

# National Gallery Technical Bulletin

Volume 9, 1985

Published by Order of the Trustees,  
Publications Department,  
National Gallery, London

National Gallery  
Technical Bulletin

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ISBN 0 901791 97 0

ISSN 0140 – 7430

Designed by James Shurmer

Printed by Westerham Press,  
Westerham, Kent

# The Palettes of Three Impressionist Paintings

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In Volume 5 of the *Technical Bulletin* we reported an analysis of the materials of an early painting by Monet [1]. At that time rather little work had been done in the National Gallery on the painting methods of the Impressionists. Since then it has been possible to take a small number of paint samples for analysis from a second painting by Monet, a Renoir river scene, both recent acquisitions [2], and also from a Cézanne landscape [3] to extend our study of the materials of later nineteenth century French painting which has continued with some recent work on Manet's *Waitress* [4]. The three paintings are: Monet's *Gare St Lazare* (No.6479, Fig.1 and Plate 1, p.18), Renoir's *The Seine at Asnières* (also called 'La Yole', No.6478, Plate 3, p.18) and Cézanne's *Mountains in Provence* (No. 4136, Plate 5, p.18).

The Monet and Renoir are close in date, whilst the Cézanne is rather later (see below). Although more or less similar palettes of mainly nineteenth century pigments are used in the three paintings, there are striking differences both in the manner of painting and the use of colour.

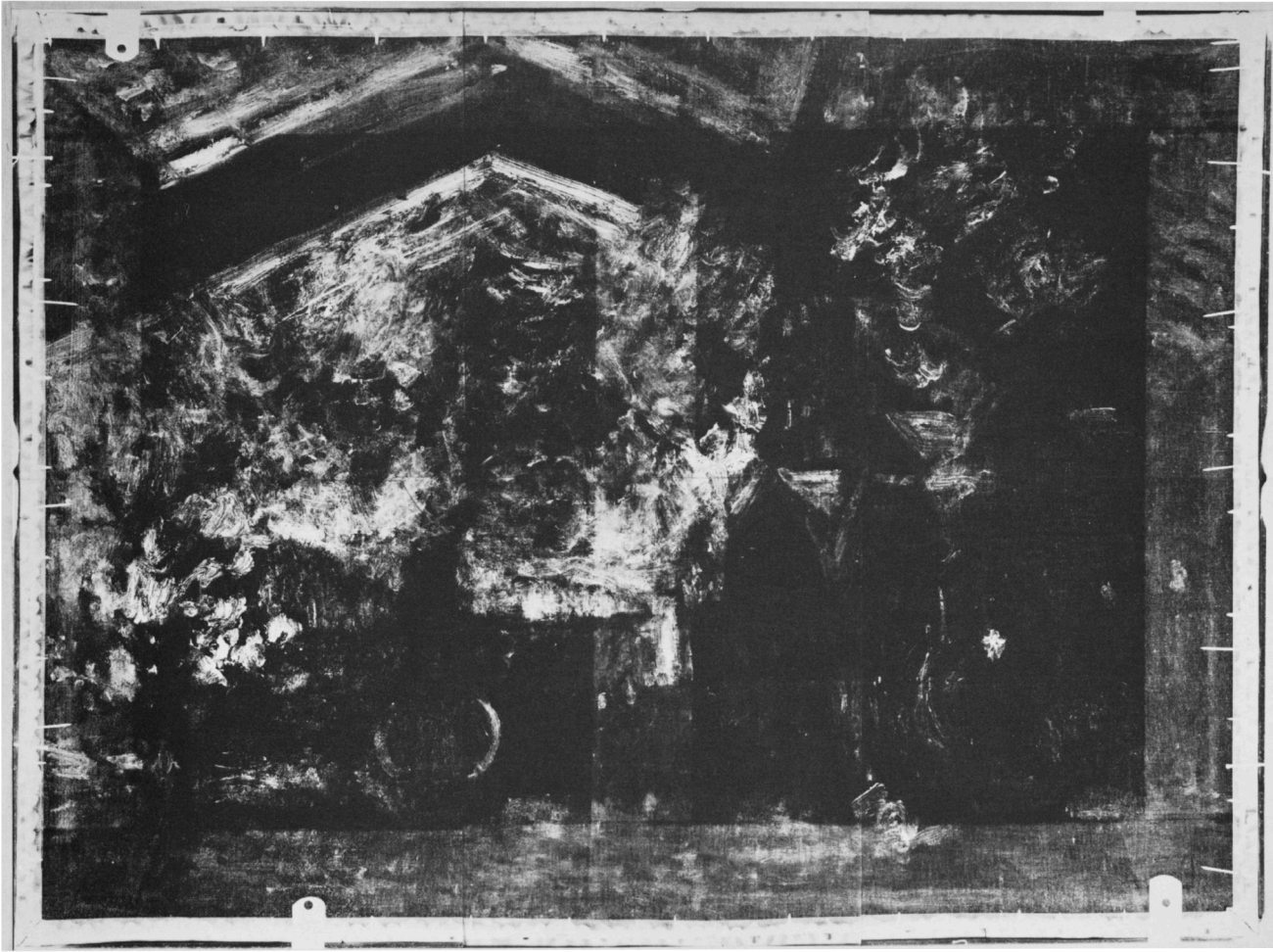
Monet's *Gare St Lazare* and Renoir's 'La Yole' are in some ways classic examples of Impressionist execution:

