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# Analyses of Paint Media

*Raymond White and Jennifer Pilc*

Artist	Picture	Date	Sample	Medium	P/S	Oil type	Notes
Attributed to the <b>Master of Saint Francis</b>	<i>Crucifix</i> NG 6361	c.1285	1. Flesh paint of Christ 2. Green from gilding	Egg Copper resinate/oil			1
<b>Jacopo di Cione</b> and Workshop	<i>Coronation of the Virgin, with Adoring Saints</i> NG 569	1370–1	1. Brown glaze-like paint 2. Green paint beneath brown layer 3. Greenish-brown paint 4. Black jewel in crown 5. White garment, upper left-hand saint 6. Blue of robe, above red book 7. Red, bole-like ground	Egg + a little oil Egg Egg Egg Egg Egg + a little oil Glue			2
	<i>Pentecost</i> NG 578	1370–1	1. Darkened, insoluble varnish trapped under fitment	Oil + resin			
<b>Niccolò di Buonaccorso</b>	<i>The Marriage of the Virgin</i> NG 1109	1372–88	1. Pale blue (reverse) 2. Red lake paint (reverse)	Egg Egg			
<b>Piero della Francesca</b>	<i>The Nativity</i> NG 908	1470s	1. Blue sky	Oil	2.8	Walnut	
			2. Discoloured green of distant trees	Oil	3.0	Walnut	
<b>Cosimo Tura</b>	<i>Saint Jerome</i> NG 773	c.1475	1. Darkened green or black of tree trunk	Oil	2.4	Walnut	
			2. Red of hat	Oil	2.2	Walnut	
			3. Pale green grass	Egg + some oil			
			4. Blue sky	Egg + some oil			
	<i>The Virgin: Fragment of an Annunciation</i> NG 905	1490–5	1. Green grass in background	Oil	2.3	Walnut	3
			2. Blue of Virgin's robe	Oil	2.8	Walnut	
			3. Green underpaint from canopy over throne	Egg			
<b>Antonio and Piero del Pollaiuolo</b>	<i>The Martyrdom of Saint Sebastian</i> NG 292	1475	1. White of sleeve 2. Green of foliage 3. Brown foliage in foreground	Oil Oil Oil + asphaltum	3.0 2.5 2.3	Walnut Walnut Walnut	

Artist	Picture	Date	Sample	Medium	P/S	Oil type	Notes
<b>Antonello da Messina</b>	<i>Saint Jerome in his Study</i> NG 1418	early 1460s	1. Brownish paint, top right-hand corner	Oil	2.4	Walnut	
	<i>Christ Blessing</i> NG 673	1465	1. Black background	Oil	2.6	Walnut	
<b>Carlo Crivelli</b>	<i>The Annunciation, with Saint Emidius</i> NG 739	1486	1. White of window frame	Egg + some oil	2.2	Walnut	4
			2. Green of Virgin's robe	Oil mainly + some resin			
			3. Brown of planks below shelf	Egg tempera			
			4. Thick globular mordant of gilding from capital of left-hand pilaster	Egg mainly + a little oil			
<b>Gerolamo Romanino</b>	<i>The Nativity with Saints Alessandro of Brescia, Jerome, Gaudioioso and Filippo Benizzi</i> NG 297	c.1525	1. Purplish wing, upper right-hand edge, within lunette	Egg			
			2. Reddish-purple drape, right-hand edge	Oil + egg			
<b>Paolo Veronese</b>	<i>Allegory of Love I ('Unfaithfulness')</i> NG 1318	mid-1570s	1. Brownish-green leaves, left-hand edge	Oil + some resin	1.7	Linseed	5
			2. White highlight of drape	Oil	1.8	Linseed	
			3. Red highlight glaze of red drape, right-hand edge	Oil	1.7	Linseed	
<b>Annibale Carracci</b>	<i>Silenus gathering Grapes</i> NG 93	1597–1600	1. Greyish-white of water	Oil + some egg tempera	2.4	Walnut	6
			2. Dark brown earth	Oil	1.6	Linseed	
	<i>Christ appearing to Saint Peter on the Appian Way (Domine Quo Vadis?)</i> NG 9	1601–2	1. Brownish shadow of robe	Oil + ?	2.6	Walnut	
			2. Blue of sky, top right-hand edge	Oil	2.4	Walnut	
			3. Green of trees	Oil	2.0	Linseed/walnut?	
	<i>The Dead Christ Mourned</i> NG 2923	c.1604	1. White highlight of shroud	Oil	3.3	Walnut	
			2. Yellow silk brocade	Oil	1.4	Linseed	
<b>Caravaggio</b>	<i>Boy bitten by a Lizard</i> NG 6504	1598–1600	1. White highlight of drape, left-hand edge	Oil + some egg tempera	3.1	Walnut	7
<b>Guido Reni</b>	<i>Christ embracing Saint John the Baptist</i> NG 191	late 1630s	1. White garment of Saint John	Oil	1.8	Linseed	
			2. Flesh paint of Saint John's hand	Oil	1.3	Linseed	

