



Painting techniques of Pierre-Auguste Renoir: 1868-1919

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Introduction

Pierre-Auguste Renoir was born in Limoges in 1841; his family moved to Paris in his childhood. He was at first apprenticed as a porcelain painter, but in 1861 he began his training in easel painting in the studio of Charles Gleyre, and was admitted to the Ecole des Beaux-Arts in 1862. In 1868 Renoir moved in with Bazille, to an apartment near the Café Guerbois, where Manet, Sisley and their contemporaries met regularly. In 1869, he painted with Monet at La Grenouillère, on the Seine to the west of Paris, and worked with him again at Argenteuil in the 1870s. He worked in his studio in the Rue Saint-Georges in Montmartre from 1873, and exhibited works in the first three Impressionist exhibitions and between 1878 and 1883 at the Salon. In 1881 he visited Italy, and on his return to France he stated that he was dissatisfied with Impressionism and throughout the 1880s he experimented with alternative approaches to the use of colour and brushwork. By this time the symptoms of rheumatoid arthritis were

affecting his working life. From 1882 onwards he made frequent visits to the south of France, and in 1908 he moved into a house that he had built for himself in Cagnes on the Mediterranean coast, where he painted until his death in 1919.

Most of the descriptions that we have of Renoir's studio practice date from his later years. The conversations recorded by Ambroise Vollard,¹ the eloquent and perhaps embroidered narrative of his son Jean Renoir,² and the succinct but immensely valuable account by Albert André³ – all are based on the practices and opinions of the artist after 1900, when he was seeking to present himself as the latest, or last, in the lineage of great European figure painters. In 1881 on his travels in Italy he was impressed by Raphael and the frescos at Pompei, which motivated his experiments in the 1880s with the use of leached oil paint media to emulate the matt look of fresco paintings, and to prevent darkening.⁴ Renoir's admiration for this craft tradition is demonstrated in the preface he wrote for a French translation of Cennino Cennini's fifteenth-century treatise *Il Libro delle' Arte*, published in 1911.⁵

Discussion of Renoir's painting materials and techniques in this article is based on a technical study of six paintings from the Courtauld Institute Gallery, London and the Kröller-Müller Museum, Otterlo. They represent significant examples of Renoir's changing painting style and span almost the length of his career including an important example of his earliest work, *The Clown*, painted in 1868 (fig. 1); the remarkable Impressionist work of 1874 *La Loge* (fig. 2); *Le Café*, dated 1876-7 (fig. 3), a landscape: *The Outskirts of Pont Aven* (1888-9) (fig. 4); *Portrait of Ambrose Vollard* (1908) (fig. 5), and *A Woman at her Toilet*, a characteristic example of the pastel-toned fulsome women he painted in 1919, the last year of his life (fig. 6).

The present technical study draws upon studies by Butler in 1973 of paintings by Renoir in the Art Institute of Chicago⁶, by Bomford et al. of *At the Theatre* (1876), *Boating on the Seine* (c.1879), and *The Umbrellas* (1881-6), published in the catalogue of the 1991 exhibition *Art in the making: Impressionism*,⁷ and an essay by Bruce Gardner et al, from 1987, that contains a discussion of the technique used for *La Loge*.⁸ These studies focused on Renoir's middle period works, while the present investigation aims to broaden our understanding of his studio practice throughout his career.

Trends in Renoir's use of materials, including pigments and binding media, changes in style and handling of materials, and his exploitation of different painterly



Fig. 1 Pierre-Auguste Renoir, *The Clown*, 1868, Kröller-Müller Museum



Fig. 2 Pierre-Auguste Renoir, *La Loge*, 1874, Courtauld Institute Gallery



Fig. 4 Pierre-Auguste Renoir, *Le Café*, 1876-7, Kröller-Müller Museum, inv. nr. KM 104.427

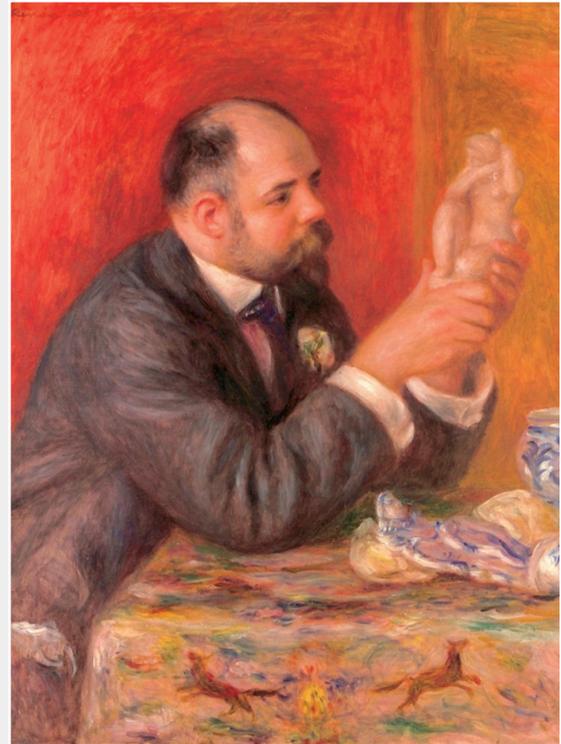
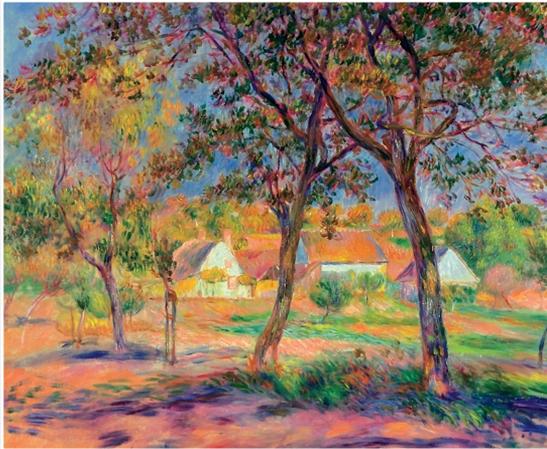


Fig. 3 Pierre-Auguste Renoir, *The Outskirts of Pont Aven*, 1888-90, Courtauld Institute Gallery



Fig. 5 Pierre-Auguste Renoir, *Portrait of Ambroise Vollard*, 1908, Courtauld Institute Gallery

Fig. 6 Pierre-Auguste Renoir, *A Woman at her Toilet*, 1919, Courtauld Institute Gallery

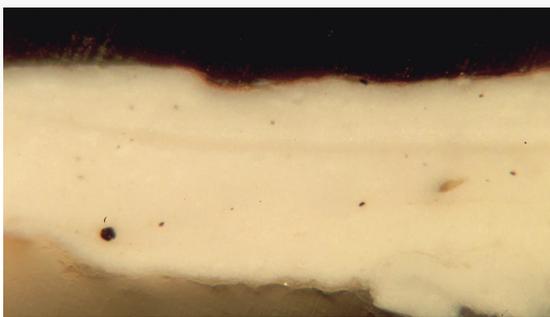


Fig. 7 Paint cross section from the red brown background in *Portrait of Ambroise Vollard* and from the sitter's grey jacket showing two layers of white priming of similar composition

effects are discussed, with reference to documented accounts of his aims and practice, as well as the influence of contemporary painters with which he associated, worked and shared materials. Renoir's early palette and some of the paints he bought in the 1890s are documented.⁹ Comparison of analytical data with written accounts, particularly those of Jean Renoir, places these findings in context, whilst testing the reliability of the documentary sources. The analysis of these paintings, together with the few previously published analyses, also throws fresh light on one issue that is central to the understanding of Renoir's position in relation to Impressionism: the question of the use of black. The abandonment of black became one of the most often cited principles attributed to Impressionism – and one that in his later years, Renoir repeatedly disavowed. This investigation allows us to refine this account and to make a crucial distinction. This study utilises a range of analytical methods includ-

Table 1. Canvas sizes and thread counts for the works in the present study

Title	Location Inv no	date	Size canvas cm ² h x w	Thread count cm ² weft x warp
The Clown	KM 100.599	1868	193.5(h) x 130 (w)	9 x 10
La Loge	P.1948.SC.338	1874	80.0(h) x 65.0 (w)	16 x 15
Le Cafe	KM 104.427	1876-7	35.7(h) x 27.5 (w)	16 x 14
The Outskirts of Pont Aven	P.1978.PG.339	1888-90	54.3(h) x 65.0 (w)	13 x 12
Portrait of Ambrose Vollard	P.1932.SC.340	1908	84.1(h) x 65.0 (w)	13x 12
A Woman at her Toilet	P.1932.SC.341	1919	50.0(h) x 56.2 (w)	9 x 7

ing standard non-invasive techniques of infrared reflectography and x-radiography (except for *The Clown* and *Le Café*), light microscopy and analysis of samples using Fourier Transform Infrared spectroscopy (FTIR), Gas Chromatography-Mass Spectrometry (GCMS) and Direct Temperature-resolved Mass Spectrometry (DTMS) for characterisation of organic media and additives¹⁰, High Performance Liquid Chromatography (HPLC) for characterisation of and lake pigment dyestuffs¹¹, and Energy Dispersive x-ray spectroscopy (EDX) for analysis of inorganic materials.¹² Results are listed in tables 2-3.

