, see Tagliaferro and Aikema 2009, pp. 193–221 and 275–304.
- 28 Girolamo Dente had been recommended to García Hernández, Philip II's Venetian representative, as capable of making a copy of Titian's *The Martyrdom of Saint Lawrence* (now in the Gesuiti). Tagliaferro and Aikema 2009, p. 15, and Hale 2012, p. 629.
- 29 For examples of works that can be attributed to Girolamo Dente, see Tagliaferro and Aikema 2009, pp. 89–106 and 154–61.
- 30 Hale 2012, p. 611.
- 31 Philip II was prepared to accept a copy of *The Martyrdom of Saint Lawrence* (see note 28) if necessary, although in the end Titian himself (almost certainly with some workshop assistance) produced the version that is in El Escorial. On the other hand, in 1564 the councillors of Brescia were not pleased to have been sent three canvases for the ceiling of the Palazzo Pubblico, which they believed to have been painted by the workshop instead of by Titian as stipulated in the contract; see Wethey 1969–75, vol. III, pp. 89 and 225.
- 32 See, for example, Madrid 2003, pp. 247 and 394.
- 33 See Krischel 2002; Matthew 2002; R. Krischel, 'The Inventory of the Venetian "Vendecolori" Jacopo de' Benedetti: The Non-Pigment Materials' in Kirby, Nash and Cannon 2010, pp. 253–66; and L.C. Matthew and B.H. Berrie, "'Memoria de colori che bisognino torre a vinetia": Venice as a Centre for the Purchase of Painters' Colours' in Kirby, Nash and Cannon 2010, pp. 245–52.
- 34 T. Weddigen and G.J.M. Weber, 'Alchemie der Farben: Tizian porträtiert seinen Farbenhändler Alvise "dai colori" dalla Scala' in Dresden 2010, p. 59, note 49.
- 35 T. Weddigen and G.J.M. Weber, 'Alchemie der Farben: Tizian porträtiert seinen Farbenhändler Alvise "dai colori" dalla Scala' in Dresden 2010, pp. 52–3.
- 36 Gould 1972, quoted in Penny 2008, p. 251.
- 37 The quantitative SEM–EDX analyses suggest that this is an ordinary *vitrum blanchum* rather than the higher quality *crystallo*. See Spring 2012 for further information on this point.
- 38 For other examples of copper pigments used as a drier for black paint in sixteenth-century Italian works see Spring, Grout and White 2003, p. 99.
- 39 Mills and White 1977, p. 58.
- 40 No medium analysis was carried out for *An Allegory of Prudence* (CAT. 2) due to the difficulty in finding an appropriate area for sampling.
- 41 In a few samples the ratio of azelate to suberate diacids was a little higher than expected for heat-bodied oil, most notably in the sample from the dark background in *The Virgin suckling the Infant Christ* (CAT. 7), but none of the results obtained gave ratios in the range expected for non-bodied oil.
- 42 The medium analysis result from the dark green-brown paint of the foreground was harder to interpret due to the presence of beeswax but on balance seems to suggest the use of linseed oil.
- 43 The lighter areas in particular are noticeably lilac in colour, and are composed of red lake, black and lead white. See CAT. 1, FIG. 84.
- 44 Kirby 2000, p. 23.
- 45 See Kirby 2000, p. 35, for a table showing relative costs of ultramarine, azurite and smalt in Venice during the sixteenth century.
- 46 Kirby 2000, p. 24.
- 47 A similar effect was perhaps the motive behind the use of a pink underpaint beneath ultramarine seen in some of Titian's earlier works. See vol. 34 of this *Bulletin*, p. 27.
- 48 Gould 1972, quoted in Penny 2008, p. 251.
- 49 G. Bortolaso, 'A study of various works from the period 1542–1576' in Venice and Washington 1990, pp. 385–6.
- 50 For a review of early examples of the use of smalt see Stege 2004 and Richter 2004.
- 51 Lazzarini 1987, p. 126, note 17. Lorenzo Lazzarini also reports that there is a small amount of smalt in Titian's *Pala Pesaro* of 1519–26, but states that it is mixed with ultramarine only as a siccative for the oil medium. See Valcanover 1979, p. 71.
- 52 Parra 1999.
- 53 C. Garrido, "'El emperador Carlos V a caballo en Mühlberg": studio técnico' in Madrid 2001, pp. 117–34.
- 54 For a review of the early history of smalt (before 1550), including the Italian recipes, see Stege 2004 and Delamare 2013, pp. 37–98.
- 55 The recipe is quoted in Stege 2004.
- 56 The larger potassium ion is able to more effectively stabilise the tetrahedral coordination around the cobalt ion in the glass that is responsible for the blue colour; see Terczynska-Madej, Cholewa-Kowalska and Laczka 2010 and Robinet et al. 2011.
- 57 Merrifield 1849, vol. 2, p. 649, and Lomazzo 1585, p. 191.
- 58 The ore was sometimes roasted to extract instead the bismuth metal, which was a valuable commodity used in alloys—for type metal, for instance. The slag that remained

