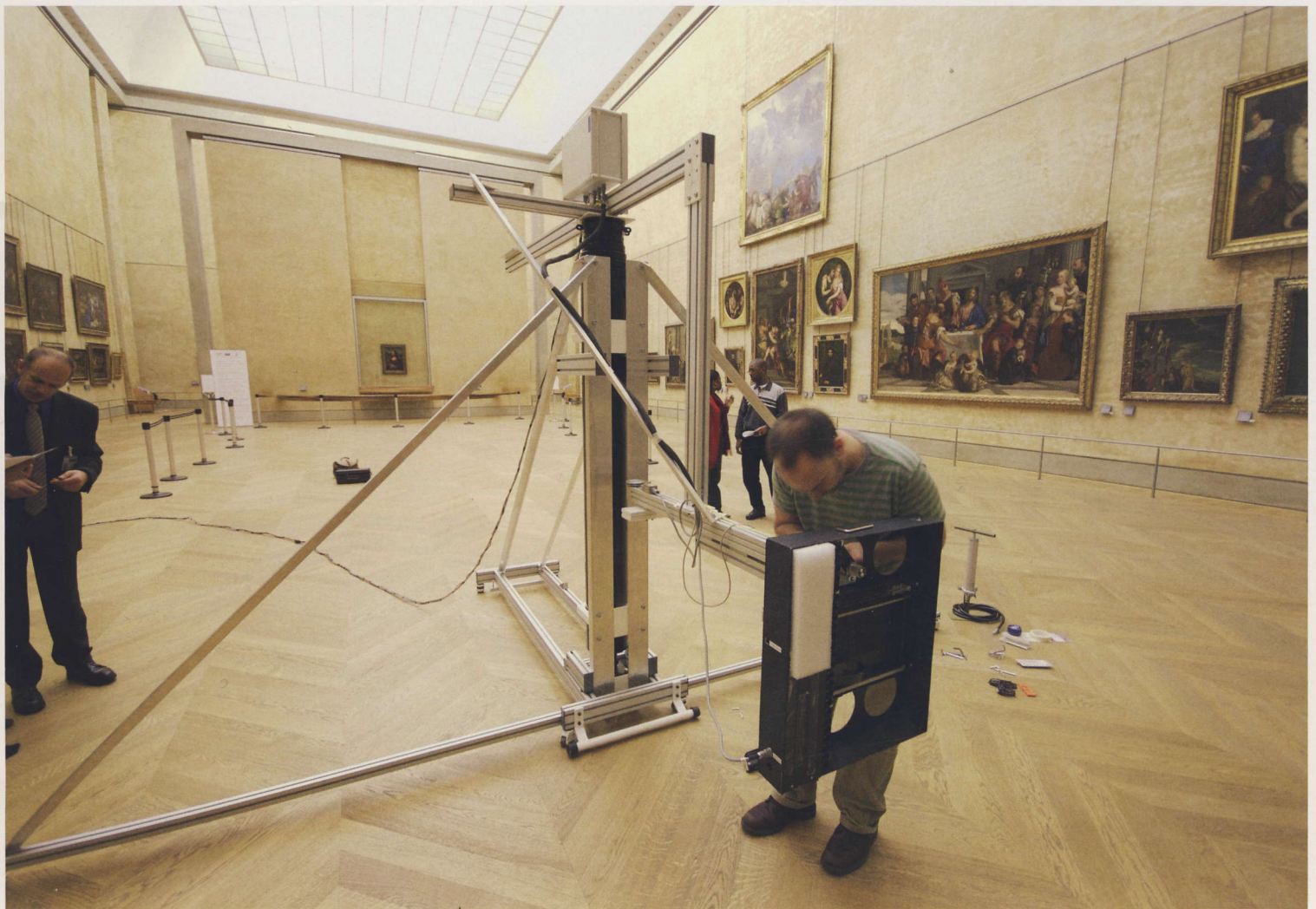


RESTAURO

Forum für Restauratoren, Konservatoren und Denkmalpfleger

HISTORISCHE ÖLFARBENTECHNIK
ZUR BESTÄNDIGKEIT VON ACRYLFARBEN
DREI TAGUNGEN: IIC, ICOM-CC, ICOMOS
GEMÄLDEREPRODUKTION MIT DEM SCANNER
FARBENFROHE ANTIKE WELT
VIER ÖLGEMÄLDE VON EDVARD MUNCH
WINTEREINHAUSUNGEN



www.restauro.de

1

Januar/Februar 2009

Tine Frøysaker and Mirjam Liu

Four (of eleven) unvarnished oil paintings on canvas by Edvard Munch in the Aula of Oslo University

Preliminary notes on their materials, techniques and original appearances

So far, little has been published on Edvard Munch's painting techniques of the first decades of the 20th century. This preliminary study, which was performed by means of non-invasive examination techniques, suggests the artist's choice of materials and ways of applications for four of the smaller motifs in his large scale room decoration in the Aula of Oslo University (1909–1916). Observations on previous treatments, the present condition and changes with regard to the original appearance are also included.

Tine Frøysaker, PhD, is a painting conservator and the leader of the Aula project. She works as Associate Professor and Coordinator of the Conservation Studies, University of Oslo (UiO), Department of Archaeology, Conservation and History (IAKH), Norway.

Mirjam Liu, MA, is a painting conservator. She works as Scientific Assistant in the Aula project at UiO, IAKH.

Introduction

Background

During the years 1904 to 1923, Edvard Munch made four room decorations,¹ two in Germany² and two in Oslo,³ the capital of Norway. Today, the artist's Aula⁴ decoration (1909–1916) is his only cycle of paintings that is still preserved in original context.⁵ The Aula decoration consists of eleven, large scale, canvas paintings, which cover c. 220 m² of the hall's three main walls (Ill. 1).⁶ All paintings are of the same height and are located at the same level. Due to the interior design of the Aula, including the dimensions of the eleven niches in the walls, as well as Munch's choice of motifs and their individual placing, the wall program contains three major canvases and their eight companion pieces. "The Sun", which is the central motif, is situated at the northern wall. Respectively, the two side walls have one main motif each, "History" on the western wall and

"Alma Mater" on the eastern. Both paintings have two companion canvases: "History" has "Chemistry" (c. 449 x 226 cm)⁷ and "New Rays" (c. 449 x 226 cm)⁸ (Ill. 2–3); "Alma Mater" has "Women Harvesting" (c. 450 x 225 cm) and "The Fountain" (c. 448 x 225 cm) (Ill. 4–5). The present paper focuses on these four side panels.

Visual examinations during a cleaning campaign in 1973 suggested that the eleven paintings could be arranged into six different categories according to their making⁹: Each of the three major paintings were categorized separately, and the eight accompanying motifs were arranged in three groups: a) "The Fountain" and "Chemistry"; b) "Women Harvesting", "New Rays" and "Spirits in the Flood of Light"; and finally; c) "Women Reaching towards the Light" and "Awakening Men in the Flood of Light". In short, the 1973 report claimed that the four accompanying paintings share some common features¹⁰: Their support includes two pieces of twill fabric each; their four joints or seams run vertical near the middle of the paintings and the numbers of canvas threads pr. cm² are almost identical.¹¹ The report also suggests that the same four paintings can be paired together across the room because of resemblances in materials and techniques (see Ill. 1).¹² "The Fountain" and "Chemistry" was noted to have a thin, light greyish, glue-bound ground. The other two paintings were claimed to have a thin, rather dark, yellowish grey ground of the same binding agent. In addition, the application of paint was described as promoting the same classification of pairs.¹³