the paint is applied wet-into-wet on a pure white or off-white ground with some mixing of paint on the canvas. In both paintings the light-coloured ground is used as a device to intensify the overall luminosity of the scene. While Renoir employs superimposed strokes of intense pure colour, often containing only a single pigment or tint, Monet's paints are complicated mixtures of disparate pigments. In contrast the Cézanne landscape is technically more organized, showing evidence of an underdrawing on the canvas and thinner superimposed independent paint layers, with the more thickly applied paint restricted to emphasis of linear elements in the design. Here too though the pale cream ground is left exposed particularly in the sky and foreground, and functions as part of the overall colour composition.

The palettes used in the three paintings are recorded below. Pigment identifications were made using a combination of optical microscopy of samples in incident and transmitted light, together with spectrographic analysis using the laser microprobe (LMA). X-ray diffraction analysis (XRD) proved particularly helpful in providing firm identifications for pure colour samples, and ground materials.



**Figure 1** Monet, *The Gare St Lazare* (No. 6479), after cleaning and restoration.



**Figure 2**  
Monet,  
*The Gare St Lazare*  
(No. 6479),  
composite  
X-radiograph.

### 1. No. 6479, Monet's 'Gare St Lazare'

*Date:* Painted at the Gare St Lazare in 1877 as one of four canvases depicting the interior [5] of the newly built station, and shown with the associated paintings at the third Impressionist exhibition in the same year.

*Support and ground:* Canvas,  $21\frac{3}{4} \times 28\frac{1}{4}$  (0.55 × 0.72). The light buff ground was analysed by XRD and found to contain lead white as the main component [6].

*Materials and technique:* The principal pigments used can be listed as follows:

*Lead white* (basic lead carbonate,  $2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$ ), *cobalt blue* (cobalt aluminate,  $\text{CoO} \cdot \text{Al}_2\text{O}_3$ ), *cerulean blue* (cobalt stannate,  $2\text{CoO} \cdot \text{SnO}_2$ ), *synthetic ultramarine* ( $\text{Na}_{8-10}\text{Al}_6\text{Si}_6\text{O}_{24}\text{S}_{2-4}$ ), *emerald green* (copper acetoarsenite,  $\text{Cu}(\text{CH}_3\text{COO})_2 \cdot 3\text{Cu}(\text{AsO}_2)_2$ ), *viridian* (hydrated chromium (III) oxide,  $\text{Cr}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ ), *vermilion* (mercuric sulphide,  $\text{HgS}$ ), and a *red lake* pigment (see Table).

In almost all the samples taken a selection of this palette is present in widely varying proportions, with certain of the paints containing in addition a very few particles of an unidentified yellow, probably chrome [7], and occasional particles of a black pigment. Table 1 shows how this range of pigments is distributed in the samples. The most common mixture is some combination of cobalt and cerulean blue, emerald green and viridian, red lake and vermilion, all mixed with a little white (see for example Plate 2a, p.18). Paint mixtures of this

complexity bear comparison with those found to have been used by Manet for his painting of the National Gallery *Waitress* [8], and must result from some mixing of wet paint on the canvas itself. Exceptionally, the brilliant scarlet touches picking out the passengers boarding the train are pure vermilion. It is clear from the handling of the paint and from the X-radiograph (Fig.2) that the scene was recorded rapidly, and although we know that Monet successfully demanded that the trains be stopped while he worked [9] there must have been some limit to the patience of the railway authorities.