- contained the cobalt that could then be used to colour glass. See Delamare 2013 and Stege 2004.
- 59 See Spring et al. 2012 for the methodology employed for quantitative analysis, a full account of the elements present in smalt, and their origin and relationship with the ingredients, as well as a preliminary assessment of the results from around 40 paintings, including a discussion of variations in cobalt and arsenic content. See also Robinet et al. 2013, which reports some preliminary attempts to understand the role of arsenic in the glass.
- 60 Spring et al. 2005.
- 61 See Kirby 2015 and Monnas 2012, p. 23.
- 62 No suitable samples were available for HPLC analysis of the red lake pigments in *An Allegory of Prudence and Diana and Actaeon*.
- 63 The majority of these existing results from HPLC analysis of red lake pigment were produced by Jo Kirby and a full assessment of them in the context of the dyestuff industry across the whole of the sixteenth century in Venice can be found in Kirby 2015.
- 64 See CAT. 1. Although dyed textile shearings were often used as the source of the dyestuff for making lake pigments, which could have resulted in a mixture of dyestuffs in a single pigment, both the ATR–FTIR imaging results and SEM–EDX analysis gave evidence that lake pigment particles with different substrates were present, suggesting that more than one type had been used.
- 65 Molà 2000, pp. 120–37, and Kirby 2015.
- 66 See Kirby 2015 for the result from the painting by Lotto. The result from *The Vendramin Family* is also discussed in this article but, based on the proposal that had been made in Penny 2008 that the painting was begun in the 1540s but then finished in the 1550s, it was assumed that the cochineal dyestuff detected was from this later stage. Here (see CAT. 1) it is proposed that all the work may well have been painted in the 1540s, and indeed the cross-section of a sample from the same red drapery that was sampled for dyestuff analysis does not show any clear evidence of more than one stage of painting, or of a cochineal-based lake used only at the surface.
- 67 See McAndrew et al. 1985, pp. 512–15, where these early HPLC results from analyses carried out by Raymond White are published.
- 68 Kirby and White 1996, p. 71. Analysis was originally carried out by thin layer chromatography (TLC) but the result was confirmed by HPLC analysis in 1994. See also Kirby 2015.
- 69 Indeed, the use of lac for dyeing was less common in Italy in this period and in 1466 was prohibited by the Genoese dyers' guild for the dyeing of silk. See Monnas 2012, p. 23.
- 70 Birkmaier, Wallert and Rothe 1995, p. 123.
- 71 These analyses have been published in various separate articles, but have been brought together and discussed as a group in Kirby 2015. See also vol. 34 of this *Bulletin*, p. 29.
- 72 Cardon 2007, p. 613.
- 73 A. Burmester and C. Krekel, 'Azurri Oltramarini, Lacche et Altri Colori Fini': The Quest for the Lost Colours' in Munich 2000, pp. 193–212, esp. p. 200.
- 74 Some other examples of Titian's use of arsenic sulphide pigments in his later work can be found in Vienna and Venice 2007–8, p. 109.
- 75 See Seccaroni 2006 for Borghini and other historic documentary sources relating to lead-containing yellow pigments, and esp. p. 110 for the Escorial documents.
- 76 See Penny, Roy and Spring 1996, for example.
- 77 Fischer et al. 1999.
- 78 For *La Bella*, see Boselli et al. 2011, p. 85. For the Berlin painting see Fischer et al. 1999, and also the unpublished experimental report on the results of autoradiography available at <https://www.helmholtz-berlin.de/media/media/oea/web/pm/2001/art-tizian.pdf>. See also the review of early examples of Naples yellow in Seccaroni 2006, with references.
- 79 For occurrences of malachite in paintings by Titian, Veronese and Tintoretto, see Lazzarini 1987; Penny, Roy and Spring 1996; and Plesters 1980.
- 80 For these much quoted and discussed letters, see, for example, Sohm 1991, pp. 11 and 16–18; London 2003, p. 140; Vienna and Venice 2007–8, pp. 146–8 (English edition), pp. 162–4 (German edition). As is the case with some of the last works, it is difficult to imagine how Titian might have made the draperies appear more highly finished. The paint that we see now is clearly not an underpainting.
- 81 For the qualities of *prestezza* in painting (and its counterpart *diligenza*) as discussed in sixteenth-century sources see Cerasuolo 2014.
- 82 Richardson 1980, p. 9. Francis Richardson also points out that Aretino, as a Tuscan, may have been conditioned to feel uncomfortable about the lack of finish in Schiavone's (and, by extension, Titian's) works. He also stresses that Schiavone varied levels of finish according to function and destination (p. 29).
- 83 For the paint handling in Tintoretto's works of the late 1540s and early 1550s see J. Dunkerton, 'Tintoretto's Painting Technique' in Madrid 2007, pp. 143–7.
- 84 Vasari (1568) 1966–87, vol. VI (1987), p. 166.
- 85 Quoted in Cerasuolo 2014, pp. 79–80.
- 86 In the letter accompanying a portrait by Titian that Philip sent from Augsburg to his aunt Mary of Hungary in May 1551, he actually complained that 'you can see very well the haste with which he has painted my armour and if there had been more time I would have had him work on it again'. There is disagreement as to whether the painting referred to in the letter is the magnificent full-length portrait of Philip in armour (Museo Nacional del Prado, Madrid), which is in fact relatively highly finished and full of detail, and may have been painted slightly earlier in Milan in late 1548. For a summary of the discussion see Humfrey 2007, p. 248.
- 87 Hale 2012, p. 540.
- 88 The painting is much damaged in some areas but this does not account for the lack of conventional finish in some parts of the composition. For the recent restoration and detail photographs see Alba 2012.
- 89 For the relationship between Titian, Niccolò Stoppio and Jacopo Strada, see Hale 2012, pp. 644–8, esp. p. 644 for quotes from the letter. The date given here, when Strada is known to have been in Venice, is given to the portrait in almost all publications. However, in the catalogue entry on the painting in Vienna and Venice 2007–8 (pp. 169–72 [English edition], pp. 199–202 [German edition]) it is dated 1566.
- 90 For the technique of the *Portrait of Jacopo Strada*, see E. Oberthaler, 'Cat. 37, Titian, *Jacopo Strada*' in Vienna 1996, pp. 175–80.
- 91 See Sohm 2007, pp. 77–81. Interestingly, this does not seem to have been an issue for Giovanni Bellini, who may have been just as old when producing his last works (like Titian, his date of birth is uncertain).