1 Map showing the placing of Edvard Munch's 11 paintings (1909–1916) in the Aula of Oslo University.

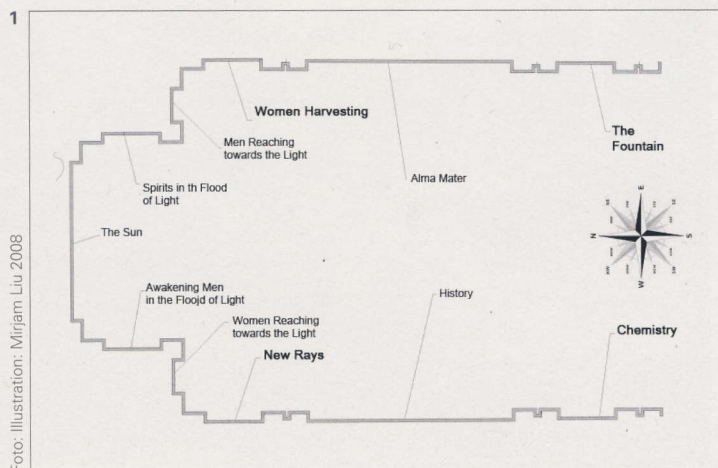


Foto: Illustration: Mirjam Liu 2008

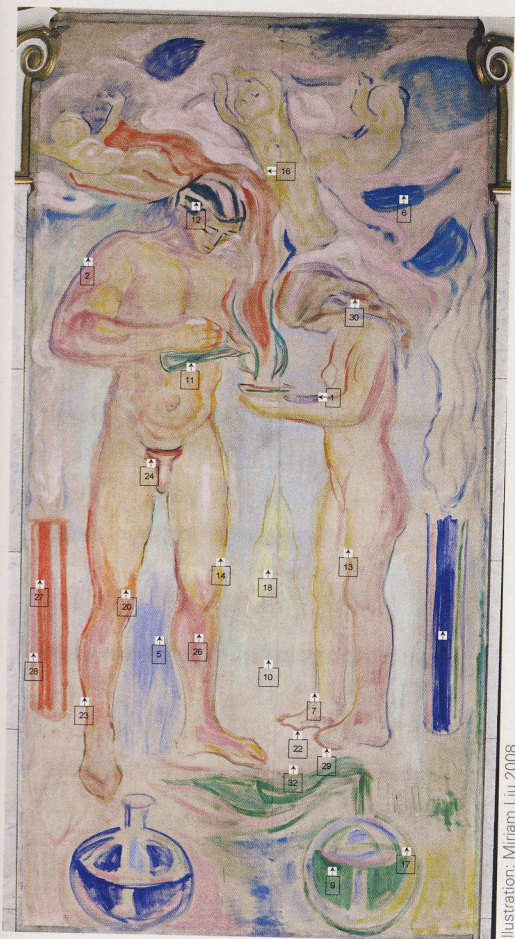


Illustration: Mirjam Liu 2008

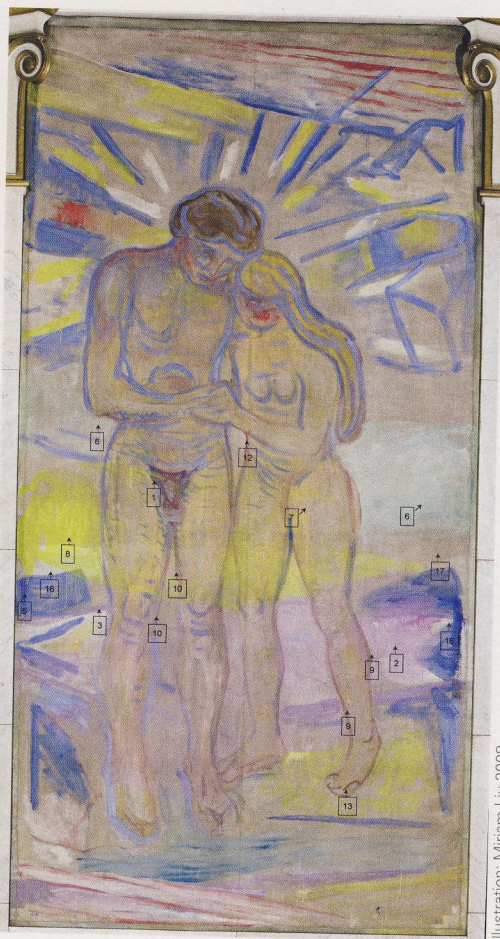


Illustration: Mirjam Liu 2008

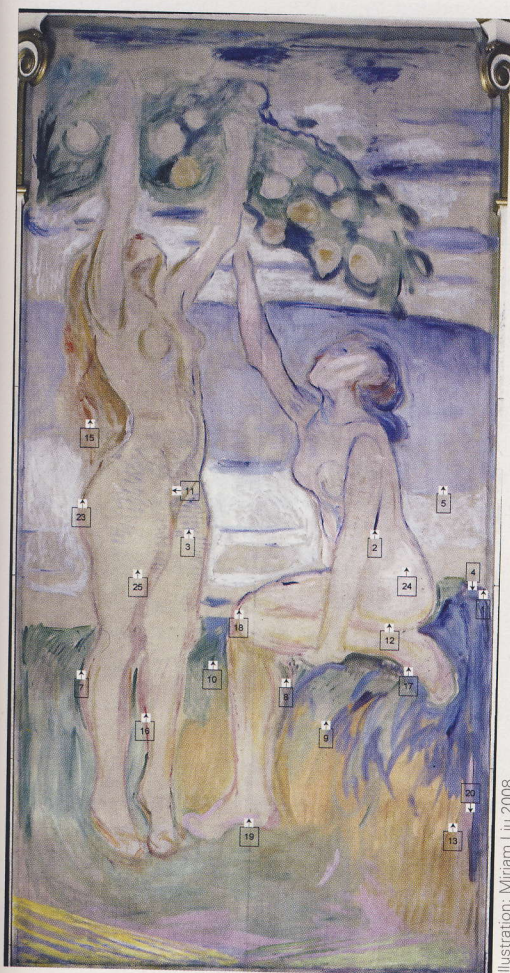


Illustration: Mirjam Liu 2008

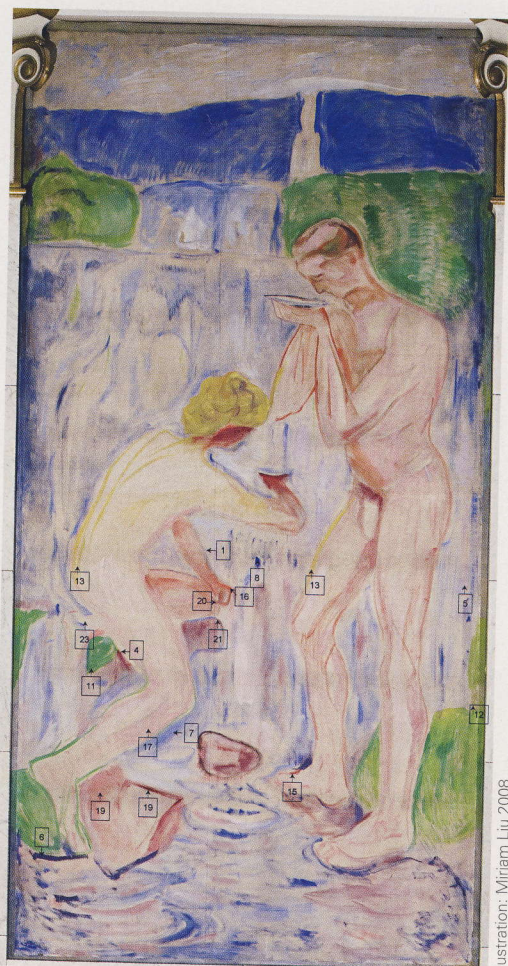


Illustration: Mirjam Liu 2008

2 Metigo Map of the test areas for the portable XRF, "Chemistry" (c. 449 x 226 cm)

3 Metigo Map of the XRF-tests, "New Rays" (c. 449 x 226 cm)

4 Metigo Map of the XRF-tests, "Women Harvesting" (c. 450 x 225 cm)

5 Metigo Map of the XRF-tests, "The Fountain" (c. 448 x 225 cm)



Photographer: Birger Lindstad 2006

6
Detail of the cleaning tests
performed in 2001, "New Rays"

Previous studies revealed that since 1916 the four paintings have undergone three structural interventions and five cleanings.¹⁴ The last cleaning was performed in 1973. During the fall of 2001, a few cleanings tests were carried out on "New Rays" (Ill. 6). By then, the dirt accumulation had been going on for twenty-eight years. Today, after seven more years, the four paintings have endured even further visual changes because of the continued soiling by air-born pollutants. In 2009, all Aula paintings will be disassembled prior to the forthcoming renovation of the room. The evacuation will last for two years and will include conservation treatments.¹⁵

Research questions

During 2007 and 2008, the four paintings were re-examined in the course of the Aula project.¹⁶ New methods were available (see below), and thus we were able to investigate the following questions: Are the supports as similar as the examination in 1973 suggested; is it possible to categorize the four grounds into two different pairs; which colours were used for the pictorial layers and how were they applied; can the arrangement into pairs from 1973 still be supported; can the present results be used to detect chronological steps in Munch's making of these paintings; and finally, what can be revealed about the original appearance of these paintings?

Methods

Archives

The archival studies of previous treatments are still in progress.¹⁷ The oldest restoration report was written in 1963 by painting conservator Jan Thurmann-Moe at the Munch-Museum.¹⁸ In 1973 (mentioned above) and 1986, painting conservator Svein A. Wiik at the University Museum of Antiquities (now KHM) wrote the other two reports.¹⁹ Recently, the Archive at Stockholm Nationalmuseum came across an internal report from 1943 on the lining practise of the museum's restorer Gustav Jaensson.²⁰ Other archives have already shown that he played a vital role in the mounting of the Aula paintings on to Masonite boards in 1946.²¹ However, Jaensson's report from 1943 is the only description found so far on how the contemporary mounting onto Masonite was performed.