Artist	Picture	Date	Sample	Medium	P/S	Oil type	Notes
<b>Domenichino</b>	<i>Saint George killing the Dragon</i> NG 75	1610–11	1. Blue sky 2. Dark brown tree trunk	Oil Oil	2.8 2.4	Walnut Walnut	
	<i>Landscape with Tobias laying hold of the Fish</i> NG 48	1617–18	1. Blackish brown of trees	Oil	1.5	Linseed	
<b>Guercino</b>	<i>The Incredulity of Saint Thomas</i> NG 3216	1621	1. Light blue of Christ's garment	Oil + some egg	2.7	Walnut	8
			2. Yellow paint of Saint Thomas's robe	Oil	2.7	Walnut	
			3. Red glaze-paint from folds of Saint Thomas's robe	Oil + some resin	2.4	Walnut	
<b>Luca Giordano</b>	<i>Saint Anthony of Padua miraculously restores the Foot of a Self-mutilated Man</i> NG 1844	c.1700	1. Red paint of architecture 2. Yellow highlight of architecture	Oil Oil	1.7 1.5	Linseed Linseed	
	<i>The Martyrdom of Saint Januarius</i> NG 6327	c.1690–1702	1. Warm white of rock 2. Dark reddish brown of architecture	Oil Oil	1.6 1.7	Linseed Linseed	
<b>Canaletto</b>	<i>Venice: Campo S. Vidal and Santa Maria della Carità ('The Stonemason's Yard')</i> NG 127	c.1730	1. Grey underpaint	Oil	1.8	Linseed	
			2. White of textile	Oil	1.8	Linseed	
			3. Yellowish cloud	Oil	1.8	Linseed	
			4. Blue sky	Oil	1.3	Linseed	
			5. Brownish-red wall	Oil	1.3	Linseed	
<b>Master of the Mornauer Portrait</b>	<i>Portrait of Alexander Mornauer</i> NG 6532	1470s	1. Dark cloak of sitter	Oil	1.7	Linseed	9
			2. Blue repaint of background	Oil	4.0	Poppy	
<b>South German School</b>	<i>Saint John on Patmos</i> NG 4901	c.1460/70s	1. Brownish green, right-hand edge	Oil	1.3	Linseed	10
			2. White of clouds	Oil	1.4	Linseed	
			3. Ground layer	Oil	1.4	Linseed	
<b>Style of Martin Schongauer</b>	<i>The Virgin and Child in a Garden</i> NG 723	1469–91	1. Green leaf of tree	Oil + a little resin	2.6	Walnut	11
<b>Lucas Cranach the Elder</b>	<i>Cupid complaining to Venus</i> NG 6344	probably 1530s	1. Mid-blue paint, left-hand edge	Oil	1.9	Linseed	
			2. Browned green paint of leaves, left-hand edge	Oil	1.8	Linseed	
			3. Cream coloured clouds	Oil	1.7	Linseed	