- 92 Jaffé and Groen 1987. In some of the paint cross-sections very thin layers containing blackish particles were observed sandwiched between paint layers. These have been interpreted as dirt that accumulated on the painting surface over the course of its fairly lengthy execution.
- 93 The painting was taken to El Escorial in 1574 but is usually dated to the 1560s. See Madrid 2003, pp. 266–7 and 402–3. The X-radiograph and infrared images show that the painting was carefully planned, with pentimenti limited mainly to Christ's right hand and to the costume of Simon of Cyrene. We are grateful to Ana González Mozo for sharing this information with us.
- 94 E. Oberthaler, "Titian's late style as seen in the "Nymph and Shepherd"" in Vienna and Venice 2007–8, pp. 113–23 (English edition), pp. 111–21 (German edition).
- 95 I. Artemieva, "The Barbarigo "Venus with a Mirror" and the "Dialogo della pittura" by Lodovico Dolce" in Vienna and Venice 2007–8, pp. 304–7 (English edition), pp. 350–3 (German edition).
- 96 Madrid 2003, pp. 260–3 and 399–400. The painting is likely to have suffered damage in a fire but this would not explain the lack of finish in some passages (for its condition see Alonso 1999, pp. 55–7). There is likely to have been some workshop participation in its execution but surely no workshop member would dare to leave passages in such an apparently incomplete state. The expanded version of the composition in the Ambrosiana, Milan, a workshop production of complex gestation and perhaps completed after Titian's death, does not include such passages (discussed in Tagliaferro and Aikema 2009, pp. 242–4).
- 8 Penny 2008, p. 214.
- 9 Penny 2008, pp. 206–10.
- 10 Dunkerton, Foister and Penny 1999, p. 270; Griswold 1993, pp. 140–1.
- 11 A survey of paintings with lozenge-twill canvas as a support is given in Seccaroni 2012.
- 12 Another advantage of this type of canvas could have been its strength and durability, useful for artists like Titian who were working for patrons from afar, enabling the pictures to be successfully rolled for transport. This relatively intricately woven fabric would have been more expensive than plain weave canvas since more skill and time was needed to set up the loom for weaving. See Seccaroni 2012, p. 60.
- 13 The *Portrait of Isabella d'Este* (Kunsthistorisches Museum, Vienna), usually thought to date from around 1536, is also painted on a canvas with a very similar weave. We are grateful to Elke Oberthaler for this information.
- 14 Reproduced in Penny 2008, p. 211.
- 15 For *The Triumph of Love*, see vol. 34 of this *Bulletin*, CAT. 13.
- 16 Lauber 2008, p. 373. See also Whistler 2009, p. 540.
- 17 Penny 2008, pp. 211 and 226.
- 18 Penny 2008, p. 223.
- 19 The switch between the two main figures revealed by the infrared images makes it more likely that the long-bearded figure really is Andrea; it makes less plausible the suggestion made by Stefanie Lew that the figure by the altar is a representation of the first Andrea Vendramin, founder of the family fortunes, and that Andrea and Lunardo, who both died in 1547, are also represented in the painting as deceased; see Penny 2008, pp. 223–4.
- 20 Penny 2008, p. 223.
- 21 *The Triumph of Love* (see vol. 34 of this *Bulletin*, CAT. 13).
- 22 If in the original design the space between Lunardo and Gabriel was to be filled with sky, a layer of indigo and white as the lowest layer in these samples might be expected. Although the gesso is not present in the sample, the samples seem generally to have sheered between the gesso and the paint layers. It is possible that it was always intended for one of the boys to occupy this area.
- 23 The copper pigment may have been introduced on the palette or during preparation of the oil.
- 24 For the clothes in the painting, see Penny 2008, p. 215.
- 25 In one sample from the deep red drapery a single large particle of smalt is present but it is not clear if it is an intentional inclusion in the mixture and this pigment was not found in any other samples.
- 26 J. Dunkerton and M. Spring in vol. 34 of this *Bulletin*, p. 27.
- 27 J. Dunkerton and M. Spring in vol. 34 of this *Bulletin*, pp. 28–9.
- 28 Analysis by HPLC found traces of ellagic acid and other tannin-related components in addition to the dye components. This implies that the principal dye source, which was kermes, had been extracted from silk shearings. ATR-FTIR showed that some of the lake particles in the cross-section contain protein, generally only seen where wool shearings (which are more soluble than silk) are the source of the dyestuff, so these must be a separate lake

Cat. 1 *The Vendramin Family, venerating a Relic of the True Cross*

- 1 This date differs from the dating suggested in Penny 2008, pp. 210–14, largely as a result of reconsideration of the technical evidence, including material not previously available.
- 2 The best-preserved areas of the painting are the more thickly painted heads and draperies in the figures that have not been changed during development of the composition. The robe over Andrea's left arm has suffered badly from flaking as has the orange garment worn by the younger brother on the right. Where changes have been made and as a consequence the paint is thicker, wrinkling and drying cracks have occurred. Overall the paint surface is worn, exposing the high points of the canvas weave in thinner parts such as the sky. In many areas paint has become more transparent with age allowing pentimenti and underdrawing to become visible. The painting has been extensively but somewhat inconsistently retouched so that some areas are heavily restored and others, such as the fur linings of the robes, left with much of the damage exposed.
- 3 Penny 2008, pp. 210–11.
- 4 Gronau 1925.
- 5 Penny 2008, Appendix 1, pp. 223–4.
- 6 For a family tree, see Penny 2008, p. 213.
- 7 Gould 1975, p. 286. In addition, if Lucha were over fifteen, he would have been entitled to wear the wide-sleeved robe (known as the *ducale*) worn by his older brother, father and uncle. Such details, however, can only provide a *terminus post quem*. Little is known about the details of how Titian worked with sitters for portraits, but it would be possible

pigment to that containing kermes and may well relate to the trace amounts of cochineal present. Lac-derived lake is usually prepared directly from sticklac through alkaline extraction of the dyestuff, rather than from cloth shearings, so it seems possible that three separate lake pigments are present.

- 29 Although here it was not possible to confirm this layer structure through a sample, a dark grey underpaint for a verdigris green has been found in *The Music Lesson* (NG 3); see vol. 34 of this *Bulletin*, CAT. 12.