Renoir's materials

• Canvases

All six paintings in this study are on commercially prepared canvases (Table 1). According to Jean, his father would '...buy large rolls of canvas, generally a yard in width, cut out a piece with tailor's scissors and fasten it to a board with drawing pins'. He also had rolls much wider for his 'big jobs'. For portraits, however he sometimes used canvas already mounted on stretchers of a set size.¹³ Jean's description reflects the materials used for *La Loge*, *Outskirts of Pont Aven* and *Portrait of Ambrose Vollard*. All are painted on plain weave canvas of similar weight and thread count. The Vollard portrait and *Le Café* shows cusping on the bottom edge only. The sizes of the works are all within one metre in one of their dimensions and could therefore have been cut from the yard-wide roll Jean describes. The largest canvas, used for *The Clown*, is a single piece and was therefore from a wider roll. The canvas for *A Woman at her Toilet* is of a coarser weave than that used for the other works examined here. There are pin-holes in the corners, and the canvas is nailed to the front of the stretcher on the right hand side. Following Jean's

description, Renoir probably pinned the cut piece to the stretcher or a board for painting and then stretched it later. Pin-holes are also evident in the canvas used for *Le Café*. In 1868 Renoir, impoverished and trying to obtain the materials for a potential portrait commission, wrote to his well-off painter friend Jules le Coeur requesting to ask the materials supplier, Carpentier, 'to send a 120 canvas, fine and very smooth, primed with several layers..and to ask him [Carpentier] to nail the canvas on to a stretcher that size ..[you will find] in the attic.'¹⁴

The canvas for *Le Café* is a standard size 5 pre-stretched canvas on its original stretcher, showing cusping at all sides, and pin-holes in each corner. An original oval-shaped canvas stamp is visible on the back scribed 'Toiles a couleur fine, Rey a Cie. Paris (?)' with some unreadable word(s) below. *Outskirts of Pont Aven* has a palette shaped canvas stamp on the back of the canvas behind the stretcher bar, and *At the Theatre*, d. 1876 (National Gallery London), has a stamp: 'Alexis Ottoz', a materials supplier, who ceased to trade under the same name soon after this date.¹⁵ From the late 1870s Renoir obtained his canvases from a number of suppliers.¹⁶

• Priming

Commercial priming consisting of a single homogeneous layer of chalk, lead white and linseed oil is used for all the paintings in this study. An approximately 3:1 proportion of lead white to chalk in the mixture in three of the paintings may represent a consistent kind of commercial priming used. There are a number of analytical variations that might have some significance, including the presence of lead carboxylate soaps in the priming used for *A Woman at her Toilet*, and an elemental spectrum of the priming from this work contained a high proportion of elemental chlorine. Neither phenomena

can be explained by conservation treatments, and the painting is unlined and unvarnished.

The commercial priming for the National Gallery *At the Theatre* (1876) appears to be closely similar to that used for the other works in this study, while exceptionally, *Boating on the Seine* (1879-80) has a thin seemingly not commercial priming, probably applied by Renoir using lead white alone.¹⁷

It seems, however, that Renoir commonly put on a second priming layer in his studio. Jean describes Renoir's practice of applying a layer of silver white to the (probably already commercially primed) canvas, before adding colour.¹⁸ 'He would ask the model or whichever of his sons was given the task to increase the proportion of linseed oil. As a result the white took several days to dry; but it gave Renoir a smoother surface to work on. He did not like fine grained canvases which were softer to paint on, for he thought them less resistant.'¹⁹

Callen describes the techniques used for *Rocky Crags at l'Estaque* (1882), including Renoir's use in the first half of the 1880s, of a thick smooth white ground of lead white mixed with one third linseed oil and two thirds turpentine spirit, applied over the white commercial priming, using a palette knife.²⁰ Butler also found a second lead white priming over a commercially applied lead white priming in *Madam Clapissou* (1883).²¹

The application of a second priming may relate to distinctly separate stages of painting in these works. For example, in *The Portrait of Ambroise Vollard* a second white priming layer has been applied over part of the commercially primed canvas. Evidence can be gleaned from cross sections. Samples taken from the red brown background and from the sitter's grey jacket include two layers of white priming of similar composition (fig. 7). A sample taken from the blue vase shows two layers of white under the paint. None of the other samples taken from the painting clearly show two white ground layers. Although this may be a result of a sampling procedure that did not produce coherent samples of all layers, the second ground layer may have been partially applied. None of the samples suggested that the white second priming was applied over an earlier composition.

• Pigments 1868-1919

[Table 2 summarises the results of analyses of pigments from the paintings in this study and those carried out by Butler and Bomford et al. Key findings are discussed below.]

Jean Renoir describes his father's materials of 1877-8 dating from his Impressionist period, including: 'Silver white, chrome yellow, Naples yellow, ochre, raw sienna,

madder lake, vermilion, Veronese green, viridian, cobalt blue, ultramarine blue. Palette knife, scraper, oil, turpentine – everything necessary for painting.' He adds that 'The yellow ochre and sienna earth are intermediate tones only, and can be omitted since their equivalents can be made with other colours.'²²

A closely similar palette has been found by analysis of paint samples from *La Loge*, painted in 1874, and for *At the Theatre* and *Lady at the Piano* both painted in 1876 (Table 2).

According to Jean, Renoir's paint dealer Mulard, '...ground the colours so carefully for him..[by hand]. ...I can still see his glassed in workshop, opening on a courtyard, and the half dozen young women he employed, working away in their white smocks with mortar and pestle.'²³ Mulard had a shop in Rue de Pigalle. The paints were supplied in tubes. Moisse (of Maison Edouard) also supplied Renoir with paint, and based on orders made by the painter in 1885, Ivory black, a carmine lake pigment and red earth pigments (Venetian red and Italian earth) can be added to his late palette.²⁴

Jean describes how Renoir arranged the colours of his late palette for *Les Grandes Baigneuses* painted in 1887 (Philadelphia Museum of Art, Tyson Collection): '...on the lower side [of his palette] next to the hold for his thumb: silver white in a thick 'sausage roll; Naples yellow in a small dot; and the same for the following colours: yellow ochre, sienna earth, red ochre, madder red, green earth, Veronese green, cobalt blue, ivory black.'²⁵

Technical studies suggest that Renoir used lead white throughout his career and, like most of his contemporaries; he favoured the traditional lead white pigment over zinc white, used at this time by Vincent van Gogh alone.²⁶ Renoir preferred Cobalt blue, although he forsakes this pigment in favour of French ultramarine after a period spent painting with his friend Paul Cezanne in 1886.²⁷ However, Renoir's preference for cobalt blue appears to have persisted in his later works, as no other blue pigments have been identified in works painted after 1886. Two kinds of red lake pigments, containing madder and carmine dyestuffs, have been used consistently, although the latter is not mentioned by Jean. The carmine-type lake pigment appears to be cast onto a calcium-containing substrate, and is associated with starch, while the madder lake on an aluminium-containing base has no starch associated with it and exhibits a marbled orange-pink fluorescence in ultraviolet light, that is a characteristic of this type of lake used here and in other paintings in this study. The carmine lake (possibly sold as *laque carminée* or carmine lake) has been used for the costume of *The Clown* (1868).

Table 2 Pigments

Painting ¹⁾	Lead white	Bone black ²⁾	Carbon black	Yellow ochre	Chrome yellow ³⁾	Naples yellow	Cobalt blue	Cerulean blue	French ultra-marine	Prussian blue	Vermillion	Red earth	Green earth	Viridian	Emerald green	Red lake ⁴⁾
The Clown 1868 *	*	*S		*			*			* 5)		*		*		Cochineal on Ca/K; S
La Loge 1874 *	*	*S		*	PbCr; PbCaCr		*				*		*			Cochineal on Ca; S
<i>Alfred Sisley 1875-6 #</i>	#				#		#				#			#		#
<i>Lady at the Piano 1876 #</i>	#	#			#		#				#					#S
<i>At the Theatre, 1876 @</i>	@	@			BaCr; PbCr		@				@				@	@
Le Café 1876-7 *	*	*S		*	PbCr; BaCr or BaSO4		*	*								Purpurin on Al ³⁺ on Al; S
<i>Boating on the Seine, 1879 @</i>	@				PbCr orange; SiCr yellow		@				@			@		@
<i>The Umbrellas, 1881-6 stage 1 @</i>	@	@			PbZnCr		@				@	@		@		@
<i>On the Terrace, 1881 #</i>	#					#	#		#		#			#	#	#
<i>Fruits from the Midi 1881 #</i>	#					#	#				#			#	#	#
<i>Crysanthemums 1882 #</i>	#					#	#				#			#	#	#S
<i>Madam Clapisson, 1883 #</i>	#					#	#				#			#	#	#
<i>Child in White, 1883 #</i>	#					#	#		#		#			#	#	#
<i>The Umbrellas, 1881-6 stage 2 @</i>	@	@		@		@			@			@			@	@
Outskirts of Pont Aven, 1888-90 *	*			*	PbCr yellow; PbCr orange		*		@			@		*	@	Madder
Portrait of Ambrose Vollard, 1908 *	*	*		*	PbCr; PbZnCr	*	*	*			*	*	*	*		*S
<i>Seated Nude 1916 #</i>	#			#		#	#				#			#		
Woman at her Toilet 1919 *	*	*		*	PbZnCr	*	*	*			*	*	*	*		*S
<i>Flowers 1919 #</i>	#	#		#		#	#				#			#		

1) # = from Butler 1973, @ = from Bomford et al. 1990, * = present study.

2) S = Starch.

3) Analysis by light microscopy and EDX; elemental combinations given. SEM EDX was performed using a JEOL100 SEM with and Oxford Instruments light element detector and Inca software.

4) The substrates could be identified as aluminium-containing or calcium-containing substrates. Tin-containing substrates, though often used in the late 19th C., were not found in our study. Organic lakes were identified using HPLC (High Performance Liquid Chromatography). Procedure described in M. van Bomme, M. Geidof and E. Hendriks.

‘Examination of the use of organic red pigments in paintings by Vincent van Gogh (November 1885 to February 1888)’, this volume of *ArtMatters* (2005), 111-137; Lake pigment dyestuffs from La Loge, and The Outskirts of Pont Aven analysed by Jo Kirby and Catherine Higgitt (personal communication).