Artist	Picture	Date	Sample	Medium	P/S	Oil type	Notes
Lucas Cranach the Elder	<i>Charity</i> NG 2925	after 1537	1. White of sky, right-hand edge	Oil	1.8	Linseed	
			2. Blue of sky, right-hand edge	Oil	1.6	Linseed	
			3. Green foliage, left-hand edge	Oil	1.8	Linseed	
Jakob Seisenegger	<i>Portrait of a Girl</i> NG 4206	c.1545–50	1. Green background	Oil	1.3	Linseed	12
			2. Black of dress, bottom edge	Oil	1.8	Linseed	
Johann Liss	<i>Judith in the Tent of Holofernes</i> NG 4597	1622–3	1. Black of helmet	Oil + resin	1.4	Linseed	13
			2. White sheet, behind body	Oil	3.6	Walnut	
Johann Carl Loth	<i>Mercury piping to Argus</i> NG 3571	late 1650s	1. Red garment of Mercury	Oil	1.7	Linseed	
			2. Cream-coloured background	Oil	1.7	Linseed	
Govert Flinck	<i>Self Portrait aged 24</i> NG 4068	1639	1. Olive-grey background	Oil	1.6	Linseed	14
			2. Black of coat	Oil	1.9	Linseed	
Follower of Rembrandt	<i>An Old Man in an Armchair</i> NG 6274	1652	1. Brownish-red lower ground	Oil	1.8	Linseed	15
			2. White impasto of cuff	Oil	2.6	Walnut	
			3. Brownish-black paint	Oil + resin	1.4	Linseed	
G. van den Eeckhout	<i>Rebekah and Eliezer at the Well</i> NG 6535	1661	1. Blue paint of sky	Oil	1.9	Linseed	16
			2. Grey-white of stone	Oil	1.7	Linseed	
			3. Dark brown shadow	Oil + resin	1.9	Linseed	
Edouard Manet	<i>Music in the Tuileries Gardens</i> NG 3260	1862	1. Ground	Oil	1.9	Linseed	17
			2. Pale blue of sky	Oil	2.9	Poppy + linseed	
			3. Black of shoe of left-hand man	Oil	2.7	Poppy + linseed	
			4. Green of trees, right-hand edge	Oil	1.8	Linseed	
			5. White of dress of girl kneeling, centre	Oil	4.4	Poppy	
			6. Brown earth, bottom edge	Oil	3.1	Poppy + some linseed	
	<i>The Execution of Maximilian (fragment)</i> NG 3294A	1867–8	1. Blue sky	Oil	4.1	Poppy	18
Claude Monet	<i>Bathers at La Grenouillère</i> NG 6456	1869	1. Ground, left-hand edge	Oil	1.4	Linseed	19
			2. Green foliage, right-hand side	Oil	4.3	Poppy	
			3. Green foliage, upper left-hand side	Oil	4.0	Poppy	
			4. White impasto, highlight of wave	Oil	4.1	Poppy	

Artist	Picture	Date	Sample	Medium	P/S	Oil type	Notes
Claude Monet	<i>The Beach at Trouville</i> NG 3951	1870	1. Ground	Oil	1.4	Linseed	
			2. White impasto by knee of woman in blue	Oil	4.2	Poppy	
			3. Black dress, right-hand figure	Oil	1.8	Linseed	
			4. Grey-blue sky	Oil	3.0	Poppy + linseed	
	<i>The Petit Bras of the Seine at Argenteuil</i> NG 6395	1872	1. Lower ground	Oil	1.4	Linseed	
			2. Upper lilac ground	Oil	1.6	Linseed	
			3. Dark green river bank	Oil	3.4	Poppy?	
			4. White impasto highlight of river	Oil	3.9	Poppy	
	<i>The Gare St-Lazare</i> NG 6479	1877	1. Ground	Oil	1.5	Linseed	
			2. Dark paint of roof of station	Oil	2.6	Linseed + poppy	
			3. Greyish-white of steam	Oil	3.9	Poppy	
	<i>Lavacourt under Snow</i> NG 3262	1881	1. Ground, bottom edge	Oil	2.1	Walnut?	
			2. White of snow, bottom edge	Oil	4.5	Poppy	
			3. Dark blue of shadow on snow	Oil + resin	2.7	Walnut	
			4. Dark green	Oil	2.5	Walnut	
Camille Pissarro	<i>Fox Hill, Upper Norwood</i> NG 6351	1870	1. Ground	Oil	2.9	Walnut	20
			2. White sky	Oil	4.4	Poppy	
			3. Blue sky	Oil	2.7	Walnut	
			4. Dark green, bottom edge	Oil	3.0	Walnut	
	<i>The Avenue, Sydenham</i> NG 6493	1871	1. White cloud	Oil	4.1	Poppy	
			2. Pale blue of sky	Oil	4.6	Poppy	
			3. Dark green of grass	Oil	2.4	Walnut	
			4. Greyish-brown paint, left-hand edge	Oil	2.5	Walnut	
	<i>The Côte des Boeufs at l'Hermitage</i> NG 4197	1877	1. Ground	Oil	1.6	Linseed	
			2. White impasto of house, centre	Oil or oil + fats?		Walnut or poppy + fats?	
			3. Dark blue impasto, top of tree trunk	Oil	2.8	Walnut	
			4. Red paint, bottom edge	Oil + beeswax	3.0	Walnut	
Alfred Sisley	<i>The Watering Place at Marly-le-Roi</i> NG 4138	1875	1. Brownish ground	Oil	1.8	Linseed	
			2. White snow, bottom edge	Oil	4.7	Poppy	
			3. Black paint, right-hand edge	Oil	1.4	Linseed	
			4. Light bluish grey of stream	Oil	3.3	Poppy + some linseed	