Cat. 2 *An Allegory of Prudence*

- 1 No selvages are included in the canvas, so although vertical threads are presumed to be warp and horizontal ones weft, this is not certain.
- 2 The painting has only a few losses, which are from around the edges, but it has suffered some abrasion and increased transparency of the thin paint, especially in the old man and the three animal heads. As a result, distracting pentimenti have become visible.
- 3 For the history of the interpretation of the painting, see Penny 2008, pp. 238–42.
- 4 Penny 2008, p. 238.
- 5 Panofsky and Saxl 1926.
- 6 Discussed in a section in Penny 2008, p. 241.
- 7 Nicholas Penny points out that Titian depicts himself as having grey eyes in his self-portraits. The eye of the old man in the *Allegory* appears dark but even when viewed under magnification it is so shadowed, smudgy and affected by small losses that it is difficult to argue whether any particular eye colour was intended. It can also be pointed out that in the X-radiograph (FIG. 97) the profile of the first version – repeated approximately in the final version – bears even less resemblance to that of Titian as it appears in the Prado *Self Portrait* (Museo Nacional del Prado, inv. P00407), dated to around 1562. The nose visible in the X-radiograph has a more marked bump and is somewhat shorter, as indeed is the whole face. Titian frequently assigned hooked and somewhat pendulous noses to mature and elderly figures, including, for example several of the Mantua Emperors.
- 8 Detection of Ca, S and O by EDX analysis indicates that the gesso consists of calcium sulphate, but the form in which it is present has not been established. As in some of the other paintings, there are also small amounts of dolomite (calcium magnesium carbonate) and siliceous minerals as impurities. In one cross-section some black pigment is present, but this is not evident in another, so is probably not a deliberate addition.
- 9 Dülberg 1990, pp. 52–3. Penny 2008, p. 242, dismisses this on the evidence of disparity in the dimensions.
- 10 The dark horizontal patch that could be read as a mouth in the image published in Penny 2008, p. 239, was caused by a void in the central stretcher joint that was not eliminated when the presence of the stretcher was digitally reduced in the X-ray image published then; this has been remedied in the X-radiograph reproduced here.
- 11 Penny 2008, p. 236.
- 12 Penny 2008, pp. 236–8.
- 13 There are many painted copies of the lost canvases but the best record of their poses and costume is likely to be the well-known, early seventeenth-century engravings made by Aegidius Sadeler II, of which a detail is illustrated here.

- 14 Penny 2008, p. 238.
- 15 A tentative association between *An Allegory of Prudence* and these 'timpani around painted by the hand of Master Titian' was made by Nicholas Penny (Penny 2008, p. 238). The compilers of the inventory, Vincenzo Mantovano and Tommaso da Lugano, were presumably told by the family that they were painted by Titian, who was, of course, still living. See Whistler 2009, pp. 539–40, and Penny 2008, p. 225.
- 16 Penny 2008, p. 238, in suggesting that the painting could date from as early as about 1550, also pointed out the similarity between the profile head of the youth and the group of portraits on the left in *The Vendramin Family* (CAT. 1), which he attributes to workshop intervention in both instances.
- 17 See Penny 2008, pp. 240–1, for discussion and illustration of some of the possible sources including 'gryllos' cameos, showing conjoined full-face and profile heads. Gabriel Vendramin may well have owned such a cameo.

Cat. 3 *Venus and Adonis*

- 1 This assumes that the warp threads are horizontal.
- 2 The painting has suffered from large paint losses in the trees, especially the part above Adonis' outstretched arm, and from the bottom right corner. Old fillings (some of which contain lead and show as white in the X-radiograph) and retouchings in these areas were not removed during the last treatment. The paint is also slightly abraded, most disturbingly in the lower body of Venus and parts of the sky, the effect of the damage now reduced by retouching.
- 3 Penny 2008, p. 280; Falomir, Joannides and Mora 2014, p. 38 (in Spanish) and p. 68 (in English).
- 4 Falomir, Joannides and Mora 2014, pp. 18–31 (in Spanish) and pp. 61–6 (in English).
- 5 Falomir, Joannides and Mora 2014, pp. 31–4 (in Spanish) and pp. 66–7 (in English); see also Joannides and Dunkerton 2007.
- 6 Discussed and illustrated in Falomir, Joannides and Mora 2014, pp. 31–51 (in Spanish) and pp. 66–71 (in English); Joannides and Dunkerton 2007; Penny 2008, pp. 280–4.
- 7 Penny 2008, p. 276.
- 8 Illustrated in Penny 2008, p. 281, and Falomir, Joannides and Mora 2014, pp. 46–7.
- 9 Falomir, Joannides and Mora 2014, p. 48 (in Spanish) and p. 70 (in English).
- 10 Reproductions of the Prado version have often included a later extension at the left edge (now covered by the frame, following recent conservation; see Falomir, Joannides and Mora 2014, p. 55 [in Spanish] and p. 75 [in English]).
- 11 Interestingly, when Philip received his painting of Venus and Adonis he complained that there was a fold caused in packing. It is very likely that this was actually the seam, which is quite prominent. Penny 2008, p. 280, and Crowe and Cavalcaselle 1877, vol. II, p. 509.
- 12 Penny 2008, p. 276.
- 13 The painting was sampled during the cleaning in 1973 by Joyce Plesters. Some new cross-sections were prepared from the remaining unmounted fragments by Jilleen Nadolny during preparation of the catalogue of the Venetian School after 1540 (Penny 2008). All existing cross-sections have been re-examined and further analysis carried out for this study.

- 14 Identified by HPLC analysis of a sample from Adonis' red drapery. Given the date of this painting this is most likely to be New World cochineal.
 - 15 The smalt particles are small and as they are degraded and are depleted in potassium the level of cobalt measured by SEM-EDX is not fully reliable, but nevertheless gives some idea of the original intensity and composition of the pigment. The content of cobalt oxide is in the range of 4.6–6.0 wt % and the As/Co atomic % ratio is 1.2–1.7, making it a high arsenic smalt as seen in the other paintings in this study.
 - 16 The identification of linseed oil in two paint samples (including the brown paint of the bow) was published in Mills and White 1977, p. 58, and an additional two samples were analysed by GC-MS in 2015. The interpretation of these new results was hampered by the inclusion of wax from previous lining treatments; however, it does appear (after careful sample preparation and critical interpretation) that walnut oil was indeed used as the binder in blue-green paint from the landscape. Both analytical campaigns (in 1977 and 2015) included a sample from the flesh of Adonis' thigh. However, due to difficulties in interpretation neither result has been included here.
 - 17 See also Penny 2008, p. 276.
- 11 Wethey 1969–75, vol. III, p. 73, seems to have read these motifs as a stag and dog, but that was before the cleaning of 1998–9.
 - 12 Semi-quantitative SEM-EDX analysis indicates that the smalt particles are depleted in potassium and therefore deteriorated rather than a grade of pigment that was always pale. The cobalt content is relatively high, measuring between 4 and 6 weight % oxide. The smalt is also quite high in the arsenic associated with the ore (As:Co atomic % ratio is 1.4–2.4), as found in the other paintings in this study.
 - 13 SEM-EDX and ATR-FTIR microspectroscopic analysis of the cross-section identified a large agglomerate of copper carboxylate in this layer.
 - 14 All the particles analysed by ATR-FTIR microscopy gave similar spectra identifying malachite. EDX confirmed this, and showed that in every particle there was a small amount of zinc in addition to copper.
 - 15 This type of lead-tin yellow has commonly been found in paintings by Titian: see vol. 34 of this *Bulletin*, pp. 29–30.