Publications

In 1945, the restorer Ole Dørje Haug wrote a newspaper article on the various interventions on the paintings during the 1940s.²² In 1960, the former principal of Oslo University, Otto Lous Mohr, published a book on the history of Munch's commission for the Aula, including comments on some of the treatments and incidents between 1916 and 1960.²³ In 1997, the painting conservator and art historian Johannes Rød provided further information on the treatment history from 1926 up to 1951.²⁴

In 2007, Tine Frøysaker published the first overview on the majority of the interventions carried out between 1916 and 2001.²⁵ This paper was followed in 2008 by an article which included a newly discovered treatment from 1937, most likely an additional cleaning campaign.²⁶ The last paper by Frøysaker regarding interventions on the Aula paintings dealt with the dismantling of one of the smaller motifs, "Chemistry", in 2008.²⁷

Besides Gösta Svenæus' (1953) and Mohr's (1960) discussions on how Munch made changes (pentimenti) on "History" and "Alma Mater"²⁸, little has been published on the artist's use of materials and techniques on the Aula paintings. In 2000, Poul Erik Tøjner edited parts of Munch's own notes on how he chose his course of action for the Aula decoration.²⁹ In addition, Frøysaker's papers from 2007 and 2008 include technical aspects from Wiik's unpublished report (1973) and preliminary findings from the Aula project.³⁰

Examinations and recordings

During 2007, the four paintings in question were examined in situ from scaffolding.³¹ Due to present health and safety rules with limitations on working height, the working platform on the scaffold did not allow us to reach the upper parts of the paintings.³² However, on January 15th of the following year, "Chemistry" was dismantled from the wall and transported to our conservation studio.³³ This facilitated a closer look at its entire surface including its reverse side.

In situ, the following non-invasive tools were employed: daylight lamps and flashlights to achieve raking light, head lens, field microscope (20x), a simple thread counter and NITON's portable X-ray fluorescence instrument (XRF).³⁴ In the conservation studio, the raking light examination was improved and the range of equipment was expanded with a laboratory microscope (4x), a UV-lamp and an IR-camera.³⁵

Both in situ and in the studio, the observations, measurements and test areas were recorded in Metigo Map.³⁶

XRF

A portable XRF analyzer (XLt) provides qualitative and semi-quantitative results.³⁷ The penetration dept of the X-rays will depend on the elements in the actual test area, its sample matrix and thickness.³⁸ The XRF-spectrum is accumulative, and it is difficult to distinct the contents of the individual layers in a multi-layered structure.³⁹ These spectrums thus indicate the total amount of elements (in this case between Mg (12) with low atomic weight and U (92) with high) detectable within the test area.

The present usage of XRF to examine Munch's Aula-paintings is to gain a preliminary overview of



Photographer: Birger Lindstad 2008



Photographer: Mirjam Liu 2008

the artist's materials prior to future sampling of cross-sections and further analysis.⁴⁰ Due to the thin layers of ground and paint compared to the matrix of canvas, Masonite and wooden framework, we expected the X-rays to penetrate the entire structure of the paintings. The procedure was as the following: The XRF was when ever possible used on single layer structures only; each colour was tested by several XRF-recordings; and every result was compared with the elements found for their individual ground.

By comparing the visual appearance of each colour with their individual XRF-spectrum, it is possible to suggest their components. These interpretations are estimated as initial, and at this early stage, far from conclusive. Since the present XRF cannot detect elements with a lower atomic weight than magnesium, organic pigments cannot be localized. In principle, there might be organic colouring material in all colours in this study. They will however, only be suggested where the XRF-spectrums lack such colouring components, i.e. when a layer of violet only seems to contain a single colorant, an inorganic blue (see below).

Some elements will occur in the spectrums of different colours. In this paper, chrome in a green colour will be called chrome green, while chrome in a yellow is interpreted as chrome yellow.

Diverging elements were found in some of the colours investigated by the present approach, pointing at pigments that cannot have a visual influence on the appearance of the colour. Some probable reasons for this are: indistinct measurements, interferences by neighbouring colours within the span of the XRF and eventually, the artist's usage of con-

taminated brushes. The origin and purpose of such elements and their possible pigments are still open to further interpretations; thus they are being presented in brackets.

Removal of subsidiary material from "Chemistry"

Prior to the dismantling of the painting from the wall, all the zinc strips (from 1946) at its outer edges were removed.⁴¹ During the studio examination, a few cleaning tests were performed: Loose surface dirt was taken off by brush and a low suction vacuum cleaner; darker and firmly attached stripes of dirt accumulation (above the wooden framework from 1946) were reduced by the use of soft "sponges" (of polyurethane foam); yellowed splashes of paste (from the lining on to Masonite boards in 1946) were removed by brush and scalpel.⁴² In addition, some colours were examined after saliva cleaning, and some small areas of retouching (from 1946) were also removed mechanically.⁴³

On the reverse side, a layer of disintegrated paper (from 1946) was removed to expose the framework, the Masonite and the insulation which were added during the post war remounting.

Results

Condition

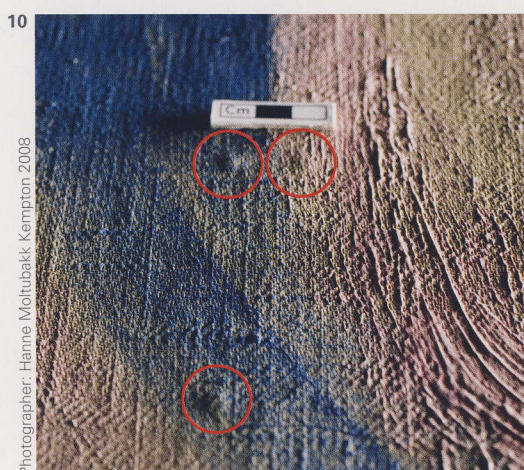
The applied approach provided new insight into the present condition of the paintings.⁴⁴ For the first time in more than sixty years, the materials on the reverse side (from the remounting in 1946) were accessible, as well as the brick wall behind "Chemistry" (Ill. 7). Close to this brick wall there was a thin layer of discoloured and brittle paper (mentioned

7 The brick wall behind "Chemistry"

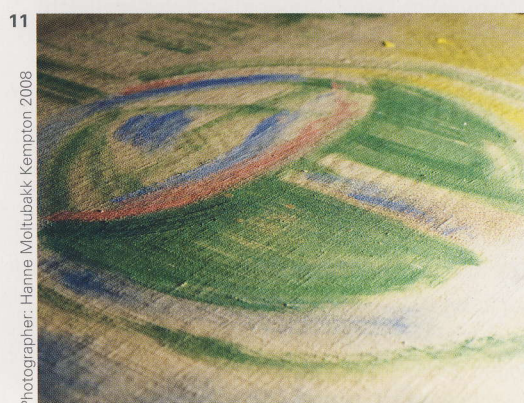
8 Detail of the wooden framework and the insulation on the reverse side of the Masonite boards from 1946



Photographers: Marie C. Mustad and Terje Syversen 2008



Photographer: Hanne Moltubakk Kempton 2008



Photographer: Hanne Moltubakk Kempton 2008

9
Detail showing the head of one of the nails which attach the Masonite boards on to the wooden framework, "Chemistry".

10
Detail in raking light showing raised nails below the canvas, "Chemistry"

11
Detail in raking light demonstrating the textural pattern of the lining paste left by the jagged edge of the application tool, "Chemistry".

above) which covered both the wooden framework and the insulation behind the Masonite (Ill. 8). The framework is attached to the Masonite by thin nails with small heads (Ill. 9). Raking light on the surface of the painting shows that some of these nails have risen slightly from the Masonite (Ill. 10).⁴⁵ In addition, the raking light also shows the textural pattern

left in the lining adhesive by the jagged edge of the application tool (Ill. 11). This textural change can indicate that the Masonite mounting was performed with rather light pressure.⁴⁶

"Chemistry" has some areas of de-lamination between the canvas and the Masonite (Ill. 12). This has never been reported previously,⁴⁷ and it is difficult to date the de-laminations found. They might have occurred during lining due to insufficient pressure or local lack of glue⁴⁸, or they resulted from movements in the wooden framework and canvas caused by changes in the room climate.⁴⁹ The attachment between canvas, ground and paint layers is however sufficient on all four paintings. Some colours have age craquelures, and only in a few cases there are minor losses of paint. The craquelures and a few lacunas seem to result from dimensional stress in canvas and framework; although most paint losses, especially in one of the paintings, were caused by previous mechanical cleaning. In "New Rays" only, there are several areas where ground and colours are missing on top of the canvas knots.

In 1926, the Aula paintings received a layer of white priming at their reverse side.⁵⁰ In some areas, drops of priming have penetrated through the canvas weave and the layers of paint. On the paint surface, there were also remnants from the treatments in 1946; discoloured splashes of the mounting adhesive along with overpaints from the colour applications on the zinc strips surrounding each painting.