Artist	Picture	Date	Sample	Medium	P/S	Oil type	Notes
<b>Pierre-Auguste Renoir</b>	<i>At the Theatre</i> ( <i>La Première Sortie</i> ) NG 3859	1876–7	1. Ground	Oil + resin	1.4	Linseed	21
			2. White collar of right-hand figure	Oil + resin	1.8	Linseed	
			3. Dark blue dress, right-hand figure	Oil + resin	1.5	Linseed	
	<i>Boating on the Seine</i> NG 6478	c.1879	1. Ground	Oil	3.9	Poppy	
			2. White highlight on wave crest	Oil	4.2	Poppy	
			3. Dark blue from foreground	Oil mixture	1.9	Linseed + a little castor	
	<i>The Umbrellas</i> ( <i>Les Parapluies</i> ) NG 3268	1881–6	1. Ground, right-hand turnover	Oil	1.9	Linseed	
			2. White impasto, right-hand girl's hat	Oil	5.3	Poppy	
			3. Red of hair, right-hand edge	Oil	5.2	Poppy	
			4. White of arm, left-hand turnover	Oil	1.7	Linseed	
			5. White cloud, top edge	Oil	1.8	Linseed	
			6. Dark blue, right-hand woman's dress	Gouache (gum)			
<b>Berthe Morisot</b>	<i>Summer's Day</i> NG 3264	1879	1. Ground	Oil	1.2	Linseed	22
			2. White highlight impasto from dress of centre figure	Oil + resin	4.3	Poppy	
			3. Grey paint of dress of centre figure	Oil + resin	2.8	Poppy + linseed	
			4. Dark blue dress, left-hand figure	Oil	4.0	Poppy	
<b>Paul Cézanne</b>	<i>Hillside in Provence</i> NG 4136	c.1886	1. Ground	Oil	1.3	Linseed	23
			2. White impasto highlight of rocks	Oil	2.6	Walnut	
			3. Greyish blue of distant hills	Oil	2.7	Walnut	
			4. Yellow, lower right-hand edge	Oil	2.5	Walnut	

## Notes to the Table

1. Samples 1 and 2 were examined by FTIR-IR microscopy.

2. A study of these two Trecento panels has been reported.<sup>1–2</sup>

In NG 569 the fragment of paint from one of the black jewels in the crown, sample 4, appeared to be in egg tempera, as was the case with samples 2, 3 and 5. Here, however, the paint was very rich in non-drying lipids, which might suggest the use of egg yolk mainly. The transparency of the essentially egg tempera medium in sample 1 (brown glaze) and the degree of colour saturation of the ultramarine pigmented sample 6 (blue robe) appears to have been augmented by the addition of a little drying oil.