Cat. 4 *Diana and Actaeon*

- 1 For an account of the recent conservation history of this painting see final essay in this volume. The painting is in good condition. There are slight losses from the edges of the canvas, in particular at the bottom right corner. A small tear crosses the little dog on the right and there is another short vertical damage to the left of Diana's right foot. Where the paint is thick because of an accumulation of layers as a result of changes to the composition it has developed drying cracks (for example, around the upraised hand of Actaeon). Thinner passages of paint may be slightly worn and some have become more transparent allowing underlayers to show more than would have been intended. In some areas the appearance of the painting has been affected by discoloration of smalt pigment and the fading of red lakes.
- 2 Wethey 1969–75, vol. III, pp. 72 and 170. Giovanni Benavides is also known as Juan de Benavides.
- 3 Lank 1982.
- 4 For a summary of the documentation, see Wethey 1969–75, vol. III, p. 139.
- 5 Crowe and Cavalcaselle 1877, vol. II, pp. 277 and 515.
- 6 See also Edinburgh 2004, p. 157.
- 7 It is not known whether there was a specific intended location for the *poesie*. Philip first received the two 'Diana' paintings at the Alcázar at Toledo in August 1560. The following year, when he moved to Madrid, he must have taken the canvases with him. See Wethey 1969–75, vol. III, pp. 78–80.
- 8 Wethey 1969–75, vol. III, p. 189; Crowe and Cavalcaselle 1877, vol. II, p. 509.
- 9 See also J. Dick, 'Technical Note' in Edinburgh 2004, p. 160.
- 10 Gypsum was identified by FTIR microscopy in transmission mode performed on an unmounted fragment from the background, using a diamond compression cell. ATR-FTIR microscopy of a cross-section sample confirmed this

Cat. 5 *Diana and Callisto*

- 1 This assumes that the seam is in the warp direction. In both canvases there is quite a lot of variation, so an average thread count is given here.
- 2 For an account of the recent conservation history of this painting see essay, p. 116. The painting is in good condition. There are slight losses from the edges of the canvas and a few small damages in the main part but no major losses. Thinner passages of paint may be worn and some have become more transparent, allowing underlayers to show more than would have been intended. Discoloration of the smalt pigment and fading of red lake pigments have affected the appearance of the painting in some areas. The thinly painted rocks behind Diana's head appear indistinct and seem to have been particularly affected by an increase in transparency, and also most probably some abrasion and wear, diminishing the sense of recession in this part of the landscape behind the figures. See also note 4.
- 3 SEM-EDX analysis of the gesso detected calcium, sulphur and oxygen, indicating that it consists of calcium sulphate, although the type has not been confirmed as there was no sample available for FTIR analysis.
- 4 Damage and likely pigment alterations to the thinly painted clouds in the sky of the *Rape of Europa* (Isabella Stewart Gardner Museum, Boston) result in a similar effect and the impression of a red-brown ground. In comparison, Rubens's copy of the *Rape of Europa* (Museo Nacional del Prado, Madrid) shows blue and grey clouds. Since the *Rape of Europa* was in the Orleans Collection along with the 'Diana' paintings and the even more damaged *Perseus and Andromeda* (Wallace Collection, London), it seems likely that they were all victims of French picture restorers of the early eighteenth century.
- 5 Harold Wethey was especially critical about the

consequences of past conservation treatments (he attributed the damage to cleaning rather than structural treatment) on these parts of the painting. See Wethey 1969–75, vol. III, p. 75.

- 6 This copy, probably painted largely by the workshop but perhaps with some intervention by Titian, must have been based on a tracing from the original design. Photographs taken of the back of the canvas when it was exposed for relining in 1912 show that at first the figure groups were carefully outlined on the canvas, with the design being exactly as in the original. During painting, the figure on the left was completely redesigned and the nymph seated at the centre was eliminated. The other seated nymph was changed slightly and the crouching dog taken out. The lapdog, however, must be the invention of a restorer, as there appears to be a large loss in this area.
- 7 HPLC analysis identified cochineal dyestuff as the major component; although from analyses it is very difficult to determine the source with certainty, given the date of the painting this is likely to be from a New World source such as *Dactylopius coccus* Costa. A smaller amount of kermes dyestuff from the scale insect *Kermes vermilio* Planchon was also found to be present.
- 8 Many other instances are known where a purple pigment mixture made with smalt and red lake has become completely brown, with a translucency that can make it indistinguishable from highly discoloured varnish. See Spring, Penny, White and Wyld 2001.
- 9 Although this second sample was from a paler passage of paint with a proportion of lead white, it probably included some of the underlying dark paint and it contained a mixture of pigments with both smalt and verdigris identified by FTIR microscopy in transmission mode using a diamond compression cell.
- 10 Crowe and Cavalcaselle 1877, vol. II, pp. 277 and 515.
- 11 See note 6.

Cat. 6 *The Tribute Money*

- 1 No selvages are included in the canvas, so although vertical threads are presumed to be warp and horizontal ones weft, this is not certain. The additions have 13 vertical threads and 12 horizontal threads per cm.
- 2 The painting is in excellent condition with only a few small, localised losses, mostly in Christ's blue drapery. Some wrinkling and drying cracks have occurred in areas where the composition was changed. Discoloration of smalt has resulted in the patchy appearance of the sky and change to the colour of the Pharisee's stole. The varnish applied in 1937 is beginning to discolour and many of the retouchings have altered in colour.
- 3 See Penny 2008, pp. 262–5, for the painting's provenance and attribution history.
- 4 Penny 2008, pp. 262–3.
- 5 Penny 2008, p. 266.
- 6 Similarities of palette with *The Entombment* (Museo Nacional del Prado, Madrid), sent to Philip II in 1559, have led to suggestions that *The Tribute Money* might have been begun then. However, the intensity of the ultramarine in these paintings is common to most of Titian's production for the King. Penny 2008, p. 263, goes further in suggesting that 'in its original conception, with its powerful contrasts of characterisation and texture, strong gestures and lighting, it recalls the *Ecce*

Homo (Kunsthistorisches Museum, Vienna), which was completed in 1543'.