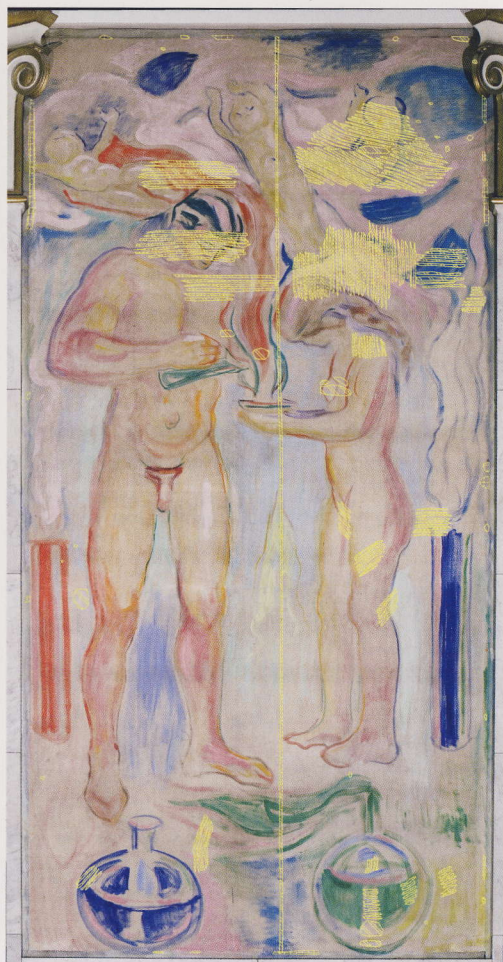
It has been reported that the Aula paintings were varnished for their first time in 1926.⁵¹ Despite possibilities like the later removal of varnish during one of the following cleaning interventions, the visual examination including the UV-lamp revealed no traces of varnish or varnish removal.⁵²

The recent local removals of dirt and paste from the surface of "Chemistry" show that the painting must have been very clean prior to the mounting onto Masonite (Ill. 13). It is obvious that all colours and grounds are heavily soiled and blurred by non-original materials.

Supports

The four paintings are made of two pieces of canvas each, and all eight pieces share the same twill weave pattern (Ill. 14). The individual pieces were stitched together in vertical pairs, either with butt joins or with a minimum of extra hems on each side of the seam.⁵³ Some of the eight textiles have quite similar widths, others differ.⁵⁴ In "Chemistry" the (viewer's) right piece is c. 101 cm and the left is c. 124 cm wide; in "New Rays" and "Women Harvesting" both the right and left textiles are each c. 113 cm wide; and in "The Fountain" the right is c. 94 cm and the left is c. 130 cm wide.

On each piece of canvas the density of the weave was established by the counting of threads per



12

Ground

In all four paintings the white ground is clearly visible because there are many areas without subsequent applications of colour. The ground was applied rather thinly and there are no traces left by the application tool (Ill. 16). The texture of the canvas weave was not reduced by this sparse layering, and there are no signs of a sanding down prior to the application of paint.⁵⁸ In all sections of exposed ground, it is matte, lean and very absorbent. The XRF-examinations of the ground on all canvases indicate zinc; lead and chalk (see Tables 1–4). The only difference noted amongst the grounds is that "New Rays" seems to be the only painting with a higher portion of zinc-containing pigment and with less use of a lead-based component (Ill. 17). No other elements that can be suggested as additional colours or fillers were found.

Illustration: Mirjam Liu 2008

cm2.⁵⁵ The average numbers of threads are slightly dissimilar.⁵⁶ The right textile at "Chemistry" has 14 x 13,5 threads and its left has 14 x 13,8 threads; "New Rays" right one has 12,7 x 13,2 and its left one has 13,1 x 13,2 threads; both textiles at "Women Harvesting" have 14 x 12,4 threads; and on "The Fountain", the right textile has 13,4 x 14 and its left has 13,2 x 13,9 threads.

A glue size layer?

Visual examination of the surfaces revealed no size layer between the supports and the grounds. In addition, in several places the priming (from 1926) on the reverse side of the canvases have penetrated the weave and formed small white pellets on the surface of the paintings (Ill. 15). The pellets are soluble in water, and in the middle they show a small crater with a pinhole. This can be a sign of water evaporation while drying. Often a glue size layer is too thin to be seen, but usually even an extremely thin film is capable of bridging the gaps in the weave of the canvas.⁵⁷ The pellets might indicate that the priming was applied on the reverse side by the use of pressure which allowed penetration in some areas. There are two possible explanations for this. One is that there was no original size. The other options are that a possible size was unevenly applied or just brittle.

12

Metigo Map of the de-laminations found between canvas and Masonite, "Chemistry"

13

Detail of local cleaning of paste on the surface, "Chemistry". Please note the contrast between the cleaned areas and their soiled surroundings.

14

Detail showing the twill weave canvas pattern, "Chemistry".

15

Detail of the white pellets which penetrated the canvas when the white reverse side priming was applied in 1926, "Chemistry".

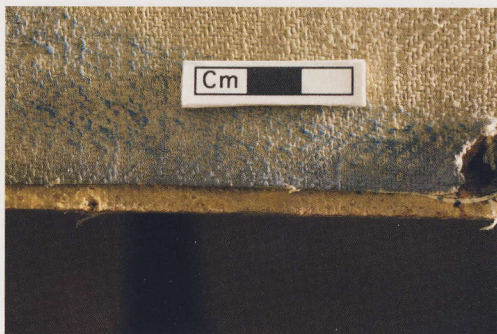
16

Close up of bare ground, "Chemistry"



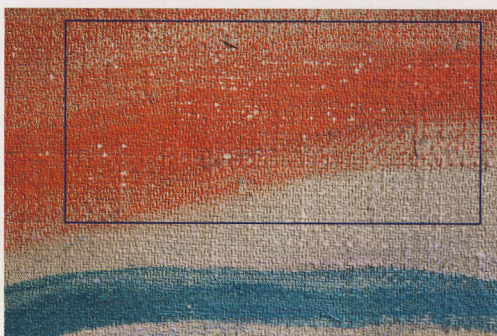
13

Photographer: Mirjam Liu 2008



14

Photographer: Hanne Moltubakk Kempton 2008



15

Photographers: Marie C. Mustad and Terje Swersen 2008



16

Photographer: Mirjam Liu 2008

Table 1. "Chemistry" [S. No. 1-32]