5) Identified using FTIR (See Table 3)

Table 3 Binding media

Sample Description	Results analysis organic media ¹⁾	Additional results ¹⁾
The Clown, KM 100.599, 1868		
Varnish	Dammar, some pine resin, linseed oil components (P/S = 1.2) (d,g).	
Dark brown on red brown	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.2), some pine resin (g), glucose (g*).	Starch inclusions (f)
Ground	Nut oil or mix of drying oils (P/S = 2.5) (g)	Lead carboxylate(f) ³⁾
Reddish background wall balcony	Nut oil or mix of drying oils (P/S = 2.4), Some beeswax (g), glucose (g*).	Starch inclusions (g,f); metal carboxylate(f) ³⁾
Blue from curtain	Poppy, nut oil or mix of drying oils (P/S = 2.9) (g).	Prussian Blue (f) ⁴⁾
Black from beard of man figure in background	No result.	
Red of balustrade	Drying oil, glucose (g*).	Starch inclusion (g,f); Metal carboxylate (f)
Ochre from background	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.4 (g), 2.0 (d)). Triterpenoid resin, presumably dammar, some diterpenoid resin (pine?) (d)	Metal carboxylate (f)
Red from left (viewer) sock	Nut oil or mix of drying oils (P/S = 2.6) (g). Trace of pine resin (g), glucose (g*).	Starch in inclusion (g,f)
Black with red from underneath trousers	Poppy, nut oil or mix of drying oils (P/S = 2.9), trace of pine resin (g).	Metal carboxylate
White paint from chair	Poppy oil and/or mixed drying oils (P/S = 2.9). Some pine resin.	Lead carboxylate ³⁾
Lining adhesive	Trace of pine resin (g), beeswax (d), drying oil components (d,g). Carbohydrate, protein, (d,f,g*)	Lead (d)
La Loge, CIA 0258, 1874		
Wax/resin adhesive ⁵⁾	Lining adhesive consists of beeswax, pine and larch resin (g,f) ⁶⁾	
Ground	Linseed oil (P/S = 2.0) (g,f) ^{7,8)} ; lining adhesive(g,f), indication for non-drying oil (g)	Lead carboxylate (f) ³⁾
Black paint of man's jacket	Linseed oil (P/S = 1.7) (g,f) ⁸⁾ ; lining adhesive, indication for non-drying oil (g)	Starch inclusions (f)
Grey of Nini's sleeve	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.2) (g) ⁷⁾ , and lining adhesive (g,f), indication for non-drying oil (g)	
Le Café, KM 104.427, 1876-7		
Varnish on swab	Dammar, some diterpenoid resin (possibly pine) (d,g)	
Ground	Linseed oil (P/S = 2.0) (g,f) ⁸⁾	
Blue paint	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.5) (g,f) ^{7,8)} , some diterpenoid resin (possibly pine) (g)	
Red paint	Oil or resin (f), beeswax (d)	Lead (d)
Purple paint	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.2), some triterpenoid resin (probably dammar from varnish), beeswax (d)	Lead (d)
Blue paint	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.5) (g,f) ^{7,8)} , some diterpenoid resin (possibly pine) (g)	
Black paint	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.3) (g) ⁸⁾	
The Outskirts of Pont Aven, 1888-90		
Dark transparent foliage	Linseed oil (P/S = 1.7) (g,f) ⁸⁾ . Additional resinous material: pine, larch and some gum dammar (g)	
Ground	Linseed oil (P/S = 1.4) (g,f) ⁸⁾ .	Lead carboxylate (f) ³⁾
Portrait of Ambroise Vollard, C-, 1908		
White commercial priming	Linseed oil (P/S = 1.6) (g,f) ⁸⁾ .	
Brown transparent material (size).	Protein and starch (f)	
Pink lake table cloth	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.2) (g,f) ⁵⁾ .	
A Woman at her Toilet, C-, 1919		
Ground	Linseed oil (P/S = 1.6) (g,f) ⁵⁾ .	Lead carboxylate(f) ³⁾
Pink paint	Linseed oil (P/S = 1.9) (g,f) ⁵⁾	
White paint	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.1) (g,f) ⁵⁾ .	
Dark green paint	Drying oil (g,f).	
Dry ochreous coloured paint	Linseed oil mixed with other drying oil or pure nut oil (P/S = 2.2) (g) ⁵⁾ .	

1) method of analysis: (f) = FTIR; (g) = GCMS, (d) = DTMS. FTIR and DTMS may also give information on the inorganic contents, but these results are not mentioned in this table as they are confirmation of the generally more reliable results from microscopy and SEM-EDX analysis. See for a description of FTIR (Fourier Transform Infrared Analysis), GCMS (Gas Chromatography-Mass Spectrometry) and DTMS (Direct Temperature-Resolved Mass Spectrometry): E. Hermens, A. Kwakernaak, K.J. van den Berg, M. Geldof. 'A travel experience: the Corot painting box, Matthijs Maris and 19th century tube paints', *ArtMatters*, 1 (2002), 104-121. (g*) is GCMS method modified for analysis of proteins and carbohydrates: hydrolysis with trifluoro-acetic acid, derivatisation with 10/1 MSTFA/TMCS. ZB50 GC column. DTMS analyses were performed at the Shell Research Centre in Amsterdam on a JEOL SX102 mass spectrometer.

2) Identification of glucose supports identification of starch by microscopy and FTIR.

3) Carboxylate could be explained as lead soap due to dissolution of a lead containing pigment or a lead dryer.

4) See Table 2.

5) The painting is heavily impregnated with the lining material. The lining adhesive was analysed separately with FTIR, but could only be analysed as part of the other paint samples in case of GCMS.

6) Wax/resin adhesive containing colophony (pine) and Venice turpentine (larch resin) in combination with beeswax were often used in the Netherlands around 1900 (ref Mireille te Marvelde).

7) The P/S ratio is slightly higher than normal for a linseed oil but is explained by the beeswax present from the lining adhesive.

8) Information about the type of drying oil can be obtained on the basis of the relative ratio of palmitic and stearic acids with GCMS and DTMS only.

The madder lake (*laque de garance*, or madder lake) is found in almost all the works painted after 1874, including *La Loge*. Both lakes have been identified in three of the later works: *Le Café*, *Portrait of Ambroise Vollard*, and *A Woman at her Toilet*. A sample from *Le Café* also contained a chemically modified madder type lake containing purpurin. Similar starch-containing red lake paints have been identified in paintings by Renoir's contemporaries Van Gogh, Monet and Seurat.²⁸

Butler identified corn starch in both red lake paint (*Lady at the Piano*, 1876) and viridian paint (*Chrysanthemums*, 1882). The use of starch as an additive to paint, rather than as a lake substrate, is suggested by the characterisation of instances of starch with bone black (Ivory black) paints used by Renoir (*The Clown*, *La Loge* and *Le Café*).²⁹

Passages of viridian containing paint from Renoir's later works, for example, *Portrait of Vollard* and *A Woman at her Toilet* exhibited characteristic drying cracks that are closely similar to those evident in the red lake paints that contain starch and it seems reasonable to conclude that these green paints also contain starch.³⁰ The viridian paint, used in the background of *A Woman at her Toilet* is very matte, and this is likely to have been another characteristic of the starch containing paint, where the starch, as for the red lake paints, was added during manufacture rather than by Renoir himself.

Renoir used both vermilion and red ochre. Vermilion was used more consistently, although the red earth found in paint samples from *The Clown* and *A Woman at her Toilet* is a bright red colour close to that of vermilion. Jean says that he saw Renoir use Chinese vermilion on occasion, placed on his palette between madder red and green earth.³¹ Given this similarity in colour, it is possible that Renoir purchased a paint labelled vermilion that had been adulterated or substituted with earth. Like Vincent van Gogh, Renoir used a range of yellow pigments that offered different hue, texture and opacity, including Naples yellow, yellow ochre and chrome-based yellows. A variety of chrome-containing yellows were used in the earlier works, as in *The Clown* from 1868, and in works after 1885. However between 1881-1885 Naples yellow appears to have been the sole yellow pigment, as was found for example in the 1881 *On the Terrace*.

The yellow ochre used in both *The Clown* and *La Loge* showed a characteristic element combination for iron oxide that included significant peaks for titanium, and chlorine (in addition to the usual Silicon, Aluminium, Iron); perhaps a characteristic batch of the pigment that may be found in other works by Renoir and his contem-

poraries. The chrome yellows that came in a range of shades, from pale yellow to orange, are used unmixed and mixed with lead white. Compounds identified include basic lead chromate yellow (sold as Chrome yellow), orange lead chromate (sold as Chrome orange), strontium chromate (found in *Boating on the Seine*, c.1879, and sold as lemon yellow), barium chromate (lemon yellow) lead zinc chromate, lead zinc potassium chromate (both sold as zinc yellow), and calcium chromate. Although none of the yellow pigments appear to have suffered deterioration that is known to occur in some lead chromate paints.³² It may be that Renoir preferred Naples yellow for another reason. Jean says that he never observed his father using chrome yellow, although it is listed amongst his paints and identified in his earlier pictures.³³

Renoir's purchase of zinc yellow from the 1880s has been documented.³⁴ Zinc containing yellows have been identified in the three late works in this study and in *The Umbrellas*.³⁵

The Impressionists reportedly rejected black paint in favour of blue for dark passages and shadows. This substitution was not made consistently by Renoir, with the exception of *Pont Aven*, where shadows are painted using viridian or cobalt blue with cerulean blue or red lake. A similar technique is used to paint shadows in the *Boating on the Seine* (1878-9, National Gallery London), where it is notable that Renoir used no black or earth pigments, with much of the work executed using paint directly from the tube.³⁶ In the other works studied, however, bone black was the black pigment of choice for Renoir. Easily identifiable because of its high calcium phosphate content, it was observed in samples from both the early and later works, but not in paintings from 1881-3, nor in the Courtauld *Pont Aven* (1888-90). The omission of black from the list of pigments used by Renoir is explained by Jean who says that his father included what he described as 'the Queen of colours' (black) only after his visit to Italy in 1881.³⁷ However, it is notable that he did not take up black again for a decade or so after that, as *Pont Aven* suggests.