Cerulean blue, not present in Monet's earlier painting [10], was quite a new introduction in 1877 [11] and although the well-proven pigment cobalt blue is used freely, most of the blue paint samples contain mixtures of the two and sometimes also incorporate a proportion of synthetic ultramarine, for example in the deep shadows of the station canopy. From this area, a sufficiently pure sample of cerulean blue could be extracted to be initially identified by LMA and confirmed with a powder diffraction pattern [12]. Although intense rather greenish blues are a significant feature of this particular representation of the Gare St Lazare, no Prussian blue seems to have been used; in the *Bathers at La Grenouillère* (No.6456) however this pigment forms the most saturated dark blue touches [13]. Cerulean probably offered a pigment of sufficiently greenish tone to displace Prussian blue, which may not have been popular by this time

**Table 1** Pigment mixtures used in Monet's *Gare St Lazare*.

Sample	Pigment composition <sup>1</sup>		
	Major	Minor	Trace
Purple shadow of canopy	red lake <sup>2</sup>	cobalt blue cerulean blue ultramarine viridian emerald green	vermilion (ivory black) <sup>4</sup>
Purple-red edge of roof beam (Plate 2b, p.18)	red lake		lead white
Opaque red-brown middle tone of canopy	vermilion	cobalt blue cerulean blue viridian emerald green	red lake yellow <sup>5</sup> (ivory black)
Dark blue shadow of canopy (Plate 2a, p.18)	cerulean blue <sup>3</sup> cobalt blue	ultramarine viridian emerald green	lead white red lake vermilion (ivory black)
Intense blue of roof beam	cobalt blue <sup>3</sup>	ultramarine cerulean blue	lead white viridian
Dark greenish black shadow of canopy	viridian cobalt blue cerulean blue vermilion	emerald green	lead white red lake (yellow)
Mid-tone blue of steam	lead white cobalt blue cerulean blue	viridian emerald green	ultramarine red lake
Light mauve of steam	lead white	cobalt blue vermilion	cerulean blue viridian red lake (ivory black)
White of steam	lead white <sup>3</sup>		cobalt blue red lake
Very dark purple of l.h. locomotive	red lake	cerulean blue viridian vermilion	lead white cobalt blue ultramarine (ivory black)
Blue-green near funnel of l.h. locomotive	cerulean blue	cobalt blue viridian	lead white vermilion (ivory black)
Dull purple-red of figure boarding train	red lake		cerulean blue
Dull grey-green patch, foreground	lead white	cerulean blue viridian	ultramarine vermilion red lake yellow ivory black

**Notes to the Table**

A number of the above samples were analysed with the laser microprobe (LMA), and average analyses of heterogeneous mixtures recorded. The resulting spectra are complex but it is possible to combine the results with microscopical examination and XRD confirmation for two of the blue pigments to deduce the pigment mixtures present. The characteristic elements detected for the pigments were as follows: lead white (Pb); cobalt blue (Co, Al); cerulean blue (Co, Sn); ultramarine (Al, Si); emerald green (Cu, As); viridian (Cr); vermilion (Hg); red lake substrate (Al, Sn).

1. The chemical identity of the pigments listed is given in the text.
2. HPLC suggests a synthetic red dyestuff.
3. Identity confirmed by XRD.
4. Where brackets are used for the incorporation of black pigment, only one or two particles were evident in the sample. Microscopically the pigment seems closest to ivory (bone) black than to the other possibilities.
5. Unidentified crystalline yellow, possibly chrome yellow.

[14], extra intensity resulting from the addition of synthetic ultramarine.

It is clear from both microscopical examination of dispersed mounts and from spectrographic analyses that in samples containing green pigment, viridian (transparent chromium oxide) and emerald green (copper acetoarsenite) are used together, a combination also found in Monet's *Bathers* [15] and in the present Cézanne landscape (see below), but not in Renoir's '*La Yole*' where viridian alone occurs. Cézanne and Renoir list both pigments as separate constituents of their palettes [16] although in colour one or the other would probably have been sufficient. There remains the possibility that mixtures of the two greens were manufactured, or that the names under which they were sold was not always a reliable guide to their chemical composition.

It can be seen from the Table that a red lake pigment is present in many of the paint mixtures, but a particularly intense rather pure streak can be seen to mark the edge of the roof beam to the right. This red lake shows a strong orange and blue irregular UV-fluorescence under the microscope (Plate 2b, p.18), an unusual effect also observed previously in a red lake sample from Manet's *Waitress* [17]. The *Gare St Lazare* sample appears to contain the same lake or mixture of lakes on a substrate containing both aluminium and tin, detected by LMA, also noted in the Manet example [18]. Preliminary analysis of two samples by R. White with high-performance liquid chromatography (HPLC) indicates the use of a synthetic red dyestuff.