S. No.	T. No.	Main colour	Application area	Applied on	Mc M D PI H	Gloss Matte	Diluted Semi-solid	Opaque Semi-transparent Transparent	XRF-elements	Suggested pigments
1	0101	Violet	Contours and shadows in the female's flesh colours (+ her hair)	bare ground	D + PI	gloss		opaque	Al, Si, S, Cd, Sn, Ca, Cr, Co, Cu, Zn, Pb	Cadmium yellow, Cerulean blue, copper green, chrome green, organic red?
2	0102	Violet	Contours in the male's flesh colours (+ shadows)	light red (+ bare ground)	D	gloss		opaque	Al, Si, S, Sn, Ca, Cr, Co, Cu, Zn, As, Pb	Emerald or Scheele's green, Cerulean blue, copper green, chrome green, organic red (?)
3	0201	Blue	Contours in the female's flesh colours (+ in the infants')	bare ground	D	gloss		semi-transparent		Ultramarine, Prussian blue and cobalt blue
4	0202	Blue	Laboratory flask (+ test tube)	bare ground	Mc + D	gloss + matte	diluted	semi-transparent	Zn, Pb, Ca, Si, Al, Fe, Co	Ultramarine, Prussian blue and cobalt blue
5	0203	Blue	Background	bare ground + on green	Mc + M	gloss			Zn, Pb, Ca, Co, Cu, As, Ba	Cobalt blue, Emerald or Scheele's green + white added
6	0204	Blue	Sky	bare ground	Mc	gloss	semi-solid	opaque	Al, Si, S, Sn, Ca, Fe, Co, Cu, Zn, Pb	Cerulean blue, some copper green and possibly ultramarine
7	0301	Green	Contours in the female's flesh colours	bare ground	D	matte	diluted	semi-transparent	Zn, Pb, Ca, Cr, Cu	Chrome green, copper green
8	0302	Green	Contours in the male's flesh colours	bare ground + on other colours	D	gloss	semi-solid	opaque		Chrome green, copper green
9	0303	Green	Laboratory flask	bare ground	Mc	matte + glossy impasto		semi-transparent	As, Cu, Zn, Pb, Ca, Cr	Emerald or Scheele's green, chrome green
10	0304	Green	Background	bare ground + on blue	Mc + M	matte		semi-transparent	Zn, Pb, Cu, As, Cr, Ca	Emerald or Scheele's green, chrome green + white added
11	0305	Green	Can, smoke and bowl	bare ground	D	gloss	diluted	transparent	Zn, Pb, Ca, Cr, Cu	Chrome green, copper green
12	0307	Green	The male's hair (+ in the female's hair)	bare ground	Mc + D	gloss	semi-solid	opaque	Si, Ca, Cr, Cu, Zn, As, Pb	Emerald or Scheele's green, some chrome green
13	0401	Yellow	Contours in the female's flesh colours	light red + on yellow	D + PI	gloss	diluted	semi-transparent	Zn, Pb, Ca, Cd, S, Hg, Ba, Cr	Cadmium yellow, vermilion, chrome yellow
14	0402	Yellow	Contours in the male's flesh colour	bare ground	D + PI	gloss	semi-solid	opaque	Zn, Pb, Ca, Cd, S, Hg, Ba, Cr	Cadmium yellow, Vermilion, Chrome yellow
15	0403	Yellow	Highlights in the female's flesh	bare ground	Mc	matte + gloss	semi-solid	semi-transparent		Cadmium yellow, chrome yellow + zinc white added
16	0404	Yellow	Middle tones in the infants' flesh colours	bare ground	Mc	matte + glossy impasto	semi-solid	semi-transparent	S, Cd, Ca, Ba, Cr, Fe, Zn, Pb	Cadmium yellow and possibly chrome yellow
17	0405	Yellow	Highlight on green laboratory flask and its background	bare ground	Mc	matte + glossy impasto		opaque and semi-transparent	Zn, Pb, Ca, S, Cd, Ba, Cr	Cadmium yellow, chrome yellow
18	0406	Yellow	Flame below bowl	bare ground	Mc	gloss		opaque	Zn, Pb, Ca, Ba, Cr, S, Cu	Cadmium yellow, chrome yellow + zinc white added
19	0407	Yellow	Contours around the flame	bare ground + on light blue and on green	D	gloss	diluted	semi-transparent		Cadmium yellow, vermilion and possibly chrome yellow
20	0501	Yellowish red	Contours and middle tones in the male's flesh colours	bare ground + on red and on light green	D	gloss	semi-solid	semi-transparent	Zn, Pb, Ca, Cd, S, Hg, Ba, Cr, Al, S	Cadmium yellow, possibly chrome yellow, vermilion
21	0601	Red	Contours in the female's flesh colours (+ shadows in the male's flesh colours)	bare ground	D	gloss	semi-solid	semi-transparent		Vermilion
22	0602	Red	Contours in the female's flesh colours	bare ground	D	gloss	semi-solid	semi-transparent	Al, Si, S, Ca, Ba, Cr, Zn, Hg, Pb	Vermilion, chrome yellow
23	0604	Red	Contours in the male's flesh colours	bare ground	D	gloss	semi-solid	semi-transparent	Zn, Pb, Hg, S, Cd, Ca, Ba, Al, Si	Vermilion, cadmium yellow and fillers?
24	0605	Red	Contours in the male's flesh colours	bare ground	D	matte	diluted	semi-transparent	Al, Si, P, Cl, K, Ca, Cr, Zn, Pb	Organic red due to alum?
25	0606	Red	Highlights in the male's flesh colours	bare ground	D	gloss		opaque		Vermilion + white added
26	0607	Red	Middle tones in the male's flesh	bare ground	Mc	matte	semi-solid	semi-transparent	Zn, Pb, Ca, S, Hg, Al, Si, Ba	Vermilion + fillers
27	0608	Red	Test tube (+ smoke above bowl)	bare ground	Mc	gloss	diluted	semi-transparent	Zn, Pb, Hg, S, Ca, Ba, Al, Si	Vermilion and possibly fillers
28	0609	Red	Highlights in test tubes (+ laboratory flasks + background)	bare ground	Mc	gloss	semi-solid	opaque	Zn, Pb, Ca, S, Co, Hg, Fe, Ba, Al, Si, P	Vermilion, cobalt phosphate, fillers? + zinc white added
29	0701	Brownish red	Contours in the female's flesh colours	bare ground	D	gloss		opaque	Zn, Pb, Ca, S, Hg, Ba, Cr, Al, Si, C(?)	Vermilion, chrome yellow (or chrome green?), organic black
30	0801	Brown	Shadows in her braid hair + in the couples' flesh colours	bare ground	D	matte + glossy impasto	semi-solid	opaque + semi-transparent	S, Cl, K, Ca, Ba, Cr, Fe, Zn, Hg, Pb	Vermilion, possibly chrome green (if not chrome yellow) and potassium
31	1002	White	Highlights in the infant's flesh colours	bare ground + on yellow	D	gloss		opaque		Unknown white + vermilion added?
32	1001	White	Background below the female's right foot	bare ground only	Mc	matte		opaque	S, Ag (interference?), Ca, Zn, Pb.	Zinc white, lead white, chalk, Zn, Pb.

Tables 1-4

Chronological number of colour applications (S. No.). The first two numbers of (T. No.) refer to the main colour and the last two refer to the individual number of each specific colour. Monochrome (Mc), modelled (M), drawn line(s) (D), the brush was dipped in more than one colour (PI), hatched (H). Please note that alternative interpretations of the elements found by XRF are possible.

Table 1

Colours, application, elements provided by portable XRF and suggested pigments, "Chemistry"

Underdrawings

All human figures in the four paintings, including the infants in the sky of "Chemistry", were drawn directly on the ground with slender, matte and greyish black lines (Ill. 18).⁵⁹ In addition, also in "Chemistry", the smoke, the test tubes and the laboratory flasks show those sketched lines. All other kinds of shapes and forms in the four paintings seem to lack any similar underdrawings. Or if present, they are completely covered by the subsequent brush strokes. In "Chemistry" there are no prominent differences between the XRF results obtained from the underdrawings and the bare ground. It is likely that the drawn lines are of organic origin such as carbon-based blacks.⁶⁰

Local underpaints

In "New Rays" there are a few local, white layers below transparent colours (Ill. 19). These white layers are brighter and more opaque than the ground

and they increase the brilliance of the subsequent transparent colours. Thus these white layers have been interpreted as local underpaints. The larger ones are situated behind the man's right thigh, knee and upper leg and behind the female's left leg as well as between her legs. Due to overlapping contours of the flesh colours it seems like the couple was more or less finished before the application of the white underpaint in their surroundings. In addition, a few local and smaller underpaints of the same colour are scattered in the sky. In a few places close to the couple, the white underpaints remain exposed. In these areas the white colour is monochrome, glossy and rather semi-solid and opaque (see Table 2, T. No. 1002). The XRF-examinations might imply that the underpaints are mixtures of zinc white,⁶¹ lead white⁶² and a small amount of chrome yellow.⁶³ Anyway, alternative interpretations cannot be ruled out.

Table 2. "New Rays" [S. No. 1-17]

S. No.	T. No.	Main colour	Application area	Applied on	Mc M D H	Gloss Matte	Diluted Semi-solid	Opaque Semi-transparent Transparent	XRF-elements	Suggested pigments in top layer
1	0101	Violet	Contours and shadows in the male's flesh colours	blue, + on yellow, + on red	D + M	matte	diluted	semi-transparent	Zn, Pb, S, Hg, As?, Ca, Si, Al	Vermilion, ultramarine, As?
2	0102	Violet	Background behind the female's legs	bare ground + on white underpainting, + on blue		gloss	diluted	semi-transparent + opaque	Zn, Pb, S, Co, Hg, Ba, Cr, Si, Al	Vermilion, cobalt blue, chrome yellow, Si + Al fillers?
3	0103	Violet	Background behind the male's right ankle (at the edge of the motif), + on top of the couple's legs	bare ground + on white underpainting, + on blue, + on the flesh colours		matt on bare ground, glossy on colours	diluted	transparent	Zn, Pb, Ca, Mn, Co, P, Si, Cu, As	Manganese violet, cobalt blue, Cu + As?
4	0201	Blue	Contours in the couple's flesh colours	bare ground + on other colours	D	matte	diluted			
5	0202	Blue	Background behind the male's right leg, + behind the female's left leg	bare ground + on white underpaint	M	matte + glossy parts	diluted	semi-transparent + opaque	Pb, Zn, S, Si, Al, Ca, Co	Ultramarine, cobalt blue, lead white
6	0301	Green	Background below the male's right elbow (+ behind the female)	bare ground + on white, + on blue	M	matte + glossy parts	diluted	semi-transparent	Zn, Pb, S, Sr, Cr, Ca, Co, Si	Strontium chromate, chrome green, cobalt blue + zinc white added
7	0401	Yellow	Middle tones in the couple's flesh colours	bare ground + on various colours		matte + glossy parts	diluted	transparent	Zn, Pb, Ca, S, Cd, Hg, As	Cadmium yellow, vermillion + zinc white added
8	0402	Yellow	Background behind the couple's thighs	bare ground		matte	diluted	transparent	Zn, Pb, Ca, S(?), Cr, Ba	Chrome yellow
9	0501	Yellowish red	Contours in the female's flesh colours	bare ground	D	matte	semi-solid	opaque	Zn, Pb, Hg, S, Cd, Si, Ba, Cr, Co, Sr(?)	Vermilion, cadmium yellow or chrome yellow, cobalt blue (= contamination?)
10	0601	Red	Contours in the male's flesh colours	bare ground	D	gloss	diluted	semi-transparent + opaque	Zn, Pb, S, Ca, Hg, Co, Si	Vermilion, cobalt pigment + lead white added
11	0602	Red	Shadows in the couple's flesh colours (+ lines in the sky)	bare ground (+ on blue?)	Mc					
12	0701	Brownish red	Contours in the female's flesh colours	bare ground	D	matte	diluted + semi-solid	semi-transparent + opaque	Zn, Pb, Ca, S, Hg, Co, Cu	Vermilion, cobalt pigment, copper pigment + zinc white added
13	0801	Brown	Contours in the female's flesh colours	bare ground	D	matte	semi-solid	semi-transparent	Zn, Pb, Ca, S, Hg	Vermilion, organic black? + zinc white added
14	0802	Brown	Hair on male (it also has some blue finishing lines on top)	bare ground (it also has some blue finishing lines on top)	Mc	matte + gloss	diluted	semi-transparent		
15	1001	White	Highlights in the male's flesh colours	other colours	D + H	matte	diluted	opaque		Unknown white
16	1002	White	Bare, exposed underpaint	bare ground	Mc	gloss	semi-solid	opaque	Zn, Pb, Ca, Ba, Cr	Zinc white, lead white, chrome yellow
17	1003	White	Background (+ highlights in the couple's flesh colours)	bare ground only		matte		opaque	Zn, Pb, Ca	Zinc white, lead white, chalk