Several pigments appear to have been used only occasionally, including red lead (for *At the Piano*, 1886), cerulean blue (mixed with cobalt blue, in samples from *Le Café*, 1876-7 and *Portrait of Ambroise Vollard*, 1908) green earth (found in samples from *La Loge* and *Portrait of Ambroise Vollard*). French ultramarine appears to have been used first in 1881 for *On the Terrace* and then again for *Child in White* painted in 1883, and for the second stage of the National Gallery *The Umbrellas*, that was completed in 1886. Prussian blue was found on two occasions, one of



Fig. 8 Detail of the bouquet held by the woman in the front row of the audience in *The Clown*



Fig.9 Butterfly pattern on *The Clown's* costume, where leanly bound strokes of vermilion, white and ochre paint dragged or dotted over the dry black underpaint

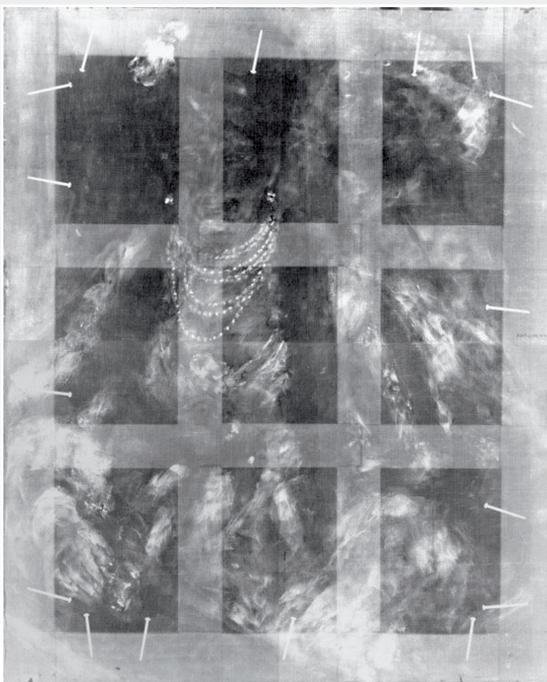
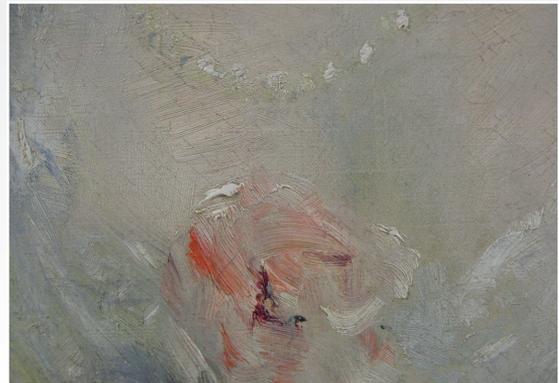


Fig. 10 X-radiograph of *La Loge*

Fig. 11 The flesh area of the woman in *La Loge*. The paint contains relatively little lead white, and is thinly painted in contrast with the flower, and pearls that are highlighted in rapid strokes of pure lead white impasto



which was in our study of *The Clown*. Carbon black has been identified in the earliest work, *The Clown*, together with bone black and charcoal, and is used in small quantities mixed with other pigments in *La Loge*, but seems to be omitted from the later paintings.

• *Renoir's binding media*

Renoir's binding media show consistent use of drying oil, in line with documentary sources of the time³⁸ and previous studies.³⁹ Linseed oil was identified in the commercial primings, except for *The Clown*, for which the analysis

indicated walnut oil or a mixture of oils.⁴⁰ The paints in all works, except for *The Clown* contained linseed oil. In several cases the results suggested that these oils were not pure linseed, but that other drying oils, presumably poppy or walnut, had been added.⁴¹

Analysis of the medium used for *The Clown* indicated that the paints contain relatively high proportions of either walnut or poppy oils. Since poppy and nut oils are less yellowing than linseed oils, they were often used for blue and white paints. One might expect that if Renoir chose his media, these oils would have been prominent on his

palette in his brighter and more colourful paintings. Renoir may have used linseed oil pure as a diluent for his paint, as described by Jean.⁴² The use of linseed oil for paintings by Renoir in the National Gallery London has been reported.⁴³

No evidence for other media than drying oils was found in the present study. The non-drying castor oil, reported for example in Renoir's *Boating on the Seine* (National Gallery) was not found.⁴⁴ Additives that were detected occasionally included resins and beeswax, which could be attributed to the paintings conservation histories in each case.

Renoir's painting techniques

• *The Clown*

The Clown (fig. 1), painted in 1868, is the earliest painting by Renoir in this study.⁴⁵ The painting is signed 'A. Renoir 68' in the lower right corner. It is a strange amalgam of Parisian popular culture with the scale and format of the court portrait. Apparently commissioned by the owner of the *Café du Cirque d'Hiver*, who went bankrupt before he could pay for the picture, it shows the clown James Bollinger Mazutreek, whose name can be made out in the inscription obliterated beneath Renoir's signature at the bottom right of the canvas.⁴⁶ Presumably this inscription was erased when the commission failed; without it, the canvas can be viewed as a genre painting as much as a portrait; it seems not to have appeared in any exhibition during Renoir's lifetime.

The overall impression of the painting is of a relatively conventional mid nineteenth-century image, exacerbated by a yellowed and cracked varnish, and the flattening effects of an old glue paste lining. However, the application of paint, in particular for the figures in the audience and for the details of the Clown's costume, show the sketchy and direct brushwork that looks forward to Renoir's work in the early 1870s.

The paint is applied wet-in-wet over a dry brown undermodelling, and suggests costumes, faces, and details such as the bouquet held by the woman in the front row (fig. 8) executed in a few wet dashes and dots of medium-rich cobalt blue, lead white and viridian paint. Alternatively, Renoir uses another technique, for example, for the butterfly pattern on the Clown's costume, where leanly bound strokes of vermilion, white and ochre paint are dragged or dotted over the dry black underpaint (fig. 9). Raking light reveals Renoir's many alterations to the painting: changes to the placement of the clown's raised arm, and changes to the position of his head and costume. A circular motif is evident in the underlying paint

of the background over the chair; the location and shape of the chair has been altered; the violin has been lowered in the final stage of painting. There are several other areas where brushstrokes are covered that do not correspond to the final image, suggesting that he laboured over the large commission, that would have brought him welcome remuneration had it succeeded.

The Clown's garter shows bright red vermilion-containing paint apparently oozing up between wide drying cracks in the upper black layer (a phenomena also observed in works made using cadmium sulphide paints). The red underlayer consists of vermilion with bone and carbon black and lead white. The poor drying of the paint used here is characteristic of both vermilion and carbon black in oil binding media, and may be exacerbated by oxygen exclusion due to the faster drying layer over it. The vermilion is here associated with an unusually high peak for elemental chlorine in EDX spectra, and shows some evidence for darkening, perhaps by a process linked with the presence of chlorine or chlorides.⁴⁷ The upper paint layer contains bone black and elemental lead. Lead white particles are not evident in the cross section, and the lead in the layer (that may be present as a drier) has reacted with the oil medium to form characteristic globules of translucent lead carboxylates, that fluoresce green in UV light.

• *La Loge*

La Loge (fig. 2), signed 'Renoir' in the lower left corner and dated 1874, was from the outset one of Renoir's best-known paintings, shown in the first Impressionist group exhibition in 1874 and many times subsequently before its purchase by Samuel Courtauld in 1925; clearly Renoir viewed it as one of his most successful works. Its subject, a box at a fashionable theatre, is treated as the pretext for an exploration of the theme of gendered viewing, as the young woman looks out into the theatre, her opera glasses unused in her hand, while her male companion scrutinises something – or someone – in a higher gallery of the theatre through his binoculars. The theme of the fashionably dressed woman on parade in public is richly complemented by the spectacular virtuosity of Renoir's technique, at the same time fluent and delicate in its treatment of her costume.⁴⁸

Renoir employed a broad brush to make *tache* brushstrokes that are not used in the later works examined in this study.⁴⁹ The *tache* marks are made by direct and rapid application of a square ended brush loaded with paint and can be seen in the man's cuffs, executed in a single broad sweep of white. Renoir's brushes are illustrated in his biography and their specifications described

by Jean 'Brushes made of marten hair; flat silk brushes.'⁵⁰ The x-radiograph of *La Loge* (fig. 10) emphasises the broad brushwork and sketchy handling of paint. The flesh areas of both figures contain relatively little lead white, and are thinly painted in contrast with the flower, earrings, pearls and purse that are highlighted in rapid strokes of pure lead white impasto (fig. 11). Renoir made a number of changes during painting, including the position of the woman's proper left hand, and of the male figure's hand and head, as well as a shift upward of his cuff.⁵¹ Although the changes are less radical than those he made while painting *At the Theatre*⁵², alterations include a hat cocked over the sitter's (a model called Nini) right eye, that is visible and defined in the x-radiograph by a single brushstroke of dense paint in a curved orbit, plus a mark made using the end of a brush in the centre of the hat – perhaps a hat-pin.⁵³ Renoir changed the height of Nini's right shoulder, making her torso appear narrower and more refined. Nini's left hand that is painted over her dress has been altered placing it further away from the fan and over her handkerchief. A reserve has been left largely unpainted to Nini's left. It is possible that in an earlier phase, her arm may have been placed in front of the man, and then later brought forward and bent at the elbow. The reserve appears densely painted in the x-radiograph, with unresolved brushstrokes that could be the back of her dress, or possibly a cast off wrap. Nini's décolletage has been broadened: the black paint of the dress has been scraped off, and short horizontal strokes of pale flesh paint have been applied to expand the area of exposed flesh. The flesh paint is generally very thinly applied, using the once-white ground as a mid-tone. The ground, which is now greyish in tone due to the darkening effects of the wax-resin lining carried out in 1934, is visible between strokes of paint that suggest the flowers of Nini's bouquet, at her proper right wrist and between locks of her hair. Her nose has just a highlight on the tip, with barely any paint over the ground. The thickest highlights are on Nini's chin, where drying crackle in the paint (perhaps attributable to starch associated with the red lake used for the flesh) is also evident. Shadows, using white mixed with ochre and cobalt blue, are smudged beneath her eyes; the same mixture of pigments is used for her hair and eyebrows. Butler found cobalt blue, combined with vermilion, Naples yellow, red lake and lead white for darker tones in Renoir's flesh paint.⁵⁴ A wisp of hair has been added across her right eye using paint rich in cobalt blue, adding an intimate suggestion of slight disarray. The man's jacket was painted with a mixture of bone

black with carmine lake bound in linseed oil (see Tables 2-3) mixed wet-in-wet with white, and applied directly over the ground. The same direct technique is used for Nini's dress, where black and white is mixed with yellow ochre. The nuanced deep blue passages of the dress are achieved using a similar mixture of bone black and white, again applied over a sienna-coloured underpaint layer. The shadows in the picture are painted using the same combination of pigments and the turbid medium effect of light over dark that produces the cool bluish tint so often attributed to the use of blue instead of black in Impressionist painting. Only for the deep shadows a pure Cobalt blue is used.