- 7 Penny 2008, p. 260, perhaps influenced by his idea that the painting had an extended execution, and by the identification of smalt on both the main canvas and the extension, appears to argue that the extensions were added by Titian. For the evidence that this is not the case (subsequently reinforced by the discovery of the workshop replica beneath the Hermitage *Saint Sebastian*), see Dunkerton 1999.
- 8 A good and accurate copy, once belonging to the Duque del Infantado, Seville, was published and reproduced in Wethey 1969–75, vol. I, pp. 164–5, plate 130. Its dimensions of 101 × 107.3 cm are close to the original canvas of the National Gallery work, although it appears to have been reduced at the top. This may be another workshop replica, but, given its provenance, it could equally have been painted in Spain.
- 9 Identified by FTIR microscopy in transmission mode using a diamond compression cell.
- 10 At the National Gallery, a calcium carbonate ground has been found on Veronese's *The Adoration of the Kings* (NG 268) and *The Queen of Sheba before King Solomon* (NG 3107) by Lambert Sustris (which was probably painted in Venice). Penny, Roy and Spring 1996, pp. 47–8, and Penny 2008, p. 126.
- 11 Analysis was carried out by SEM–EDX. The difference in the ratios of the atomic percentage of cobalt to arsenic in the smalt from the original and from the additions was clear, with that from the original having an As/Co ratio varying between 1.3 and 2.5 (average 1.7), and that from the additions conversely containing roughly one and a half to two times more arsenic than cobalt (Co/As 1.3–2.3, averaging 1.7). This suggests a more strongly roasted ore was used to make the smalt on the additions. See Spring et al. 2012, for methodology of analysis and context for interpretation of results, esp. pp. 118–20.
- 12 Smalt from other Venetian paintings such as those by Veronese is also high in arsenic. See Spring et al. 2012.
- 13 Dunkerton 1999, p. 119.
- 14 In the X-radiograph there is a suggestion of lettering on the first coin, which can be read to include the word 'FERRARA', an echo of Titian's first painting of the subject. See Penny 2008, p. 264.
- 15 Penny 2008, p. 266. Penny also notes in the print the two little metal masks that attach the purse to the belt, which he suggests would be a characteristic detail of Titian's that was perhaps present in the painting at an earlier stage when seen by Rota, but later deleted. It would seem that this is not the case, since there is no sign of them in the X-radiograph and one would expect them to have been painted using X-ray-opaque pigments such as lead-tin yellow.
- 16 A sample taken from the sky above the Pharisee's head shows that smalt is combined with carbon black and a little ultramarine in the underpaint. Over it is a more intense blue layer consisting of ultramarine and lead white. Although degraded and discoloured through loss of potassium from the glassy pigment, the blue colour of the smalt is still retained in some of the larger particles. For the degradation of smalt, see Spring et al. 2012.
- 17 J. Dunkerton and M. Spring, see vol. 34 of this *Bulletin*, p. 24.
- 18 Powder X-ray diffraction analysis using a Debye-Scherrer camera confirmed the presence of orpiment (in agreement with JCPDS file no. 19–84).

- 19 Particles that were more opaque and a slightly lighter green than the very obvious large grains of verdigris were seen under the stereomicroscope and are likely to be malachite, although this has not been confirmed by analysis.
 - 20 Identified by FTIR microscopy in transmission mode using a diamond compression cell.
 - 21 HPLC analysis identified kermes from the scale insect *Kermes vermilio* Planchon, together with cochineal. The type of cochineal could not be confirmed but based on the date of the painting it is likely to be from a New World source such as *Dactylopius coccus* Costa. FTIR analysis suggested that the lake substrate included a proportion of sulphate. Although two dyestuffs were detected in the sample by HPLC, it was not possible to determine whether these were present in two separate lake pigments. Differences in substrate composition seen by SEM–EDX can sometimes be helpful, but here the paint cross-section was too tiny to be able to make firm conclusions from analysis of individual lake particles. The EDX spectra did, however, indicate a substrate based on hydrated alumina.
 - 22 Hendy 1947, pp. 36–7, no. 148.
 - 23 Penny 2008, p. 264.
 - 24 For discussion of this much-quoted letter, the possible effects of old age on the eyesight of Titian (and other painters) and the use by them of spectacles, see Sohm 2007, pp. 77–81.
- 10 Although HPLC analysis cannot distinguish between all Old and New World sources of cochineal, the date of this painting would almost certainly suggest the use of Mexican cochineal (*Dactylopius coccus* Costa).
 - 11 Semi-quantitative analysis by SEM–EDX of the smalt particles shows that they are depleted in potassium, confirming that they are deteriorated (rather than a low grade that was always pale). The smalt contains a fairly high level of cobalt, at 4.3–5.0 wt% oxide, and is rich in arsenic (as found in the other works in this study), with the As/Co atomic % ratio being in the range 1.3–1.5.
 - 12 This local underpainting was incorrectly reported in Penny 2008, p. 268, as an *imprimatura* applied across the whole canvas (on the gesso) before painting.
 - 13 Penny 2008, p. 268.
 - 14 A cross-section of a sample from the shadowed area of the brown background at the top edge towards the left shows that it was laid in with a mixture consisting mainly of yellow and red earth (the latter sometimes in large agglomerates) with a little coal black. The shadow paint applied on top contains mainly black pigment with a little earth, explaining the dark appearance in the infrared image of the strokes around the contour. It also contains some red lead and a very small amount of colourless powdered soda-ash glass, both probably added to enhance drying.