3. In the case of Tura's *Virgin* (NG 905) samples of green paint from the grass in the background and blue paint from the Virgin's robe were identified as being bound in walnut oil, whereas a green under-paint from the canopy over the throne was found to be bound principally by egg tempera; nevertheless, there was a small amount of drying oil, possibly from vestiges of a green upper layer. This matched quite well the pattern observed in other paintings by Tura in the Collection (NG 3070 and NG 772).<sup>3</sup> His *Saint Jerome* (NG 773) had a much leaner and more matt appearance overall. Whereas a very dark green or black tree trunk contained walnut oil (with no evidence of resin) and the red paint of a hat was bound very leanly with walnut oil, both the pale green paint of the grass and the blue sky paints were

found to contain predominantly egg tempera medium with a small amount of drying oil.

4. The examination of the medium presented here represents further investigation carried out on works by Carlo Crivelli. In the past,<sup>3–4</sup> Crivelli paintings have shown quite a sophisticated use of both egg tempera and oil media, and the current work — NG 739 — proved to be no exception.

Brown, rather ‘dry’ paint was identified as in egg tempera medium alone. White paint of a somewhat richer quality seemed to be composed of egg tempera with a little drying oil. Neither of these paints was found to contain any detectable amounts of diterpenoid or triterpenoid resins. However, green paint (from the Virgin’s robe) consisted of oil medium predominantly, but with some egg tempera. In this case, unlike the other samples, there was also clear evidence for the inclusion of pine resin from the presence of methyl dehydroabietate and methyl 7-oxodehydroabietate (by GC-MS).

Adhesive from the gilding, sampled from the capital of an enjoined pilaster and which appeared as rather globular droplets under the optical microscope, was shown to contain mainly egg — with a dash of oil — but no resin.

5. Some ten years ago samples were taken from Veronese’s *Allegory of Love I*, NG 1318.<sup>5</sup> Since that time other *Allegories* in the series have been examined, as well as NG 931, *Saint Mary Magdalene laying aside her Jewels*.<sup>6</sup> In several works by Veronese, we have found examples of his preference for the use of walnut oil in the whites and pale colours, with evidence of copper resinate in transparent greens. In some works, however, these preferences have not been encountered. NG 1318 was just such a case and we were anxious to re-examine fresh samples of green and white as a check on our original findings. A sample of white highlight from a white sheet proved to be linseed oil following GC analysis and, reassuringly, the methyl palmitate/methyl stearate ratio was found to be close (1.8) to our original measurements of 1.9. The presence of oil was also supported by FTIR analysis employing the IR-microscope.

A sample of green paint from a leaf in the original investigation, aside from containing linseed oil, was not demonstrated to be a copper resinate-based paint. In part this may have been due to the fact that the analysis had been carried out by GC alone and we became acutely aware, following the acquisition of GC-MS, that additions of natural resin could easily be missed without the added selectivity and sensitivity of the mass-spectrometer. Upon further investigation (using the FTIR-IR microscope) it was possible to detect resinate bands. GC of the sample, following an infra-red investigation, produced a chromatogram, which pointed to the use of linseed oil and which,

moreover, possessed a slight undulation of the baseline in the diterpenoid region normally associated with methyl dehydroabietate. A sample of red glaze-like paint from a drape — not examined in the original study — was found to contain linseed oil.

6. Annibale Carracci’s *Silenus gathering Grapes* (NG 93) consists of two irregularly shaped wooden panels and is thought to have been part of the decoration originally of a harpsichord or similar musical instrument. A sample of the brown foreground from the bottom edge of the larger panel was identified as linseed oil by GC. However, a curiously fresco-like greyish-white paint was found to be a mixture of egg tempera and — predominantly — oil (again by GC). The substantial palmitate-to-stearate ratio was well within the region associated with walnut oil and, even allowing for distortion by the non-drying tempera fats, could not conceivably represent linseed oil. FTIR-microscopy on a section substantially confirmed these conclusions, but different areas of the section seemed to vary markedly as to the intensity of protein and drying lipid bands. Thus the curious appearance of this particular area of paint may be the result of a failed emulsion.