Renoir obtained brown tones by mixing several pigments, including green earth, ochre, chrome yellow, red lakes and bone black. The mixture is used as a dilute wash for Nini's hair. Elsewhere a warm brown paint is made by mixing vermilion with black. This bright red pigment is otherwise used only for highlights on the surface of the painting, such as the impasto of the flowers, and for the lips, mixed with white.

The curtain is painted with a madder lake that appears to be well preserved compared with the red paint of the balustrade, now cracked and opacified, where a thick layer of pure carmine lake is applied over the thin reddish undermodelling.

The painting is varnished with a yellowed natural resin that exacerbates the darkening caused by wax lining. An investigation was made, following up an observation of the yellowish appearance of passages of paint that cannot be attributed to yellowed varnish or darkening of the ground by the lining.⁵⁵ A sample taken from above Nini's sleeve showed, beneath the varnish, a translucent yellow medium mixed with lead white and cobalt blue applied over the grey paint layer. This may have served a similar function to the lemon yellow and cobalt blue-containing layer found used for the greenish yellow background of *At the Theatre*, to depict the colour of artificial light.⁵⁶ It should be noted however, that organic analysis of samples from *La Loge* suggests a non-drying oil may have been applied to parts of the painting, perhaps an 'oiling out', that might account for the yellow appearance of other passages of the surface.

• *Le Café*

In the mid-1870s Renoir adopted a finer and more broken touch even in the more highly worked areas of his paintings, a touch that undercuts the solidity of the forms depicted whilst at the same time evoking the immediacy of the painter's visual experience by giving a great sense of liveliness to the picture surface.⁵⁷ *At le Café* (fig. 3)

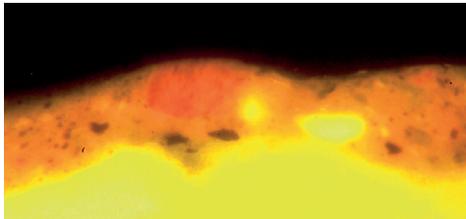


Fig. 12 Close detail of the women's heads illustrating the consistent use of small brushes and filigree strokes

Fig. 13 Paint cross section from *Le Café*; purple paint of the background in the upper left corner showing two kinds of red lake (a/ tungsten light and b/UV light)

Painted c. 1876-7, is a much smaller and more informal canvas than *La Loge*, with certain areas, such as the lower right corner, seemingly left unfinished.⁵⁸ The painting was acquired by Helene Kröller-Müller at 31 October 1919 from Bernheim-Jeune, Paris. The man with the hat on the left of the composition is the critic and painter Georges Rivière; the foremost woman may be the actress Jeanne Samary and the bearded man is Frédéric Cordey.

The finely textured surface of *Le Café* was executed by Renoir using very small brushes of a consistent size, each colour applied pure and wet-in-wet. The brushstrokes are feathered, with some impasto and heavily worked passages, most notably in the hands and faces of the two women (fig. 12) and male figure in top hat. Where the paint is less worked and between heavily loaded brushstrokes, the thin wash of sienna-coloured undermodelling paint is visible, applied using a wide brush. A single sample taken from the left outline of the woman's back on the left edge of the painting showed a number of fine carbon black particles in a fluid medium over the white ground, which might indicate underdrawing beneath the undermodelling layer. The two kinds of red lake paint are used (Table 2). A madder lake of a deep red hue is applied pure for the nearest woman's hair-band while a striking pink-coloured lake is used for the figures' costumes and for the screen in the background. This pigment has faded in the more thinly painted areas, as evidenced by the horizontal strokes of pink paint used for the screen, where the troughs of the strokes are translucent and yellowish while the thickest edges of the strokes retain their colour. Both pigments are present in a sample taken from the purple paint of the background in the upper left corner (fig. 13a-b).

Purple paint used for *Le Café* is made from red lake pigments mixed with cobalt blue and cerulean blue, found in the standing male figure's jacket and the woman's skirt. The use of a closely similar mixture of blue pigments in samples from the tablecloth from Renoir's *Portrait of Ambroise Vollard* in this study suggests the blues were pre-mixed by the manufacturer or paint supplier.

- *The Outskirts of Pont Aven*

The Outskirts of Pont-Aven (fig. 4), painted c. 1888-90, post-dates Renoir's so-called crisis of the 1880s. Its crisp and relatively assertive brushwork is quite unlike the filigree touch seen in *At the Café*, and reflects the artist's technical experiments of the decade; at the same time, the order and rhythm of the touch suggests the impact of the recent work of Paul Cézanne, with whom Renoir worked on a number of occasions during the 1880s. Of the paintings in the present study, *The Outskirts of Pont Aven* is the only work that may have begun as a *plein air* sketch. The surface of the painting is marked with canvas weave imprints in many places, suggesting that the painting was stacked or leant against other canvases while still wet. Paint appears to have been used pure and unmixed from the tube. Jean Renoir stresses firmly how fastidious his father was in his working practices to retain the clarity of his colours, related in particular to his use of separate brushes for each colour, and to frequent washing of brushes so as not to muddy the colours, that were mixed on the painting itself. The same stringent preparation is said to have been used for both his indoor and outdoor work.

'...Renoir's palette was as clean as a new coin. It was square and fitted neatly into the cover of his paint box. Into one of his double paint saucers he poured linseed oil, and into the other a mixture of linseed oil and tur-

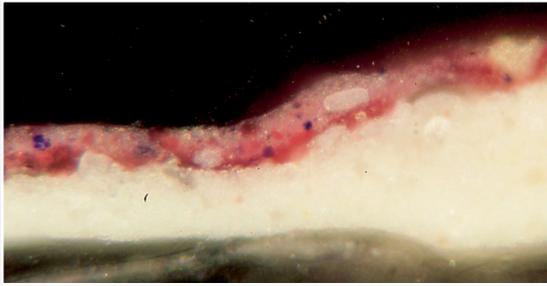


Fig. 14 Cross section from *The Outskirts of Pont Aven* showing cobalt blue and red lake mixture for mauve of largest tree



Fig. 15 *The Outskirts of Pont Aven*, detail of the foreground showing use of colours directly from the tube. Cobalt blue with a madder lake is used the foliage of the largest tree, creating an intense dark mauve hue

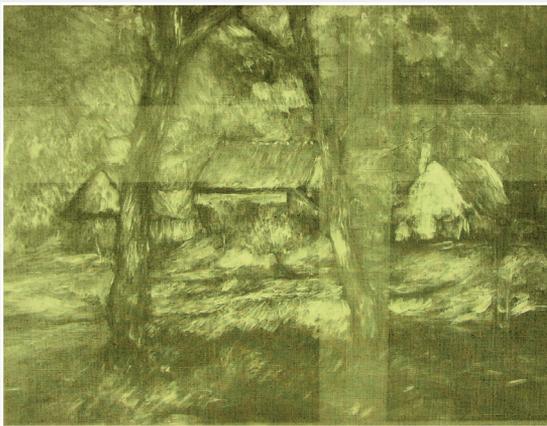


Fig. 16 X-radiograph of *The Outskirts of Pont Aven*



Fig. 17 Detail of tablecloth with objects, from *Portrait of Ambrosie Vollard* showing wet in wet technique

Fig. 18 X-radiograph of *Portrait of Ambrosie Vollard*. Detail of background showing hatched feathery brush strokes

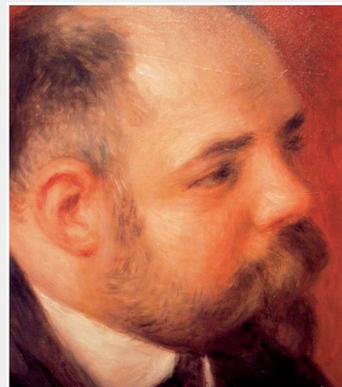
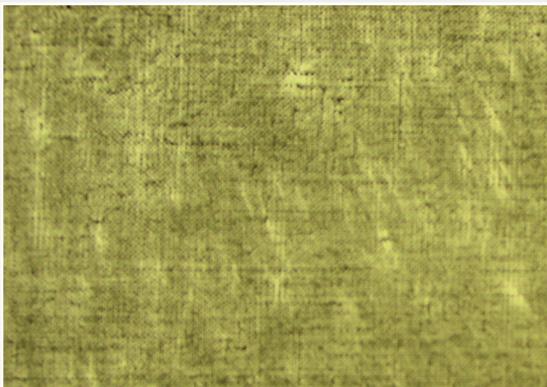


Fig. 19 Detail of Vollard's head, shows feathery tick-shaped brush strokes and the use of a hard-edged tool to apply or scrape down paint beneath the current composition

pentine in equal proportions. On a low table at the side of his easel he had a glassful of turpentine, in which he almost invariably cleaned his brush after applying colour...'⁵⁹ Jean stresses the neatness of his father's set up, how he always rolled the end of the tube to squeeze out exactly the right amount of paint and how his palette was immaculately cleaned between sessions and his '...Brushes were washed with soap and cold water...'⁶⁰ In the upper right corner of *The Outskirts of Pont Aven* there are a series of broad brushstrokes that contain a mixture of pigments characteristic of 'brush washings' that appear unrelated to the composition but may be the result of Renoir's practice of cleaning paint or diluents off his brushes.