Cat. 7 *The Virgin suckling the Infant Christ*

- 1 No selvages are included in the canvas, so although vertical threads are presumed to be warp and horizontal ones weft, this is not certain. This assumption is supported, however, by the observation that the horizontal threads are much less even and are slubby.
- 2 The painting is generally well preserved with only a few small areas of local damage, mostly around the edges. The paint is not particularly worn and abraded, although uneven paint discoloration and wrinkling, and ingrained residues of dirt and old varnishes in depressions in the brushstrokes and canvas weave, give the impression of a rubbed surface, which in the past has led to the assumption that it is in poor condition. The varnish applied in 1962 is in good condition and only a very little discoloured.
- 3 Gould 1975, p. 283; Penny 2008, pp. 268–9.
- 4 The pose of Titian's Infant Christ resembles that of the Child in Michelangelo's large drawing (perhaps a cartoon made for another painter) in the Casa Buonarroti, Florence (inv. 71F). The drawing, however, is generally dated to the 1520s, when Michelangelo was in Florence (Hirst 1988, pp. 88–9). It could have been taken to Rome, but equally the similarity may be generic or Titian might have seen another derivation.
- 5 Engraving by Pieter de Jode the Younger, reproduced in Penny 2008, p. 271, fig. 1.
- 6 Penny 2008, p. 270.
- 7 Claude Phillips, in his 1898 monograph on Titian. Phillips 1898, vol. II, p. 106.
- 8 Charles Holmes, Director of the National Gallery when the painting was acquired as part of the Mond Bequest. Holmes 1923, p. 195.
- 9 The gesso was analysed only by SEM–EDX. The conclusion that calcium sulphate is present is therefore based on the detection of the elements Ca, S and O, but the type has not

Cat. 8 *The Death of Actaeon*

- 1 The thread count of the canvas is very variable, measuring between 12 and 15 warp per cm and 16 to 18 weft per cm. The average value is given in the entry.
- 2 Apart from a surface clean and revarnish, no treatment has been made to this painting since it was acquired by the National Gallery in 1972. The varnish already present before the surface clean, identified as mastic by GC–MS, may date from around 1920 if it was indeed cleaned at that time by Cavenaghi as had been proposed, or possibly earlier, and has discoloured to yellow but retains reasonable saturation and transparency. The paint is mostly in fairly good condition but there is a large damage in the bottom right corner, which has required the insertion of an irregularly shaped piece of canvas (approx. 25 × 32 cm). Elsewhere, paint has been lost from around the edges, the thicker paint of the trees on the right has suffered flaking and there are other small damages, which may be the result of the canvas having been folded or rolled. Thinner paint has suffered some wearing, exposing the tops of the canvas threads. Some retouchings have discoloured, particularly noticeable in the sky in the top left corner. Smalt, used in various places, including the sky and Diana's dress, has discoloured, and the red lake pigments have faded somewhat.
- 3 Crowe and Cavalcaselle 1877, vol. II, pp. 512–13; Wethey 1969–75, vol. III, pp. 76 and 136–7; Penny 2008, p. 250.
- 4 Penny 2008, pp. 253 and 255.
- 5 It was described as 'not quite finished' as early as 1636–8, when it was included in the list of paintings submitted by Lord Fielding (the British ambassador to Venice) to the Marquess of Hamilton; see Penny 2008, p. 253. Among the scholars who believed the painting to be incomplete are Wethey 1969–75 (but only lacking 'some final glazes',

- pp. 76–7 and 136); Hope 1980, pp. 164–5. Other recent writers on Titian have argued that the lack of conventional finish in this and some other late works is intentional: see Sohm 2007, pp. 83–103, esp. p. 98; and Gentile 2012, pp. 377–80.
- 6 See C. Hope in *Vienna and Venice 2007–8*, pp. 27–39 (German edition) and pp. 29–41 (English edition).
 - 7 The thickness of the paint layers makes a thread count of the weave from the X-ray image difficult, but in one direction at least a count of 17 threads per cm was possible, which would make the canvas the same as that for *The Vendramin Family*. If the inserted piece were cut from the sky the presence of indigo in the lowest paint layers of a cross-section might provide confirmation. Unfortunately no samples exist from this area.
 - 8 In weave and texture the canvas is similar to that used for the later version of *The Entombment* in the Museo Nacional del Prado, Madrid, dated as late as 1572, and painted very much in the manner of Titian's last works, even if his workshop may have contributed to its execution. Another example of a rather rough twill weave can be seen in the Vienna *Nymph and Shepherd*, where it seems that Titian deliberately chose the rougher and more textured side of the fabric for his painting surface; see E. Oberthaler in *Vienna and Venice 2007–8*, p. 113 (German edition) and p. 115 (English edition). Titian did, however, also use twill canvases earlier in his career, notable examples being the *Portrait of Doge Andrea Gritti* (National Gallery of Art, Washington DC), painted in the late 1540s, and *The Triumph of Love* (see vol. 34 of this *Bulletin*, CAT. 13) from the first half of that decade.
 - 9 The *Annunciation* must have been installed on its altar in the church by the mid 1560s since it was mentioned by Vasari. Gentile 2012, pp. 332–4.
 - 10 It was first X-rayed at the Courtauld Institute in 1961. The radiograph was reproduced in Wethey 1969–75, vol. III, plate 152.
 - 11 His death did not necessarily occur in Diana's presence. Diana's inclusion here shows how Titian sometimes chose to conflate his main source, Ovid, with ideas from other authors, possibly in this instance a description of Diana hunting taken from Apuleius. See Penny 2008, p. 252.
 - 12 See Penny 2008, pp. 251–2; also Penny 1999. Wethey 1969–75, vol. III, p. 76, also commented on the apparent lack of ultramarine in the sky.
 - 13 See note 2 and Penny 2008, pp. 248 and 258.
 - 14 As depicted in David Teniers the Younger's *Gallery of the Archduke Leopold William*, painted in 1651 (Royal Museums of Fine Arts of Belgium, Brussels), *The Death of Actaeon* appears notably cool in colour, especially in comparison with other paintings represented that are still known to us, including the *Portrait of Jacopo Strada* and Giorgione's *The Three Philosophers* (both Kunsthistorisches Museum, Vienna).
 - 15 The lower smalt layer has become a translucent yellow-brown due to the loss of colour of the smalt and the concurrent yellowing of the oil binding medium. In the cross-section, from the deepest part of the sky at the top left, the ultramarine layer on top is relatively thin. SEM-EDX analysis of the smalt confirms that it is depleted in potassium and therefore degraded rather than a grade that was originally pale. A cobalt content of around 4.5 weight % oxide was measured, indicating that it originally had quite a strong blue colour. As in the other paintings in this volume, the smalt is rich in arsenic, with a As:Co ratio of 1.5.
 - 16 Identified by HPLC analysis.
 - 17 The slightly dull tone of the drapery is probably not only due to the yellowed varnish but also to the presence of discoloured smalt.
 - 18 A few particles of discoloured smalt were found by analysis in the mixture, so the vegetation may have originally had a slightly more green tinge.
 - 19 An observation made by Wethey 1969–75, vol. III, p. 136.
 - 20 Boschini 1660 (Pallucchini ed. 1966), pp. 711–2.