Table 2

Colours, application, elements provided by portable XRF and suggested pigments, "New Rays"

Application of colours

By looking for overlapping brush strokes, it was possible to find some general trends in the sequences of the artist's applications: First, the contour lines around the figures were painted followed by the rest of the flesh colours (see below). Then their surroundings were applied, and often some new contours were added around the female and the male. In "Chemistry" it seems like the flame below the

bowl was amongst the last areas to be painted. In "New Rays" a few contours on top of the transparent yellow layer across the couple's thighs is likely to be the artist's finishing brushstrokes. In "Harvesting Women" the large branch with fruits might have been the last application. And finally, in "The Fountain" the ultimate contours seem to be Munch's final touches.

Table 3. "Women Harvesting" [S. No. 1-27]

S. No.	T. No.	Main colour	Application area	Applied on	Mc M D Pl H	Gloss Matte	Diluted Semi-solid	Opaque Semi-transparent Transparent	XRF-elements	Suggested pigments
1	0101	Violet	Ground behind the seated female	bare ground (+ on yellow)	D	matte		semi-transparent	Pb, Zn, Ca, S, Si, Al, P, Mn, Co, Fe	Manganese violet, cobalt blue
2	0201	Blue	Contours in the seated female's flesh colours	bare ground	D	matte	semi-solid	semi-transparent	Pb, Zn, S, Si, Al, Ca, Fe	Ultramarine, Prussian blue
3	0202	Blue	Shadows in the standing female's flesh colours	bare ground + on yellow	H	matte	semi-solid	opaque	Pb, Zn, S, Si, Al, Ca, Fe	Ultramarine, Prussian blue + white added
4	0203	Blue	Ground behind the seated female	lighter blue	M	matte		semi-transparent	Pb, Zn, Ca, S, Si, Al, Fe, Co	Ultramarine, Prussian blue, cobalt blue
5	0204	Blue	Hill behind the females	bare ground	M	matte		semi-transparent	Pb, Zn, S, Si, Al, Ca, Fe	Ultramarine, Prussian blue + lead white added
6	0205	Blue	Corner below the standing female	light red		gloss		opaque		Ultramarine, Prussian blue
7	0301	Green	Grass behind standing female's leg (+ contours in her flesh colours)	bare ground	D	matte	diluted	semi-transparent	Zn, Pb, Ca, Cr, Ba, S, Si, Al, Hg	Chrome green and possibly some cadmium yellow, vermilion + fillers?
8	0302	Green	Contours in the seated female's flesh colours	bare ground	D	matte	diluted	semi-transparent	Zn, Pb, Ca, S, Cr, Fe, Ba, Si, Hg, Cu	Chrome green, some iron and copper green and possibly fillers?
9	0303	Green	Light grass below the seated female	yellow	M	matte + gloss		opaque + semi-transparent	Zn, Pb, Ca, Cr, Ba, S, Si, Al, Cu	Chrome green, copper green + white added
10	0304	Green	Dark grass between the females	bare ground	Mc	matte	diluted	semi-transparent	Zn, Pb, Ca, Cr, Ba, S, Si, Al, Hg	Chrome green, vermilion + fillers?
11	0401	Yellow	Contours (and hair) in the standing female's flesh colours	bare ground	D + M	gloss (+ matte)		semi-transparent (+ semi-solid)	Zn, Pb, Ca, S, Cd, Hg	Cadmium yellow, some vermilion + zinc white added
12	0402	Yellow	Contours in the seated female's flesh colours	bare ground	D	matte	semi-solid	semi-transparent	Zn, Pb, Ca, S, Cd, Fe	Cadmium yellow?
13	0403	Yellow	Ground below the seated female	bare ground	M	matte	diluted	semi-transparent	Zn, Pb, Ca, S, Cd, Fe	Cadmium yellow, some yellow ochre? + lead white added
14	0404	Yellow	Lines in corner below the standing female	light red + on blue over light red	D	gloss		opaque		Cadmium yellow
15	0501	Yellowish red	Hair on the standing female	bare ground		matte + glossy impasto	semi-solid	opaque	Zn, Pb, S, Hg, Ca, Cd, Si, Al, Fe	Cadmium yellow, vermilion and possibly red ochre?
16	0601	Red	Contours in the standing female's flesh colours	bare ground	D	matte + glossy impasto	semi-solid		Zn, Hg, Pb, S, Ca, Si, Fe	Vermilion, some red ochre?
17	0602	Red	Contours in the seated female's flesh colours	bare ground	D	gloss		semi-transparent	Zn, Pb, Ca, S, Hg, Fe	Vermilion, red ochre? + zinc white added
18	0603	Red	Contours in the seated female's flesh colours	bare ground	D	gloss	semi-solid	opaque	Zn, Hg, Pb, S, Ca, Al, Si	Vermilion
19	0604	Red	Contours in the seated female's flesh colours	green + on yellow + on bare ground	D	gloss		semi-transparent	Pb, Zn, Co, P, Si, Al, Mn	Cobalt blue or violet(P?) and/or manganese violet + lead white added
20	0605	Red	Ground below the seated female	green + on bare ground + on yellow	M	matte + gloss		semi-transparent	Pb, Zn, Ca, Si	Organic red? + lead white added
21	0606	Red	Hair on the standing female	bare ground	M	matte	semi-solid	semi-transparent		Vermilion
22	0701	Brownish red	Hair on the seated female	bare ground	Mc					
23	0801	Brown	Contours in the standing female's flesh colours	bare ground	D + Pl	matte			Zn, Si, Pb, Ca, S, Cd	Cadmium yellow, organic black?
24	1001	White	Highlights in the seated female's flesh colours	bare ground	H	gloss		opaque + semi-transparent	Pb, Zn, Ca, S, Si, Al, P, Mn, Co, Fe	Lead white
25	1002	White	Highlights in the standing female's flesh colours	bare ground only	Mc	matte		opaque	Al, Si, Ca, Fe, Zn, Pb	Zinc white, lead white, chalk
26	1003	White	Water(?) behind the females	bare ground	M + H	gloss		opaque + semi-transparent		Unknown white and some blue
27	1004	White	Behind the seated female's back	bare ground only	Mc	matte				

Table 3
Colours, application, elements provided by portable XRF and suggested pigments, "Women Harvesting"

Visual examination implies that a drying oil was used as binding media for the paint layers above the ground.⁶⁴ The surface gloss of the paintings shifts from matte ground and lustreless colours to several nuances of shiny and glossy tints. Gloss is still visible in raking light as well as in a few minor cleaning tests (with saliva) which also revealed high gloss.

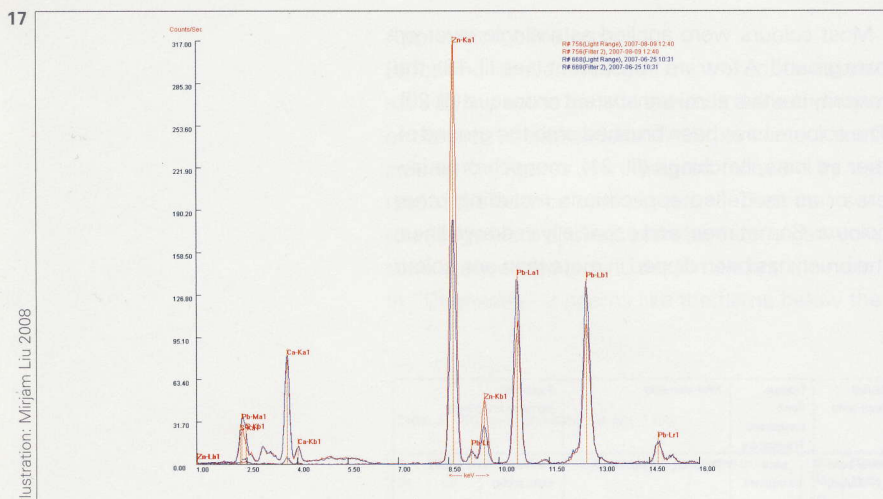
Most colours were applied as a single layer on bare ground. A few are transparent (see Ill. 13); the majority is either semi-transparent or opaque (Ill. 20). The colours have been brushed onto the ground either as lines, hatchings (Ill. 21), monochrome layers or as modelled applications including other colours. Sometimes, and especially in drawn lines, the brush has been dipped in more than one colour