Renoir used cobalt blue with a madder lake for the foliage of the largest tree, creating an intense dark mauve hue (fig. 14). The same paint is used to outline and reinforce the drawing of the house and other elements in the composition (fig. 15), and the same combination of pigments were found in mauve passages in the National Gallery's *At The Theatre* (c.1876-7) and both painting stages of *The Umbrellas* (1881-6). The frequent occurrence of these two pigments in similar proportions could suggest that it was available as ready-mixed mauve tube paint. A similar mixture has been suggested for purple paint by Field⁶¹ while ultramarine and madder lake have been found in tube paints from the same century.⁶² Mixtures of pigments used in single tube paints appear to have been commonplace in manufactured paints from the late nineteenth-century.⁶³

The brownish paint used to lay in the composition over the white ground for *The Outskirts of Pont Aven*, is visible in many places. Elsewhere, the painting is a cacophony of saturated colour. Some wet-in-wet blending of colours is evident in the foreground, painted in horizontal strokes of mauve (here made using red lake, cobalt blue and white, with minor components of ochre, viridian and Naples yellow) over a layer of pure cobalt blue. Dark transparent viridian is applied wet over cobalt blue, or mixed with bright chrome yellow over the sketchy pink underpaint of the terrain. The summer's day is effectively depicted by Renoir by contrasting a pure viridian paint for the shadows cast by the large trees, with the hot dry earth of the foreground painted using red and yellow ochre with white; a mixture also used for the terra-cotta roofs of the houses. By overlaying feathered vertical and horizontal brushstrokes in chrome orange together with chrome yellow and viridian, Renoir captures the mottled shadows and filtered sunlight on the tree-trunks and on the ground

beneath them. The reflection of hot sun is depicted in the distant foliage, with strokes of bright chrome yellow, ochre, and pure dark cobalt blue, giving the smallest trees the appearance of flames against the pale blue sky, thinly painted with cobalt blue and white. The paint used for the trees is thickly applied, with the underpaint visible around the edges of the brush strokes used for the trees and houses. An x-radiograph of the painting shows reserves left for the tree trunks, and the contours of the houses (fig. 16). The reserve for the tree with yellow foliage on the left is significantly smaller in the radiograph than it appears in the final composition, suggesting that Renoir enlarged it in the painting stage. A *pentimento* to the left chimney of the left house is indicated by a train of chimney smoke executed in white impasto now beneath the upper paint layer.

The main departure from the planning stage is the over-painting of a path, or possibly a road in the mid-ground that ran in front of the houses to the base of the large tree. Reserve lines for the road, present in the under-painting layer, have been worked over in loose brushstrokes containing lead white with other pigments, of sufficient density and opacity to obscure the underlying composition. It is possible that Renoir painted out the road to reconcile the perspective distance between the largest tree in the right foreground and the road. Other changes to the planned composition, made during painting include the foliage of the small green shrub in front of the middle house, between the largest tree-trunks, adjusted from a hotter shade to a cool tone by glazing with transparent green paint.

Infrared reflectography revealed carbon-containing lines that give a sense of the perspective. This carbon-containing material is however, applied on top of the first paint layers, which suggests that Renoir used drawing at the painting stage to adjust the perspective of the composition. However, the IR Vidicon used in the present study was unable to detect drawing, if it exists, beneath the reflective earth-containing undermodelling layer.

• *Portrait of Ambroise Vollard*

The 1908 *Portrait of Ambroise Vollard* (fig. 5) reveals Renoir as an artist who was self-consciously seeking to emulate the great masters of the European figure painting tradition through his fluent painterly technique, and specifically promoting himself as the descendent of Titian and Rubens. Depicted holding a small plaster figure by Aristide Maillol, Vollard is presented as an archetypal connoisseur, very much in the tradition of the collector portraits of the Italian Renaissance.⁶⁴ Jean Renoir

reflects on his Father's friend and dealer: '...Vollard gave the impression he was dozing most of the time. But in reality his eyes were taking in everything behind those half-closed lids...Vollard was very natty, and had his clothes made by one of the best tailors...' Jean describes how his father tried to convince Vollard to pose wearing a toreador's costume, saying that the colour would suit him.⁶⁵

Renoir's use of transparent thin washes is paramount in this painting which is very thinly painted overall. A set of similarly fine brushes have been used for the whole painting. Renoir has employed feathered, tick-shaped strokes regardless of the passages he depicts – these brushstrokes are particularly evident in the tablecloth (fig. 17). The same technique has been used to paint both the fleshy hands of the sitter and the hard plaster of the statues. The prone statue appears particularly soft in texture, bedded down in her napkin.

Impasto is limited to the white highlights on the vase and handkerchief, with low yellow impasto used for the decorations on the tablecloth. In general, the linseed oil-bound paint has been diluted to make washes of paint that has dried as drips – for example in the green passages of the tablecloth. The undermodelling of the composition is visible everywhere apart from the most heavily worked passages of the flesh paint.

The x-radiograph of the painting is low in contrast, reflecting Renoir's sparing use of lead white. This is particularly evident in the flesh paint. There are a number of highlights in the radiograph that do not correspond to either light passages or impasto in the final image and may be indicative of changes in the painting. These include: hatched feathery strokes in the background, especially in the left of the picture (fig. 18) and a dense stroke on the tablecloth near the handkerchief that may be associated with the white priming. There is no direct correspondence between the shape of the figurine and the use of dense lead white. A horizontal brushstroke from cuff to the right edge of the x-radiograph has no relationship to the surface highlight, and there is a dense spot on the upper left corner, next to the signature.

In this respect another interesting observation can be made. It seems that a hard-edged or possibly toothed tool, 4-5 inches wide, has been used either to scrape off still wet paint in the underlying composition or to apply a very thin layer of white over the commercial priming. These marks can be seen in the left side of the painting, below the sleeve of the jacket and in the upper left corner of the background, also in the head and torso of the raised sculpture. The tool marks are visible in both

infrared reflectograms and in the x-radiograph, in particular in the underarm of the sitter's jacket, where a 'v' shape has been made in the underlying ground, and similar marks are clearly evident around the raised figurine's head. Scraping down in the central part of the composition, beneath the jacket and the sitter's proper left shoulder is indicated by shallow horizontal grooves. The use of a palette knife to apply white priming may be indicated by a series of zigzag lines through the centre of the canvas, and one of these lines, indicating variation in ground thickness, passes through the nose and finger of the sitter. The area between the sitter's face and the raised statuette shows these markings. Monet in a letter to his wife from 1886, recounts a conversation with Renoir in which the painter described how he scraped down his paintings after they were rejected by his dealer Durand-Ruel.⁶⁶

Similar evidence for scraping down and re-priming has been observed in a technical study of paintings by Honoré Daumier.⁶⁷

Renoir concentrated most of his reworking on the face of the sitter, with adjustments made using thin opaque ochre-brown coloured paint around the eyes. A sample from the flesh paint of the sitter's wrist contains a mixture of lead white with vermilion, yellow ochre and bone black. A similar paint mixture has been used to alter the background around the pot to the right, and the shadow cast by the arm on the tablecloth, and the hand of the raised figurine. The grey of Vollard's hair is painted in cobalt blue; the most pronounced blue hue is at his temples and over his ear (fig. 19).

The thin grey paint of Vollard's jacket has been painted over a pocket above the current handkerchief in the jacket pocket. This alteration is executed in two layers of translucent paint, applied over the white underlayer that shows through to some extent. The highlights of the jacket are scumbled over the grey paint layer, comprising bone black, lead white with a few particles of chrome yellow and yellow ochre over the thin under-paint layer – the three-dimensionality of the figure's plump form relies on the translucency of the layers and the visibility of the white ground below.

The most colourful passage of the painting is the tablecloth. Painted without intentional perspective, the top is a blur of colour executed in short, curving horizontal strokes of cobalt blue and white, applied wet over underlayers containing white, bone black, vermilion and red lake. One of the horses on the front of the cloth is painted in similarly blurred strokes while the other is more sharply defined with no real intention of either fold or depth. A sample of the darkest green from the table-



Fig. 20 Detail of lower right corner of *A Woman at her Toilet* showing washes of paint used for the background and the white impasto of the bed sheet. The white ground is visible in the lower right corner where the canvas was pinned to the stretcher while painting



Fig. 21 Viridian-containing green paint, used to paint a crude shadow of the pillow on the bed showing cracks associated with inclusion of starch

cloth, which has blanched at the surface, contains green earth with a few particles of yellow ochre, vermilion and bone black. For the blue vase, Renoir used a mixture of cobalt blue with a small proportion of cerulean blue paint in a greenish fluorescing medium (not identified) that was also found in blue paint from *Le Café*.

Ochre and reddish-coloured paint from the background contains carmine lake with starch inclusions. Fading of the lake is evident, in particular in the cuffs and shirt-front of the sitter, and in the underpaint of the tablecloth. The pink from the tablecloth contains the madder lake on an aluminium-containing substrate bound in nut oil, or in a mixture of linseed and other drying oil. Characteristic cracking of the red paint in the sitter's neck-tie, in the shadows for the table cloth and figurine, and of dark green paint used in the cloth suggest that

carmine and viridian paint also contain starch inclusions.