Whether the Impressionist painters omitted black from their palettes has been a matter of speculation [19]. For this picture Monet seems to have compromised and used just a little black pigment to darken some of the shadow mixtures although in none of the samples examined was the content more than a trace (see Table). Apart from the swirls of smoke and steam the overall tonality of the National Gallery *Gare St Lazare* is sombre, but even in the intense virtually black paint of the locomotives and the depths of the station canopy very little black pigment is actually present. Instead these areas are a very dark purple or an intense deep blue. In the locomotives both dark shades are employed side by side, in the canopy the warmer shadow predominates to the right, the cooler to the left. Monet seems to have evolved a sort of universal dark tone made up of almost the whole range of his palette. The resulting cast, whether a dark tone tinged with purple or with a bluish green is determined by the dominant colour in the mixture, in this case either the red lake pigment or the cerulean/cobalt blue combination (see Plate 2a, p.18). The steam and smoke at the other extreme of the tonal range are painted in similar pigment combinations, but these passages contain large amounts of lead white (Fig.2) tinted with small quantities of blue, green and red pigment.

Monet's painting method for the *Gare St Lazare*, with its concentration on the effects of atmosphere on light, his adoption of a continuously variable and complex mixture of pigment to express the full range of colour and illumination, and the evident speed and vigour of execution, illustrate some of the more theoretical aspects

of Impressionist technique. In the decade when the Movement was at its most experimental, it is perhaps characteristic that Monet should have chosen such a challenging subject to explore the technical limits of the new method of painting.

## 2. No.6478, Renoir's '*The Seine at Asnières*'

*Date:* This scene was painted perhaps in 1879 about ten years after Renoir and Monet had worked together painting the river at La Grenouillère [20]. In their earlier outdoor paintings there is no doubt that they worked *sur le motif*, but it is not known whether No.6478 was painted at Asnières or in the studio. By the early 1880s, after visits to Italy and North Africa, Renoir had modified his style and method of painting, and '*La Yole*' represents one of his last pictures of a much favoured Impressionist subject treated using the paint handling techniques of Impressionism.

*Support and ground:* Canvas,  $28 \times 36\frac{1}{4}$  ( $0.71 \times 0.92$ ). The light-coloured ground consists principally of lead white detected in a sample by XRD and LMA.

*Materials and technique:* Renoir's palette for '*La Yole*' is deduced from the samples to be as follows:

*Lead white, cobalt blue, viridian, chrome yellow* (lead chromate,  $\text{PbCrO}_4$ ), '*lemon*' yellow (strontium chromate,  $\text{SrCrO}_4$ ), *chrome orange* (basic lead chromate,  $\text{PbCrO}_4 \cdot \text{Pb}(\text{OH})_2$ ), *vermilion*, and a *crimson lake* pigment.

This selection with the exceptions of the chrome orange and 'lemon' yellow are recorded in Renoir's notebook in an entry which dates from his early Impressionist period [21]. There is no mention of a black pigment at this stage in his career [22]. A comparable range of colours has been found by Marigene H. Butler for a group of paintings dating between 1875–1919 [23] which show some variation in palette over a long period, but the consistent use of cobalt blue and vermilion in all the pictures analysed.

Table 2 shows how specific pigments are used in No.6478, and also notes the means of their identification.

The adoption of chrome pigments for '*La Yole*' is interesting. In the biography of his father, Jean Renoir says that he never saw him use chrome yellow [24], and indeed it does seem to be absent from the paintings of the 1880s onwards [25]. He also mentions that there was no rigid choice of palette, but that Renoir was suspicious of newly-introduced materials [26].

His working method was said to be scrupulous, and there is confirmation of this in the use of paint for '*La Yole*', probably more easily achieved in the studio than in the open air. In complete contrast to Monet's station picture, dabs and even quite large patches of almost unmixed pigments are used, except of course where colour is mixed in tint, for example in the delicate pinks of the woman passenger's clothes where vermilion and white are combined. Where pigment mixtures do occur, generally a second colour is introduced to effect some minor adjustment in the tone of the principal component; the use of a small quantity of viridian to modify the chrome yellow of the yellow-green areas of foliage is an example. The relative lack of involved