Table 4. "The Fountain" [S. No. 1-25]

S. No.	T. No.	Main colour	Application area	Applied on	Mc M D H	Gloss Matte	Diluted Semi-solid	Opaque Semi-transparent Transparent	XRF-elements	Suggested pigments in top layer
1	0101	Violet	Contours in the seated person's flesh colours (+ in the standing male's)	bare ground + on red (+ on bare ground)	D	matte + glossy in pastose areas	semi-solid (+ diluted)	semi-transparent	Pb, S, Zn, Co, Hg, Si	Vermilion, cobalt + lead white added
2	0102	Violet	Shadows in the standing male's flesh colours	bare ground	Mc	gloss	diluted	semi-transparent		
3	0103	Violet	Middle tone in the seated person's flesh colours	bare ground		gloss	semi-solid			Vermilion, cobalt blue, copper
4	0104	Violet	Rock below the seated person	bare ground	Mc	gloss	diluted + semi-solid	semi-transparent	Zn, Pb, Ca, S, Co, Cu, Hg, P(?)	Vermilion, cobalt blue, a copper pigment + white added
5	0105	Violet	Water below and behind the standing male	bare ground	Mc	gloss		opaque + semi-transparent	Pb, S, Zn, Co, Hg, Si	Vermilion, cobalt blue + Lead white added
6	0201	Blue	Dark blue water below the seated person's right foot	bare ground + on violet, + on light blue		gloss	semi-solid	semi-transparent	Pb, Co, Zn, S, Hg, Al, Si, P	Cobalt blue, possibly some ultramarine + lead white added
7	0202	Blue	Somewhat lighter blue water below the seated person's right knee	on light violet					Zn, Pb, Ca, Co, Al	Cobalt blue + zinc white added
8	0203	Blue	Dark water between the two persons	bare ground + on violet + on dark blue		gloss + matte in pastose areas	semi-solid	semi-transparent	Zn, Pb, Ca, Co, Sn, Cu, As, Al	Cerulean blue, Emerald or Scheele's green
9	0301	Green	Contours in the seated person's flesh colours	bare ground	D	matte + glossy in pastose areas	diluted	semi-transparent		
10	0302	Green	Hair on the standing male	on red	Mc	gloss				
11	0303	Green	Green below the seated person (+ on the hills above?)	bare ground (+ on violet, + on blue)	Mc (+ H)	matte + glossy in pastose areas	diluted (+ semi-solid)	semi-transparent	As, Cu, Pb, Zn, Ca	Emerald or Scheele's green
12	0304	Green	Light green behind the standing male	bare ground + with yellow highlight		matte	semi-solid	opaque	Zn, Pb, Ca, Fe; Si, Ba	Green earth + zinc white added
13	0401	Yellow	Contours in the standing male's flesh colours (+ on the seated person)	bare ground + on red (+ on bare ground)	D	gloss	(+ semi-solid)	opaque (+ semi-transparent)	Zn, Pb, S, Ca, Cd, Cr, Ba, Hg, Co	Chrome yellow, cadmium yellow, some vermilion + lead white added (Co?)
14	0402	Yellow	Hair on the seated person (it also has some dark red(?) finishing lines on top)	on yellow	M	gloss		opaque		
15	0601	Red	Contours on the standing male's flesh colours	bare ground	D	matte	diluted	semi-transparent	Zn, Pb, Hg, S, Ca, Si, Al, Fe	Vermilion, red ochre + fillers?
16	0602	Red	Contours in the seated person's flesh colours		D				Pb, Hg, S, Zn, Al, Si, Ca, Fe, Cr, As(?)	Vermilion, red ochre, Cr?, As?
17	0603	Red	Middle tone in the seated person's flesh colour	bare ground	Mc	gloss	semi-solid	semi-transparent	Zn, Pb, S, Hg, Co, Ca, Si, P, Mn, Cu	Vermilion, cobalt blue, manganese violet, Cu?
18	0604	Red	Shadows in the seated person's flesh colours	bare ground	Mc	gloss	diluted	opaque + semi-transparent		
19	0605	Red	Contour on rock below the seated person (+ shadow)	bare ground	D + Mc			(+ semi-transparent)	Zn, Pb, Ca, S, Hg, P, Co, Al, K(?), As(?)	Vermilion, cobalt phosphate and/or organic red
20	0701	Brownish red	Shadow in the seated person's flesh colours	bare ground	D	gloss	semi-solid	semi-transparent	Pb, Zn, S, Hg, Cd, Fe, Si, Cr, Ca	Vermilion, chrome green, an earth pigment, cadmium yellow + lead white added
21	0800	Brown	Contour on rock below seated person		D				Pb, Zn, S, Ca, Fe, Hg, Si	Vermilion, an earth pigment + lead white added
22	1001	White	Highlight in the seated person's flesh colours	bare ground						Unknown white mixed with red
23	1002	White	Highlights in the couple's flesh colours	bare ground only	Mc	matte			Zn, Pb, Ca (XRF taken behind the seated person)	Zinc white, lead white, chalk
24	1003	White	Upper waterfall	bare ground				semi-transparent		Unknown white
25	1003	White	Highlights in the sky and in the water	bare ground + on blue						Unknown white mixed with unknown blue

Table 4

Colours, application, elements provided by portable XRF and suggested pigments, "The Fountain"



17
XRF-spectra of the grounds
in "New Rays" (red) and in
"Chemistry" (blue)

18
Detail of greyish black
underdrawings, "Chemistry"

(Ill. 22). In other modelled parts the applications must have been performed wet-in-wet, wet-beside-wet or as wet-on-dry.

Some colours were diluted, probably with turpentine to form thin and fluid paints with the same surface texture as the bare ground (Ill. 23). Others have a range of impasto from low to high (Ill. 24), or they were applied as semi-solid strokes only covering the knots of the canvas weave (Ill. 25). Hairs from the paint brush are embedded in almost all types of colours, especially in "Chemistry" (Ill. 26). The diluted colours, however, bear no evidence of brush-marks, in contrast to the less viscous ones.

Colours

The XRF examinations suggest that the majority of colours are composed of more than one individual pigment:

Violets: "Chemistry" seems to have the most complex mixtures of violet (see Table 1, T. No. 0101 and 0102): One contains Cerulean blue⁶⁵ and perhaps organic red⁶⁶ (and possibly cadmium yellow⁶⁷

copper green⁶⁸ and chrome green⁶⁹); the other also seems to have Cerulean blue and an organic red (as well as Emerald or Scheele's green,⁷⁰ copper green and chrome green). In addition, in "New Rays" one of the violets is composed of cobalt blue⁷¹ and red vermilion⁷² (and chrome yellow. Table 2, 0102).

Apart from additions of white pigments for the light shades, the other violets probably are mixtures of two individual pigments: manganese violet⁷³ and cobalt blue were found both in "New Rays" (Table 2, 0103) and in "Harvesting Women" (Table 3, 0101); "New Rays" also contains ultramarine⁷⁴ and vermilion (Table 2, 0101); and finally, "The Fountain" displays cobalt blue and vermilion (Table 4, 0101, 0103, 0105) as well as cobalt blue, vermilion and a copper pigment (Table 4, 0104).

Blues: Both "Chemistry" and "Harvesting Women" contain blue colours consisting of ultramarine, Prussian blue⁷⁵ and cobalt blue (Table 1, 0201, 0202, Table 3, 0203). It seems like "Chemistry" also has a mixture of ultramarine and Cerulean blue (and some copper green. Table 1, 0204). In addition, "Harvesting Women" has light shades of ultramarine and Prussian blue (Table 3, 0202, 0204). Both "New Rays" and "The Fountain" display mixtures of ultramarine and cobalt blue (Table 2, 0202, Table 4, 0201).

Two paintings contain blue colours which include Emerald or Scheele's green: In "Chemistry" the green is mixed with cobalt blue (Table 1, 0203); whereas in "The Fountain" it seems to be mixed with Cerulean blue (Table 4, 0203). The only blue colour with a single blue pigment found so far, is a light blue in "The Fountain", where the tint seems to contain cobalt blue and zinc white (Table 4, 0202).

Greens: Emerald or Scheele's green was also found among the green colours: In "Chemistry" it was mixed with chrome green (Table 1, 0303, 0304, 0307); in "The Fountain" it appears as a single green pigment (Table 4, 0303). In the latter painting, also a single green earth⁷⁶ pigment was apparently used (Table 4, 0304).

Chrome green is present in the other greens: In "Chemistry" and in "Harvesting Women" it is mixed with copper green (Table 1, 0301, 0302, 0305, Table 3, 0303); in the latter it is also mixed with some iron (Table 3, 0302, as well as with cadmium yellow; and with vermilion. Table 3, 0301, 0304); in "New Rays" it might be mixed with strontium chromate and cobalt blue (Table 2, 0301).