NG 2923, *The Dead Christ Mourned*, by the same artist appeared to contain a white, slightly impasto-like paint, which was based on heat-bodied walnut oil as medium. Paint of the yellow silk brocade, in contrast, was identified as linseed oil, which had not been heat-bodied.

Walnut oil was identified as binder in samples 1 and 2 from *Christ appearing to Saint Peter on the Appian Way (Domine Quo Vadis?)* (NG 9). Sample 3, which was a fragment of green paint from the trees, exhibited an ambiguous palmitate/stearate ratio of 2.0 at the boundary of linseed and walnut oils. Moreover, by GC, there was some evidence for poorly resolved components in the general diterpenoid region of paint from a brownish, heavily crackled paint on the robe (sample 1). A portion of this sample has been reserved for future examination by GC-MS.

7. One sample was taken from Caravaggio’s *Boy bitten by a Lizard* (NG 6504), a cool highlight of a white drape. FTIR-microscopy clearly indicated a proteinaceous component among the drying glycerides of the binder in the same layer. Thus one must conclude the presence of some form of egg/oil emulsion. GC revealed a significant amount of dimethyl azelate component, relative to methyl palmitate, but with an obvious dilution of the drying oil by non-drying fats. The palmitate/stearate ratio was in the upper range of that expected for walnut oil. Thus the drying oil component is likely to be walnut rather than linseed oil.

8. Sample 3, a red glaze-paint, was found to contain some pine resin by GC.

**9.** A fragment of a non-original blue background was examined by GC only. The sample taken was a light scraping to avoid material from a lower varnish and paint layer below. The results suggested that a heat-bodied poppyseed oil had been used as medium. The overall chromatogram indicated some measure of maturity and probably represents an eighteenth-century overpaint. Original paint from the dark cloak of the sitter was identified as bound in linseed oil.<sup>7</sup>

**10.** Sample 1 was considered a possible candidate for a copper resinate green paint which had browned. Neither GC nor FTIR microscopy was able to demonstrate any presence of resin within. However, GC revealed the use of a heat-bodied drying oil.<sup>8</sup> In this case the P/S ratio confirmed linseed oil. Hence the darkening would seem to result from the darkening of the oil medium alone. Similarly a warm white paint of a distant cloud and a sample of earth were identified as being bound in linseed oil medium; on this occasion it was not heat pre-polymerised.

**11.** GC confirmed the presence of walnut oil, much as had been identified in a sample of blue paint at the previous investigation some years ago.<sup>9</sup> The chromatogram hinted at the presence of dehydroabietic ester, but was not sufficiently clear for the unambiguous identification of pine resin. FTIR using the IR microscope in transmittance mode (on a thin section cut from a sample embedded in silver chloride) did suggest the presence of a resinate pigment.

**12.** Here the question had been posed as to whether there might be copper resinate in the green background. GC of the principal paint layer only indicated the use of linseed oil paint medium. A sample of black paint from the dress also contained linseed oil, but this time it had been heat pre-polymerised. FTIR results for these two samples were rather disappointing, but once again there was no evidence for resin in the medium.

**13.** A rich black paint of the helmet provided a gas-chromatogram which suggested the use of linseed oil and some diterpenoid resin. In particular, one component had the same retention time as larixyl acetate<sup>10–12</sup> and so it would seem that larch resin (Venetian turpentine) is indicated. This was further supported by FTIR-IR microscopy.

**14.** Linseed oil was identified in both samples and neither medium appeared to have been subjected to heat-bodilying or to contain resin. The amount of dimethyl azelate component in the sample of black paint (sample 2) was slightly less than that of methyl palmitate, though not seriously so. Although this was more likely to be the result of the ageing pattern associated with the black pigments rather than an input of egg tempera medium, it was decided to check this by FTIR microscopy. No evidence for proteinaceous content was found.

**15.** Samples 2 and 3 showed evidence for heat pre-polymerisation, with the brownish-black paint containing traces of pine resin too.

**16.** Sample 3, a dark brown shadow, showed signs of 7-oxodehydroabietic ester in its chromatogram, suggesting an addition of pine resin in this instance.