• *Woman at her Toilet*

A Woman at her Toilet (fig. 6) painted c.1919 in Cagnes at the very end of Renoir's career, reveals the greater breadth and expansiveness of Renoir's touch in his final years, or alternatively, given the advanced condition of his arthritis at this time, a typical rapidly executed work made freely using long familiar techniques and habitual painting practice. The female model is represented as a simple country woman, treated with a range of vivid colours set off against bold white highlighting. The canvas evokes the idea of a healthy, sun-bathed natural world that Renoir was seeking to create in his art, as an escape from, or an antidote to, the immeasurable suffering created by the First World War.

This painting has survived unvarnished and unlined, possibly because it has not been treated since its acquisition by Samuel Courtauld, directly from Renoir's London dealer in 1922.⁶⁸ In a review of Renoir's correspondence on the subject of varnishing his paintings, Swicklik argues that with the exception of a short period following his visit to Italy in the 1880s, Renoir consistently varnished his works or asked his dealers to varnish them before sale or exhibition.⁶⁹ Therefore, the question of whether the painting was intended to be displayed unvarnished, or whether Renoir's dealer simply sold it unvarnished may be crucial to our interpretation of his work.

If the painting was intentionally left unvarnished, it presents an opportunity to observe Renoir's appreciation of the nuance of surface texture that is not clearly evident in the other varnished works in this study. Notable also is the variation in surface gloss, mattness and texture of the paint unaffected by lining or varnish. Study of the surface shows the use of a combination of dry, lean, low impasto of pure ochre, and pure relatively medium rich lead white paint used for the bedclothes. The matt, opaque flesh paint of the woman's back and neck contrasts markedly with the glossy impasto of her skirt, petticoat straps, and for the final paint layer used for her hair. Matt washes of paint including vermilion with cobalt blue and madder lake are mixed with white to create the purple washes, used for shadows in the flesh and in the upper left passages of the background, while brown made from mixtures of vermilion, bone black and a -now moderately faded - carmine lake in varying proportions are used much diluted with medium, for the foreground (fig. 20).

Once again, matt passages of reddish-brown paint, for example, used for the woman's hair and the shadow under the chair, exhibit the pronounced cracking associated with carmine lake with starch, and the viridian-containing green paint, used to paint a crude shadow of the pillow on the bed is similarly cracked (fig. 21). Minimal *pentimenti* highlighted in the x-radiograph include a dense passage of paint below the woman's left arm, between her legs and above the cushion, suggesting an alteration to the position of her leg, or to her petticoat. The painting technique is otherwise direct and without significant areas of reworking. Small, hatched feathery brushstrokes are evident in the x-radiograph in the whole of the background. There is no evidence of these strokes in the composition at the surface of the painting, and the marks may be associated with the application of a white priming. Similar marks, although less densely applied, are evident in the x-radiograph of the *Portrait of Ambroise Vollard*.

Discussion

The present study of six paintings by Renoir that were painted between 1868 and the year of his death in 1919, show a surprisingly consistent use of materials. *The Clown*, although stylistically situated closer to the mid nineteenth century, is materially and in the preparation of the composition, similar to his later paintings. Consistent throughout Renoir's oeuvre are his preference for white grounds, his laying in of the composition in brownish washes and wet-in-wet painting using paint directly from the tube. We found some evidence of drawing. It is possible that transfer from preliminary drawings was used in the preparation of the paintings. According to Jean, his father used tracings and repeated the same motif several times.⁷⁰ Albert André noted Renoir's method of tracing the composition onto canvas from a full-sized drawing on brown paper for a copy of his *Les Grandes Baigneuses* of 1887, commissioned by Vollard in 1903 (Musée des Beaux-Arts Jules Chevreton, Nice).⁷¹ In the copy, a black under-drawing in a fluid medium is visible through thin washes of coloured paint. However, evidence for this process has not been found in the six paintings studied.⁷² Renoir used sienna-coloured washes of paint for sketching or undermodelling the composition in all the paintings in this study. The undermodelling layer is present in some cross sections and is also visible on the surface, between brushstrokes of overlying paint. This layer, which comprises red earth, bone black and red lake, with a few particles of green earth, chrome yellow, yellow ochre and lead white, is most clearly evident in *The*

Portrait of Ambroise Vollard and in *A Woman at her Toilet*. It covers the white priming layer to a varying extent: while passages of *La Loge* are directly painted over the white priming, in the later works the brown undermodelling is more extensively used.

Non-invasive examination techniques reveal that the undermodelling stage was simply the first stage of the composition, which was then developed in paint with numerous changes, particularly visible in x-radiographs. The method of paint application was clearly important to Renoir, which is demonstrated in the transition from the varied Impressionist brushwork of *La Loge* to the consistent use of sometimes very small brushes, often applying pure colour in separate strokes as exemplified by *Le Café* where filigree strokes are used, and for *Portrait of Ambroise Vollard* where a variety of different materials were painted with tick-like marks. The latter as well as the later *A Woman at her Toilet* provide examples of another trend in Renoir's painting technique: his increasing use of transparent thin washes of paint, thinned with medium or diluent. This trend is even more evident in the work of Paul Cézanne. It seems likely that their close association as painters may have influenced Renoir in this development, as well as Cézanne's influence on his palette.

Whilst the developments in Renoir's painting style are derived more from experiments with brushwork and handling of paint than from changes in his palette, there are exceptions. These include his use of Naples yellow from the 1880s, experiments with French ultramarine, and most notably the inclusion of black. Black is found in *The Clown* (1868), *La Loge* (1874) and traces of it recur in *At the Café* (c. 1877); it seems not to be used in *Boating on the Seine (The Seine at Asnières)* of c. 1879⁷³, or in *The Outskirts of Pont-Aven* from the late 1880s, before reappearing in the *Portrait of Ambroise Vollard* in 1908. From both documentary and visual evidence we know that Renoir reintroduced it into his palette during the 1890s; in her diary in 1898, Julie Manet recorded him telling her: 'There is nothing except black and white in painting.'⁷⁴ A year later, he told her: 'Pissarro made Georges Lecomte say in his book on Impressionism that it was necessary to banish black from the palette – a useless colour. I have tried that, and it is only with black that one obtains a certain lightness (*légèreté*): Titian said that a great painter is one who knows how to use black. It seems that it's better to listen to Titian than Pissarro. Nothing is as difficult in painting as using black and white. Manet's blacks are so beautiful, always done in a single stroke.'⁷⁵ In this conversation Renoir went on to talk about Velázquez's use of black and white, as he had

observed in paintings in the Prado. It is especially significant that black does not appear in *The Outskirts of Pont-Aven*, since this shows that he did not readopt black in the mid-1880s, when he was seeking to reintroduce draughtsmanship into his art after his trip to Italy in 1881-2. Indeed it is possible that Renoir's experience of Velázquez on his visit to Madrid in 1892 may have been the catalyst for his reassessment of the value of black; only further technical analysis including canvases from the 1890s will clarify this.

However, there is a vital distinction to be made about Renoir's use of black pigments. In his early work, including *The Clown* and *La Loge* its use is evident to the eye, and it plays a significant role in the final effect of the painting; in *At the Café*, by contrast, its presence is invisible in the dominant bluish hues of the dark zones of the painting. Exactly the same shift can be seen in Monet's work in the same years, from the visible black in *The Petit Bras of the Seine at Argenteuil* of 1872 to the invisible traces of black found in *The Gare Saint-Lazare* of 1877 and the absence of black in *Lavacourt under Snow* of 1879/81.⁷⁶ As far as we can tell, Monet never reintroduced black; when Renoir did, it was, as he said, used as a colour, and as an integral part of the visible effect of his canvases.

The results of the present study have highlighted some consistent use of pigment mixtures and media in paint used by Renoir for different paintings that could suggest that some of the mixtures were supplied in single tubes. Examples include a mixture of cobalt blue with cerulean blue in a characteristic greenish fluorescing medium, and a mixture of cobalt blue with a madder lake to make mauve paint.

Material changes evident in the present study include the cracking of red lake and viridian paints that can be attributed to their starch content. Fading of red lakes was also found, in particular in the starch-containing carmine lakes. Darkening of vermilion used for *The Clown* was noted. Otherwise, changes in the paintings could be attributed to the effects of lining, varnishing and oiling out of the surface.

Renoir's attitude to the durability of his works, and his awareness that the works change on ageing is also mentioned by his son: '...he knows that it would take a good 50 years for 'se caser', the expression he used for letting colours find their balance.' Jean says that Renoir himself observed that '...his earliest canvases were already turning black...', although no further explanation was offered for the cause of the darkening. Apparently Renoir '...had no great faith in new chemical products that had not yet been proved reliable...'⁷⁷ Renoir was reported to have made experiments between 1883-1889, using leached oil paint to emulate the effects of fresco painting that he admired, but this may have been simply to avoid darkening attributed to the medium, rather than as aesthetic preference for a matt surface.

The Outskirts of Pont Aven that was painted towards the end of this period is varnished, and it is impossible to judge whether the surface presented today is what Renoir envisaged, equally, and conversely, *A Woman at her Toilet*, may have remained unvarnished by omission rather than by choice. Although on examination of the surface of this painting it appears that Renoir made subtle use of matt and glossy textured paint. If coated with a harmonising and saturating layer of varnish, the surface would change significantly. Cross sections from *Outskirts of Pont Aven*, *Portrait of Ambroise Vollard* and *Le Café* all exhibit a significant layer of dirt on the paint beneath a coating of varnish, which may suggest that the works were left for some time before varnishing, although we do not know when or how many times they have been varnished. Sadly there is not enough evidence from technical studies or documentary sources to conclude with certainty Renoir's intentions in this respect. However, this discussion highlights the importance of the history of the works for their current interpretation.