**Table 2** Pigment occurrences in Renoir's *The Seine at Asnières ('La Yole')*.

Sample	Pigment/s <sup>1</sup>	Main spectrographic lines (LMA) <sup>2</sup>	Agreement with JCPDS file No. (XRD)
White cloud, top edge	lead white		[13–131]
Deepest blue of water	cobalt blue + lead white	Pb, Al, Co	[10–458] + [13–131]
Mid-blue of water	cobalt blue + lead white		
Lightest blue of water	lead white + cobalt blue <sup>3</sup>	Pb, Al, Co	
Mauve of water, r.h. edge	red lake <sup>3,4</sup>	Al	
Yellow impasto on water	chrome yellow	Pb, Cr	[8–209]
Pink highlight on water	lead white + vermilion	Pb, Hg	
Intense green of reeds	viridian <sup>3</sup>	Cr	non-crystalline
Yellow-green of reeds	viridian <sup>3</sup> + chrome yellow	Pb, Cr	
Light yellow-green of reeds	chrome yellow + viridian <sup>3</sup> + lead white	Pb, Cr	
Yellow-green foliage, top edge <sup>5</sup>	chrome yellow + 'lemon' yellow <sup>6</sup>	Pb, Sr, Cr	[8–209] + [15–368]
Orange foliage, top edge	chrome orange	Pb, Cr	[8–437]
Brownish yellow of skiff	'lemon' yellow + chrome yellow	Pb, Sr, Cr	[15–368] + [8–209]
Pink of woman's costume	lead white + vermilion <sup>3</sup>		

**Notes to the Table**

1. The main pigment is listed first.
2. Strong lines were detected for the elements listed. Certain of the spectra showed weaker lines for other elements, particularly aluminium and silicon arising perhaps from small quantities of inert filler materials in the paint.
3. Microscopical identification combined with elemental or crystallographic confirmation in similar samples.
4. HPLC suggests a synthetic dyestuff.
5. In dispersed samples at high magnification two crystallite types are present: fine slender rods of 2–5  $\mu$  length, and small rounded particles of about 2  $\mu$  diameter. These presumably represent the two chrome pigments used; the rod-like particles are similar to reference mounts of lead chromate.
6. 'Lemon' yellow is associated with either the chromate of strontium or of barium. Only strontium was detected in the samples by LMA.

pigment mixtures has also been noted by Butler [23]. Of course since *'La Yole'* is painted wet-into-wet, as the brushstrokes merge patches of colour intermingle within the streaks drawn out by the brush, but the intention seems to be more the Impressionist concept of optical colour mixing rather than of the physical combination of paints to produce some desired colour effect. This particularly is the technique for the key elements of the picture: the boat and its occupants, the river and the reflections on the water's surface as well as the bank of vegetation in the foreground. The paint is thickly applied in superimposed and adjoining strokes of rather pure colour. Short, dry brushstrokes are dragged over the surface to represent the orange reflections of the boat over the deep blue of the water (Plate 4, p.18). Elsewhere the paint was applied with greater fluidity, as in the foreground bank of reeds, but the individual brushstrokes remain clearly discernible. For the more recessive parts of the composition — the sky and distant river bank, the villa and railway bridge — the paint is much thinner and flatter and made up of palette mixtures which necessarily produce softer more gradual tones than those of the foreground.

In addition to attempting the optical mixture of

colour, by juxtaposing in the central subjects of the painting the orange of the skiff and the extensive blue of the river, Renoir seems to apply one of the fundamental ideas of the colour theory which most influenced Impressionist thinking. This was called the 'law of simultaneous contrast', advanced by Michel-Eugène Chevreul [27] in 1839, but it is curious that the principle should be so clearly expressed in a Renoir composition since of his circle he was probably the least interested in the formal application of colour theory to painting. On the Chevreul colour wheel, orange and blue are placed in opposition and when seen as adjacent colours the 'height of tone' (intensity) and 'colour property' (hue) of each are, according to the theory, perceived as mutually enhanced. The choice of pink for the dress of the woman reading in the skiff similarly exploits another of Chevreul's ideas that by placing a tint of colour, in this case red, next to a colour adjacent to it on the colour wheel, here orange, results in an emphasis of contrast between the two.

**Table 3** Paint composition in Cézanne's *Mountains in Provence*.

Sample	Composition <sup>1</sup>
Mid-tone blue of sky, top edge right	Lead white + ultramarine
Pale turquoise sky, top edge, left	Lead white + ultramarine and emerald green in equal proportions
Brilliant green foliage, r.h. edge (Plate 6b, p.18)	Emerald green <sup>2,3</sup> + a little viridian
Brilliant green field, middle distance	Emerald green + a little viridian
Yellow-green grass, edge of path, r.h. edge	Yellow lake glaze <sup>3</sup> over lead white + viridian <sup>4</sup>
Rose-mauve patch, middle distance, r.h. edge	Lead white + vermilion and trace of ultramarine
Bluish mauve patch, middle distance, r.h. edge	Lead white + ultramarine, with a little vermilion and a few particles of emerald green
Grey-blue horizon, r.h. edge	Lead white + ultramarine, with a little vermilion and black pigment <sup>4</sup>
Intense dark blue shadow between rocks, centre left (Plate 6a, p.18)	Ultramarine, some lead white and a little black pigment <sup>4</sup>
Thin brown 'wash' on foreground rocks <sup>3</sup>	Yellow and yellow-brown earth pigment mixed with a yellow lake glaze and a trace of vermilion
Straw-coloured foreground, r.h. edge	Thin yellow glaze + a little vermilion and black pigment

1. Based principally on microscopy of cross-sections and unmounted samples.

2. XRD

3. LMA

4. A few particles of other coloured pigments are present in these samples.

### 3. No.4136, Cézanne's 'Mountains in Provence'

*Date:* From the late 1870s Cézanne spent much of his time in the South, at l'Estaque on the coast or near Aix. The National Gallery painting dates from around 1886, and although evidently painted in Provence, the precise location is uncertain [28].