The Conservation History of Titian's Diana and Actaeon and Diana and Callisto

- 1 Fry 1933.
- 2 Kennedy North 1933. See also the National Portrait Gallery online resource 'British picture restorers, 1600–1950' (2nd edition, August 2014), compiled by Jacob Simon, which outlines the career of the artist and picture restorer Stanley Kennedy North, who was based in London (<http://www.npg.org.uk/research/programmes/directory-of-british-picture-restorers/british-picture-restorers-1600-1950-n.php>). He worked on a number of pictures in the Royal Collection, including Duccio's Triptych in or after 1930, and Andrea Mantegna's *The Triumphs of Caesar* at Hampton Court in 1931–4, which he relined. For this he used a wax adhesive, as he did for the lining of Titian's *Diana and Actaeon* and *Diana and Callisto* in 1932, and for Titian's *Venus Rising from the Sea* in 1931, which was also in the collection of the Duke of Sutherland.
- 3 See cats 54 and 55 in Edinburgh 2004, pp. 160–2.
- 4 For the full provenance see cats 54 and 55 in Edinburgh 2004, pp. 160–2, and <http://www.nationalgallery.org.uk/paintings/research/titian-diana-actaeon>.
- 5 Toynbee 1903, p. 77. See also Kennedy North 1933, p. 10, where he quoted this phrase, implying that it could be assumed that the two Bridgewater Titians had certainly undergone this kind of treatment, an assumption that has made its way into much of the subsequent literature on these works. For the conservation history of Sebastiano del Piombo's *Raising of Lazarus* (NG 1), which did undergo transfer while in the Orleans Collection, see Dunkerton and Howard 2009.
- 6 See Penny 2008, pp. 461–8 on the Orleans Collection.
- 7 Herbert George Haines (1857–1933) was the last in a dynasty of picture restorers, starting with William Henry Haines, whose uncle was William Seguyer who was appointed Keeper at the National Gallery in 1824. W.H. Haines set up business with his younger brother Frederick in 1844. H.G. Haines was listed in the 1891 census records as 'restorative artist (pictures) and art expert'. The Haines family business ran until 1931. For this and a full description of the activity of the Haines family as restorers see 'British picture restorers, 1600–1950' (details in note 2).
- 8 Ingamells 1982, p. 340.
- 9 Kennedy North 1933, p. 10.
- 10 See Kennedy North 1932, p. 4.
- 11 See Kennedy North 1932, p. 2.
- 12 The paintings seem to have had glue-paste linings in place before the treatment undertaken by Kennedy North. The lifetime of a lining is expected to be between about 70

and 100 years, so it is unlikely that these linings dated from the recorded treatment by Haines only around 30 years before Kennedy North's examination. It is therefore very possible that the most recent relining before 1932 was in the eighteenth century, either in London as Kennedy North presumed, or even earlier while the paintings were in the Orleans Collection, possibly in the 1770s when it is known that many of the paintings underwent conservation treatment.

- 13 Kennedy North 1932, p. 13.
- 14 Kennedy North 1932, pp. 3–4.
- 15 Kennedy North 1930.
- 16 The phrase in Kennedy North's obituary is quoted in Burnstock et al. 1993, p. 682. In 1931 Kennedy North had treated the *Peasant Family* (Petworth House), one of the paintings by Le Nain discussed in this article, and had documented it in the same detailed way as for the Titians.
- 17 See Ruhemann 1968, pp. 54–5, for remarks on the context and new developments in the conservation profession in the 1930s.
- 18 Kennedy North 1932, p. 3.
- 19 Kennedy North 1932, p. 3.
- 20 Kennedy North 1932, p. 3.
- 21 Kennedy North 1932, p. 3.
- 22 See Saunders 2000, which also includes these quotations (originally from the National Gallery archive).
- 23 Ruhemann 1968, p. 50.
- 24 For the treatment by Haines see 'British picture restorers, 1600–1950' (details in note 2). The 1942 cleaning is recorded in the National Gallery conservation dossiers for these works and even includes some early colour measurements comparing cleaned and uncleaned areas with a Tintometer by E.I.G. Rawlins. These seem to confirm the yellow state of the varnish.
- 25 See cats 54 and 55 in Edinburgh 2004, pp. 160–2. In the 'Technical Note' initialled by John Dick (JD) it states that this adhesive was 'wax-resin' rather than wax alone, which would have given it better adhesive properties, but given the relatively rapid deterioration in the lining after the 1932 treatment Kennedy North may well have used only wax, as he implied in his documentation.
- 26 Kennedy North 1932, p. 8.
- 27 Kennedy North 1933, p. 10.
- 28 Ruhemann 1968, p. 42.
- 29 Kennedy North 1933, p. 15.
- 30 Fry 1933, p. 3.
- 31 John Dick was Keeper of Conservation at the National Galleries of Scotland from 27 January 1964 to 14 January 1999. He completed the restoration of these two works between 1998 and 1999.
- 32 See 'Technical Note' initialled by John Dick (JD) in cats 54 and 55, in Edinburgh 2004, pp. 160–2.
- 33 See Ruhemann 1968, p. 290.
- 34 Wethey 1969–75, vol. III, p. 75.
- 35 Brigstocke 1978, p. 162.
- 36 Brigstocke 1978, p. 162.
- 37 Kennedy North 1933, p. 15.

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