This study has established the usefulness of the technical information contained in Jean Renoir's account of his father's materials, although his stated artistic intentions may reflect more about Renoir's desire in his old age to place himself amongst the old masters that he so admired.

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Technology Centre (Dr. W. Genuit), by Klaas Jan van den Berg.

Notes

¹ Most readily accessible in Ambroise Vollard, *En écoutant Cézanne, Degas, Renoir*, (Paris, 1938)

and reprints.

² Jean Renoir, *Renoir*, (Paris, 1962), translated, at times inaccurately, as *Renoir, My Father*, (London, 1962).

³ Albert André, *Renoir*, (Paris, 1928).

- 4 M. Swicklik, 'French Painting and the use of varnish 1750-1900', *Conservation Research, Studies in the History of Art*, 41 (National Gallery of Art, Washington, 1993), 168.
- 5 B. Erlich White, *Renoir: his life, art & letters*, (New York, 1984), 250.
- 6 M. H. Butler, 'Technical Note', in J. Maxon ed., *Paintings by Renoir*, (The Art Institute of Chicago, Illinois, 1973), 208-214.
- 7 D. Bomford, J. Kirby, J. Leighton, A. Roy, R. White and L. Williams, *Art in the Making: Impressionism*, [exh. cat. National Gallery London] (New Haven and London, 1990). See also: A. Roy, 'The palettes of three impressionist paintings', *National Gallery Technical Bulletin*, 9 (1985), 12-20.
- 8 R. Bruce-Gardner, G. Hedley and C. Villers, 'Impressions of Change', in *Impressionist and Post-Impressionist Masterpieces: the Courtauld Collection*, (London, 1987).
- 9 A. Callen, *The Art of Impressionism: Painting Technique & The Making of Modernity*, (New Haven and London, 2000), 104-5.
- 10 S. de Groot, H. van Keulen, A. Burnstock and K. J. van den Berg, 'FTIR analysis of five paintings by Pierre-Auguste Renoir', in *Preprints of Infrared Users Group meeting*, (Florence, 2004), in press.
- 11 M. van Bommel, M. Geldof and E. Hendriks, 'Examination of the use of organic red pigments in paintings by Vincent van Gogh (November 1885 to February 1888)', *ArtMatters*, 2 (2005), 111-137.
- 12 Experimental notes on the techniques are given in the appropriate tables.
- 13 Renoir 1962, 344-345.
- 14 Ehrlich White 1984, 28-29.
- 15 Bomford et al. 1990, 44-50. See on Ottroz: S. Constantin, 'The Barbizon painters: a guide to their suppliers', *Studies in Conservation*, 46 (2001), 49-67.
- 16 Callen 2000, 104.
- 17 Bomford et al. 1990, 44-50.
- 18 Silver white is a 'good quality' lead white. L. Carlyle, *The Artist's Assistant. Oil Painting Instruction Manuals and Handbooks in Britain 1800-1900 - with Reference to Selected Eighteenth-century Sources*, (London, 2001), 512, 514, 515.
- 19 Renoir 1962, 343.
- 20 A. Callen, *The Techniques of the Impressionists*, (London, 1982), 118.
- 21 Butler 1973.
- 22 Renoir 1962, 208.
- 23 Renoir 1962, 344.
- 24 Callen 2000, 104-105.
- 25 Renoir 1962, 345.
- 26 E. Hendriks and M. Geldof, 'Van Gogh's Antwerp and Paris canvases', *ArtMatters*, 2 (2005), 39-75.
- 27 J. House, Renoir, [exh. cat., Hayward Gallery London Grand Palais Paris, Museum of Fine Arts Boston, 1985-6], (Paris, 1985), and as has been discussed with reference to the repainting of *The Umbrellas* (National Gallery London) completed in 1886, in Roy 1985, 12-20.
- 28 Van Bommel et al. 2005; A. Burnstock, unpublished results from technical study of Monet; J. Kirby, K. Stonor, A. Burnstock, A. Roy, A. Grout and R. White, 'Georges Seurat's Painting Practice: Theory, Development and Technology', *National Gallery Technical Bulletin*, 24 (2003), 4-37.
- 29 De Groot et al. 2005.
- 30 I. Lanfear, A. Burnstock, K.J. van den Berg, L. Carlyle, E. Hendriks and J. Kirby, 'A comparison of the fading and surface deterioration of red lake pigments in six paintings by Vincent van Gogh with artificially aged paint reconstructions', in ICOM-CC preprints, (*The Hague*, 2005), in press.
- 31 Renoir 1962, 342.
- 32 H. Kühn and Mary Curren, 'Chrome yellow and other Chromate pigments', in A. Roy ed., *Artists' Pigments: A Handbook of their History, Characteristics and Use*, I, (Washington and Oxford, 1986), 187-218.
- 33 Renoir 1962, 342.
- 34 Callen 2000, 104.
- 35 Bomford et al. 1990, 191.
- 36 Bomford et al. 1990, 175.
- 37 Renoir 1962, 342.
- 38 Carlyle 2001.
- 39 Bomford et al. 1990, 72-75.
- 40 The medium analyses give information about the type of binding medium as well as the possible presence of additives. GCMS and DTMS are analytical methods which can in principle distinguish between different types of oil used as a medium. This is done on the basis of their palmitic to stearic acid (P/S) ratios. Typical media used till the early twentieth century are linseed oil (P/S 1.5), walnut (P/S 2.5) and poppy (4.0). Mixtures of drying and non-drying oils will give other ratios. See note 41.
- 41 Recent research by Dr. L. Carlyle (Personal communication) in the Winsor and Newton archives indicated that these paint manufacturers in the nineteenth century routinely mix poppy and linseed oil media together, in varying ratios. Although this may not apply necessarily to Renoir's French art suppliers, this must be taken into account in the interpretation of analyses of paint media.
- 42 Renoir 1962, 343.
- 43 Bomford et al. 1990, 74-75.
- 44 Bomford et al. 1990, 74.
- 45 Provenance: Ambroise Vollard, Paris. Mrs Thea Sternheim, La Hulpe (close to Brussels). Purchased by H. Krölller-Müller at auction house Fred Müller, Amsterdam, 11 Feb. 1910, no. 12. *Paintings of the Rijksmuseum Krölller-Müller*, 1969, 222.
- 46 On this, see, most recently, C. Bailey, *Renoir's Portraits*, [exh. cat., National Gallery of Canada, Ottawa] (New Haven and London, 1997), 27-9, where a photograph is published of Mazutreek wearing the same distinctive butterfly costume as he wears in Renoir's portrait; the information about the commission derives from J. Meier-Graefe, *Auguste Renoir*, (Paris, 1912), 12.
- 47 M. Spring and R. Grout, 'The Blackening of Vermilion; an analytical study of the process in paintings', *National Gallery Technical Bulletin*, 23 (2002), 50-61; K. Keune and J. Boon et al., *Zeitschrift für Kunsttechnologie und Konservierung*, in press.
- 48 On this, see J. House et al., *Impressionism for England: Samuel Courtauld as Patron and Collector*, Courtauld Institute Galleries, (London and New Haven, 1994), 134, and J. House, *Impressionism: Paint and Politics*, (New Haven and London, 2004), 129-30.
- 49 Bomford et al. 1990, 92-93
- 50 Renoir 1962, 342.
- 51 *The Courtauld Collection 1987*.
- 52 Bomford et al. 1990, 154.
- 53 A similar hat might be found worn by the kneeling woman in a fashion plate by Heloise Leloir c.1875 from *La mode Illustree in V. Steele*, *Paris Fashion, a Cultural History*, (Oxford, 1998), 117.
- 54 Butler 1973.
- 55 Courtauld 1987.
- 56 Bomford et al. 1990, 156.
- 57 On these changes in Renoir's brushwork, see House 2004, 169-71.
- 58 For what is known of its early history, see A. Distel's catalogue entry in Renoir, [exh. cat. Hayward Gallery] (London, 1985), 212-213.
- 59 Renoir 1962, 343.
- 60 Renoir 1962, 342.
- 61 Carlyle, 503.
- 62 E. Hermens, A. Kwakernaak, K.J. van den Berg, M. Geldof, 'A travel experience: the Corot paint box, Mathijs Maris and 19th century tube paints', *ArtMatters*, 1 (2002), 104-121, 117.
- 63 J.H. Townsend, L. Carlyle, N. Khandekar, S. Woodcock, 'Later nineteenth century pigments: evidence for additions and substitutions', *The Conservator*, 19 (1995), 65-77.
- 64 On Vollard and this portrait, see most recently Bailey 1997, 238-40.
- 65 Renoir 1962, 354.
- 66 Ehrlich White 1984, 166.
- 67 A. Burnstock and H. Bradford, 'An examination of the relationship between the materials and techniques used for works on paper, canvas and panel by Honoré Daumier', in A. Roy and P. Smith eds., *Painting technique, history, materials and studio practice*, Symposium Preprints IIC Dublin (London, 1998), 217-222, 218.
- 68 Dennis Farr, Samuel Courtauld as Collector and Founder of the Courtauld Institute in *Impressionist and post impressionist Masterpieces 1987*.
- 69 Swicklik 1993, 168.
- 70 Renoir 1962, 345.
- 71 Ehrlich White, 221.
- 72 The opportunity for further technical study of *The Clown* will follow in conjunction with the forthcoming conservation of the painting at the Getty Conservation Institute and this may provide more information on Renoir's drawing techniques.
- 73 D. Bomford et al., *Art in the Making: Impressionism*, [exh. cat. National Gallery London] (New Haven and London, 1990), 175, 201.
- 74 Julie Manet, *Journal (1893-1899)*, (Paris, 1979), 191, diary entry for 2 October 1898.
- 75 Manet 1979, 248, diary entry for 7 August 1899.
- 76 Bomford et al. 1990, 144-7, 169-70, 186-7, 200-1.
- 77 Renoir 1962, 344.