*Support and ground:* Canvas, 24 $\frac{3}{4}$  × 31 (0.63 × 0.79). Analysis by XRD and LMA of the cream-coloured ground showed it to contain lead white, a trace of earth pigments and possibly also some barium sulphate extender [29].

*Materials and technique:* Cézanne's landscape is painted with an apparent simplicity and assurance characteristic of many of the artist's Provençal scenes of the late 1870s and 1880s. Quite thinly applied blocks of colour are hatched in for the middle distance hillside overlapping only here and there, while the sky and foreground are very lightly applied leaving partially exposed the cream ground. Only the path's rocky border and its surmounting vegetation are more thickly elaborated, mainly in the treatment of the shadows between the slabs of rock and in the darker parts of the trees.

The narrow outlines used to pick out the principal forms in the landscape are amongst the thickest use of paint in the picture and might be described as drawing with the paintbrush, an emphasis which accords with Cézanne's insistence that drawing and painting are inseparable activities [30]. Apart from the definition of the edges in the composition in lines of paint, there is evidence from paint cross-sections for an initial sketch on the canvas probably in pencil [31]. Vestiges of a preliminary drawing may also be seen through the thin-

nest paint on the picture itself, most clearly where the highest distant hillside meet the skyline to the right.

The pigments Cézanne chose for *Mountains in Provence* can be determined from a fairly limited range of samples. The palette is:

*Lead white, synthetic ultramarine, emerald green, viridian, vermilion, yellow and yellow-brown natural earth pigments* (hydrated ferric oxide), and a *yellow glazing pigment* (see text).

Both single pigment colours and colour mixtures are used (see Table 3), the most complicated of which occur in the deep shadows between the rocks (Plate 6a, p.18). The darkest tones tend to contain synthetic ultramarine and only occasionally are a few particles of black pigment present, probably of ivory (bone) black.

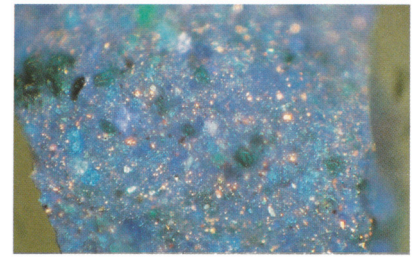
Synthetic ultramarine is the only blue used and occurs in tint for the pale blue sky, the paint containing in addition a proportion of emerald green in the turquoise right-hand corner. Virtually pure emerald green, confirmed by XRD and LMA, is used for the brilliant green fields in the middle distance, but contains also a trace of viridian evident from microscopic examination and from the spectrographic detection of chromium in addition to copper and arsenic in a sample (see Plate 6b, p.18).

The brownish yellow of the track and its bordering rocks and also of the hillside fields are painted in natural earth pigments, in places subtly modified with vermilion, or a few particles of black, ultramarine or viridian. No red earth pigment was found, and the only red employed is vermilion of fairly large particle size, as a constituent for example of the mauvish grey rocks and of the line of the horizon. The rose-mauve patches incorporate vermilion, white and varying degrees of artificial ultramarine, as well as traces of emerald green.