**17.** The interpretation of the P/S ratios for samples 2, 3 and 6 follows the guidelines as set out in Note 23 below.

**18.** During the course of cleaning and reassembling the sections of this work<sup>13</sup> a sample of blue sky was identified as being bound in a very lean poppyseed oil medium. This would help to explain the vulnerability of this layer. Remnants of a greyish, unpigmented surface coating between the paint and varnish were identified as a somewhat immature walnut oil. This represented most probably the remnants of an oiling-out layer.

Samples of white and dark green paints from fragment NG 3294C, examined and reported upon earlier,<sup>14</sup> had P/S ratios of 3.0 and 3.5 suggestive of the use either of walnut oil or, and more likely, a mixture of poppyseed and linseed oils. Similar P/S ratios (3.0, 3.9 and 3.4) were reported from two other paintings by Manet (*Déjeuner sur l'herbe* and *Le Balcon*) both in the Louvre.<sup>15</sup>

**19.** NG 6395 provided two paint samples which exhibited low azelate/suberate ratios and so provide evidence of heat pre-polymerisation. These were samples 2 (upper ground) and 4 (white impasto highlight). Sample 3 (dark green) gave an ambivalent P/S ratio bordering on the overlap areas of poppyseed and walnut oils, but is most likely to represent the former. Sample 3 of NG 3262 contained a little pine resin mixed with the walnut oil.

**20.** A white impasto from *The Côte des Boeufs at l'Hermitage* (NG 4197) at first sight seemed to contain some non-drying egg fats. However, there was no evidence for protein associated with egg tempera and so it must be concluded that either a non-drying oil or fat (but not castor oil in this case — see Note 21) had been added to the main drying oil component. This of course would affect the P/S ratio somewhat and makes the identity of the drying oil difficult to ascertain. Since the ratio was towards the upper limit of the walnut region, we may postulate the use of walnut or possibly poppyseed oil. Sample 4 contained vermilion, a very heavy pigment which tends to settle within the medium when such paint is stored in tubes and when painted out is inclined to settle and leave an oil-rich surface to the paint layer. In this sample, the medium was found to contain a little beeswax in addition to the oil. This would thicken the medium and reduce the tendency for the vermilion to settle before the oil has gelled sufficiently to fix the particles in place.

**21.** In NG 3859, the ground and dark blue paints showed evidence of heat prepolymerisation of the linseed oil, whereas the white paint did not. All showed evidence of the inclusion of pine resin.

A white highlight from *Boating on the Seine* (NG 6478) contained heat-bodied poppyseed oil. Sample 3 — blue paint from the foreground — was identified as linseed oil mixed with a little non-drying oil. This would suggest a commercially prepared paint, the purpose of the non-drying oil (identified as castor oil by the presence of methyl ricinoleate) being to retard the drying of the oil, prevent the paint from hardening in the tube and, perhaps, to provide a plasticiser.

**22.** Here both samples 2 and 3 contained some diterpenoid resin components but not pine resin, rather some form of hard copal.

**23.** Media analyses were carried out on a range of paintings by Impressionists and an outline only of the results was published.<sup>16</sup> In all, 61 samples have been examined, of which (approximately) 31% were based on poppy oil, 34% on linseed oil, 23% on walnut oil and, possibly, 11% on a mixture of poppy and linseed oils. About 10% of this group contained additives in the form of pine resin diterpenoids and 8% had a stand or 'fat' oil component, that is to say, an oil which has been heat prepolymerised or heat-bodied.

Some comments on interpretation of 'walnut region' palmitic-to-stearic ester ratios (c.2.2–3.3) should be made at this point in relation to the results below. Several paintings contain poppyseed oil and linseed oil in the same work, these being used with different colours. In such cases, where areas of paint give fatty ester ratios intermediate between the two extremes, the results have been cautiously interpreted as 'poppy + linseed oil mixture'. It is, however, a reasonable first assumption that those pictures with samples which indicate consistently the presence of walnut oil, or walnut oil with only one of the other oils, are less likely to contain mixtures of linseed and poppyseed. So here the results obtained have been attributed to the presence of walnut oil rather than mixtures of linseed and poppyseed oils. Such is the case with NG 4136.

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