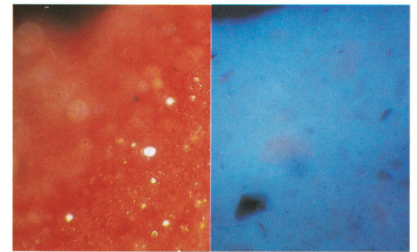


**Plate 1** Monet, *The Gare St Lazare* (No. 6479), after cleaning and restoration.



a

140x



b

**Plate 2** (see facing page)



**Plate 3** Renoir, *The Seine at Asnières* (No. 6478), after cleaning and restoration.



**Plate 4** (see facing page)

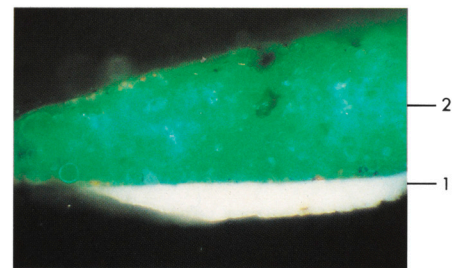


**Plate 5** Cézanne, *Mountains in Provence* (No. 4136), after cleaning and restoration.



a

150x



b

150x

**Plate 6** (see facing page)

**Plate 2** Monet, *The Gare St Lazare* (No. 6479), photomicrographs of paint samples.

**(a)** Dark blue shadow of station canopy. Top surface of paint sample, photographed in reflected light at 220 ×  
A highly heterogenous mixture of pigments is used, principally cerulean and cobalt blue with artificial ultramarine, viridian and emerald green. The darkest green particles are viridian. Red lake pigment is also visible in the sample.

**(b)** Purple-red edge of roof beam. *Left:* top surface of paint sample mainly red lake pigment, photographed in reflected light at 220 ×  
*Right:* the same sample photographed in UV light under the microscope to show the strong varicoloured fluorescence of the red lake pigment. Filters UG1 and K430, 220 ×, 27 seconds exposure.

**Plate 4** Renoir, *The Seine at Asnières* (No. 6478), detail of the brushwork of the water.

**Plate 6** Cézanne, *Mountains in Provence* (No. 4136), photomicrographs of paint cross-sections, photographed in reflected light at 220 × magnification; actual magnification on the printed page shown opposite.

**(a)** Intense dark blue shadow between rocks.

1. Ground layer, mainly lead white.
2. Trace of underdrawing, probably in pencil.
3. Background colour of the rocks, warm light brown, comprising lead white, vermilion and a little emerald green. There may also be a trace of red lake pigment.
4. Dark blue shadow: artificial ultramarine, a little lead white and some black pigment. There are also a few scattered particles of other colours.

**(b)** Brilliant green foliage, right-hand edge.

1. Ground layer, mainly lead white.
2. Impasto streak of foliage: largely emerald green with a few darker particles of viridian. The spherical particle form of copper acetoarsenite can be seen in one particle near the base of the layer. A very thin underpaint containing artificial ultramarine and a little earth pigment is just evident on top of the ground.

It is unusual in a picture of this date to find glazing pigments used to modify surface colour. There is evidence for a transparent yellow, probably a lake, in certain areas notably as the final layer of the yellow-green grass by the path's edge. An opaque underpaint consisting mainly of white, viridian and a few particles of synthetic ultramarine carries on top a translucent lemon yellow glaze rich in aluminium [32]. Touches of similar appearance can be seen in other parts of the picture and probably result from adjustments to the final tonal composition in the studio. A yellow lake seems also to have been mixed with earth pigments for the thin straw-coloured paint of the foreground.

Cézanne produced many pictures of the scenery around Aix and their visual coherence as a group suggests a formula in working method, particularly in colour and paint manipulation, and probably the choice of a familiar palette. A painting belonging to the Minneapolis Museum of Art, *Chestnut Trees*, dated 1885–86 has also been sampled and analysed by Marigene H. Butler [33] and her findings of pigment choice and of pigment mixtures bear a close resemblance to those in the National Gallery landscape, despite their difference in scale of subject matter. It seems that once the working method had been refined the principal interest became the form and underlying structure of the landscape.

It was Cézanne's ambition to make of Impressionism 'something solid and durable' [34]. To this end he developed a manner of working more formalized and traditional than that of his Impressionist associates of the 1870s, using drawing, reworking the composition of landscapes in the studio and employing glazing pigments to modify colour, but retaining the higher key palette closer to Monet and Renoir than to Corot and Courbet. In his painting practice too, he produced pictures which were also technically solid and durable.

### Acknowledgements

I would like to thank Michael Wilson, Deputy Keeper at the National Gallery for a most useful discussion of the three paintings and for his comments. I am also grateful to Marigene H. Butler, Head of Conservation at the Philadelphia Museum of Art for sending me her excellent and comprehensive study of Cézanne's painting materials.

### Notes and references

1. WILSON, M., WYLD, M. and ROY, A., 'Monet's "Bathers at La Grenouillère"', *National Gallery Technical Bulletin*, 5 (1981), pp.22–5.
2. The two paintings were cleaned in the Conservation Department of the National Gallery on acquisition in 1982, the Monet by Martin Wyld, and the Renoir by David Bomford.
3. Although Cézanne's identification with the Impressionist Movement is based on his early career and friendship with Pissarro, there is some reason to regard Impressionism as a continuing influence on his later landscape painting technique.  
The painting was cleaned by David Bomford in 1981.

4. BOMFORD, D. and ROY, A., 'Manet's "The Waitress": An Investigation into its Origin and Development', *National Gallery Technical Bulletin*, **7** (1983), pp.13–19.
5. The three other interior scenes of the Gare St Lazare are in Paris (Louvre, Jeu de Paume), Chicago (The Art Institute of Chicago) and Cambridge, Mass. (Fogg Art Museum). Three further canvases showing the station yard were also exhibited by Monet in 1877.
6. JCPDS file No.13–131. LMA showed the presence of lead with lesser quantities of iron and barium. The canvas probably carries a commercial priming.
7. Chrome yellow is suggested solely from its microscopical appearance since insufficient material was available for chemical analysis. The dull greenish patches in the foreground and elsewhere probably contain the pigment.
8. See BOMFORD and ROY, *op. cit.*, pp.13–14.
9. The anecdote is recounted in RENOIR, Jean, *Renoir, My Father* (trans. R. and D. Weaver), Collins (London 1962), pp. 157–8.
10. WILSON, WYLD and ROY, *op. cit.*, p.23.
11. Although discovered early in the century, cerulean blue only appears as an artists' pigment around 1860. The blue was also noted to have been used by Manet for 'The Waitress' (No.3858) painted in 1878, see BOMFORD and ROY, *op. cit.*, p.15.
12. The eight strongest lines in Angstroms of the XRD pattern for cerulean blue (cobalt stannate) are: 4.99 (30), 3.06 (20), **2.61** (100), 2.49 (20), **2.16** (30), 1.66 (30), **1.53** (50), 1.12 (20). Relative intensities in brackets. See JCPDS file No.29 – 514. LMA showed the presence of cobalt and tin.
13. WILSON, WYLD and ROY, *op. cit.*, p.23 and Plate 2b, p.25.
14. See for example Renoir's antipathy to Prussian blue quoted in VOLLARD, A., 'Les Théories "Impressionnistes"', *Auguste Renoir*, G. Crès (Paris 1920), pp.126–7.
15. WILSON, WYLD and ROY, *op. cit.*, p.23 and Note 8, p.24.
16. The list of colours used by Cézanne is given by REWALD, J., in *Cézanne*, Albin Michel (Paris 1939), p.404. Renoir's Impressionist period palette is noted by his son. See RENOIR, Jean, *op. cit.*, plate facing p.209 and p.342. In both cases emerald green (copper acetoarsenite) is to be identified with Veronese green in the colour lists.
17. BOMFORD and ROY, *op. cit.*, p.16.
18. *ibid.*
19. See for example CALLEN, A., *Techniques of the Impressionists*, Orbis (London 1982), p.58.
20. WILSON, WYLD and ROY, *op. cit.*, pp.14–18.
21. See Note 16 above.
22. See RENOIR, Jean, *op. cit.*, p.342.  
Even the signature on 'La Yole' although very dark seems not to be in black paint. Both the signature and the darkest touches on the hair of the woman rowing show fairly high reflectance in an infra-red photograph.
23. BUTLER, M. H., 'Technical Note' in *Paintings by Renoir*, Catalogue of the exhibition in Chicago, 1973, The Art Institute of Chicago (Chicago 1973), pp.210–11.
24. RENOIR, Jean, *op. cit.*, p.342.
25. See BUTLER, *op. cit.*, p.211. Naples yellow (lead antimonate) seems to have replaced chrome yellow in the later paintings.
26. RENOIR, Jean, *op. cit.*, p.344.
27. *De la loi du contraste simultané des couleurs* (Paris 1839).
28. In 1886 Cézanne was living in Gardanne just south of Aix-en-Provence. See DAVIES, M., *National Gallery Catalogues: The French School*, revised by Cecil Gould (London 1970), p.18.
29. In addition to lead, LMA showed the presence of iron, silicon, aluminium and barium in a sample of ground.
30. See DORAN, P. M. (ed.), *Conversations avec Cézanne*, Collection Macula (Paris 1978), p.16 and pp.36–7.
31. Microscopical examination of a few particles from the drawing layer suggested the use of a graphite pencil. The particles were seen to be irregular flat flakes with a pronounced lustre when viewed as a dry preparation.
32. Detected by LMA.
33. BUTLER, M. H., 'An Investigation of Pigments and Technique in the Cézanne Painting, "Chestnut Trees"', *AIC Bulletin*, **13**, 2 (1973), p.77ff. Since this study a more comprehensive report on Cézanne's materials has been published, see BUTLER, M. H., 'An Investigation of the Materials and Technique Used by Paul Cézanne', *AIC Preprints*, 12th annual meeting, Los Angeles 1984.
34. DORAN, *op. cit.*, p.170.