Yellows: Cadmium yellow seems to be present in all the yellow colours except one of the yellows in "New Rays" where it only contains chrome yellow (Table 2, 0402). "Chemistry" and "The Fountain" seem to have mixtures of cadmium yellow and vermilion (Table 1, 0401, 0402 and Table 4, 0401). "Chemistry" also displays mixtures of cadmium yellow and chrome yellow (Table 1, 0404–0406). "New



Photographers: Marie C. Mustad and Terje Swersen 2008

Rays" and "Harvesting Women" probably have mixtures of cadmium yellow and vermillion (Table 2, 0401 and Table 3, 0401). "Harvesting Woman" seems to be the only painting in which cadmium yellow is mixed with yellow ochre⁷⁷ (Table 3, 0403); as well as cadmium yellow being the only yellow pigment in another yellow colour in the same painting (Table 3, 0402).

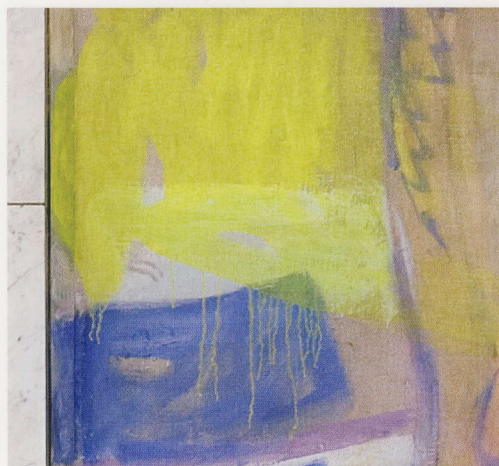
Yellowish reds: Few colours can be characterized as yellowish red. None of them seems to be displayed in "The Fountain". In "Chemistry" the yellowish red is a mixture of cadmium yellow, possibly chrome yellow and vermillion (Table 1, 0501); in "New Rays" it contains vermillion, cadmium or chrome yellow (and maybe some cobalt blue. Table 2, 0501); and finally, in "Harvesting Women" it seems to be a mixture of cadmium yellow, vermillion and perhaps an ochre⁷⁸ (Table 3, 0501).

Reds: Vermilion is probably present in all the red colours except for single organic reds in "Chemistry" and in "Harvesting Women" (Table 1, 0605, Table 3, 0605); as well as in a light red shade with cobalt blue or violet and/or manganese violet together with lead white in the latter (Table 3, 0604).

The other reds in "Chemistry" are either mixtures of vermillion with chrome yellow, with cadmium yellow, with cobalt phosphate, or vermillion is the only individual red (Table 1, 0602, 0603, 0609, 0607 and 0608 respectively). Likewise, in "Harvesting Women", there is a pure vermillion colour (Table 3, 0603). In addition, both "Harvesting Women" and "The Fountain" mixtures of vermillion and red ochre were used (Table 3, 0601, 0602, Table 4, 0601, 0602). Finally, three red mixtures of vermillion and a cobalt pigment were found: In "New Rays" there is a light red shade (Table 2, 0601); in "The Fountain" there are two; one of vermillion, cobalt blue and maybe manganese violet; the other either contains cobalt phosphate and/or organic red together with vermillion (Table 4, 0603, 0605).

Brownish red: This colour is rare, but it has been used in limited areas on all four paintings. Except for the brownish red hair on the seated female in "Harvesting Women", three brownish reds have been examined by XRF. They are mixtures of vermillion and other pigments: In "Chemistry" it also contains chrome yellow or chrome green (Table 1, 0701); in "New Rays", vermillion is mixed with pigments of cobalt and copper (Table 2, 0701); and in "The Fountain", chrome green and an earth pigment as well as cadmium yellow seem to be present together with vermillion (Table 4, 0701).

Browns: Brown has been used only to a limited extent: In "Chemistry", it is a mixture of vermillion, possibly some chrome green or chrome yellow and potassium (Table 1, 0802); in "New Rays", it seems to contain vermillion and an organic black⁷⁹ (Table 2, 0801); in "Harvesting Women" it might be a mixture of cadmium yellow and an organic black (Table 3,



19

Photographer: Miriam Liu 2008

0801); and finally, in "The Fountain", vermillion and an earth pigment are suggested.

Blacks: None of the paintings have colours that can be characterized as black (or dark shades of grey).

Whites: Except for large areas of exposed white ground and some limited areas of local white underpaints (see above), all paintings have additional white colours: In "Chemistry", "Harvesting Women" and "The Fountain" there are whites that seem to be mixed with small amounts of red or blue pigments (Table 1, 1002, Table 3, 1003 and Table 4, 1003). The three latter ones also seem likely to have white colours that could contain white pigments only (Table 2, 1001, Table 3, 1001 and Table 4, 1003). So far, lead white and zinc white are the only white pigments suggested for the white and the light shades of mixed white applications above the ground (Tables 1–4).

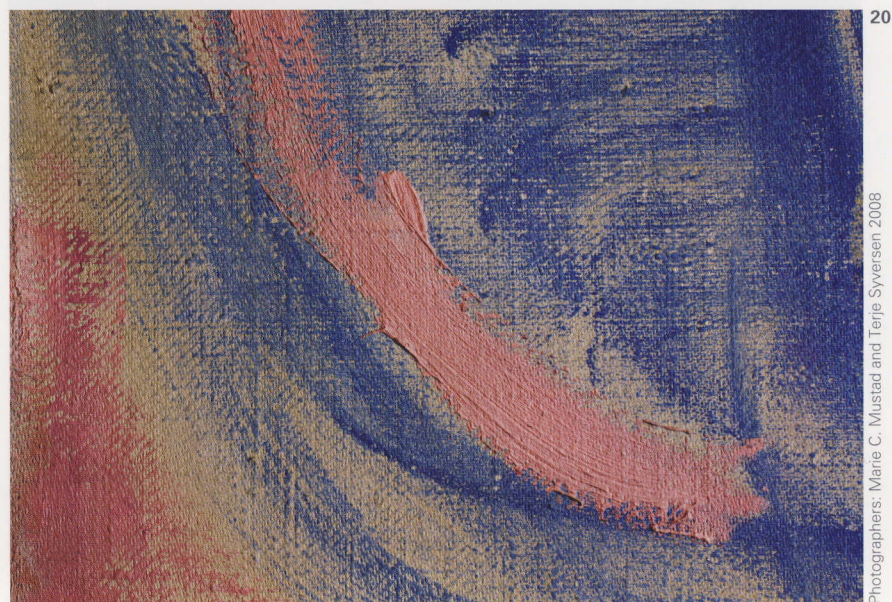
Flesh colours: All humans are depicted with multicoloured contours, light highlights, a few middle tones and shadows, with the bare ground as their main component (Tables 1–4).

19

Detail of a white local underpaint, "New Rays"

20

Detail of semi-transparent and opaque colours, "Chemistry"



20

Photographers: Marie C. Mustad and Terje Syversen 2008

Discussion

Supports

Tøjner has found two statements on the Aula canvases among some of Munch's own notes: "I had the best canvas brought from Holland"⁸⁰ followed by: "They are painted on Block-Brussel, huge canvases which were unobtainable after the war".⁸¹ Maybe, the artist wanted to stress that he had used high quality material only. He did not mention whether the canvases were made of linen or hemp.⁸² Usually, the latter was darker, stronger and less expensive than linen.⁸³ Since Munch spent seven years on the whole room decoration including the large number of painted drafts,⁸⁴ he presumably bought canvas

on more than one occasion. His supplier(s) could also have changed the assortment during the same period. This might be some of the reasons why the eleven Aula paintings are made of canvases of both twill and tabby weave.⁸⁵

As mentioned above, all the four paintings contain twill canvases throughout. In addition, "New Rays" and "Women Harvesting" share the fact that their vertical seam between their two pieces of canvases is located along the middle of their motifs. The other two have their seams somewhat further to the right of the middle of their motifs, although at "Chemistry" a bit less than "The Fountain", and only with a difference of just a few cm.

Due to the substantial height of the paintings, in all likelihood the vertical canvas threads represent the warp and the horizontal ones the weft. The average numbers for warp vary from 12,7 to 14 and the average for wefts vary from 12,4 to 13,9. Taking into account that these eight pieces of canvases cover c. 40 m² and that their total length all together is c. 36 m, such variations might be considered to be too small to be of any important significance. It is worth mentioning, however, that except for a minor difference in the average numbers of weft in the two canvas pieces in "New Rays" (13,1 and 12,7), each of the four paintings contain almost identical pairs of canvas density. In addition, none of the paintings share the same average number of threads pr. cm².

Ground and colours

The present study could not reveal any significant differences in the four grounds. Below the dirt layer accumulated during the last thirty-five years, the grounds appear to have the same white colour, they seem to have been applied with similar thickness, and they contain the same inorganic elements.

According to Munch's notes he used oil colours for easel painting from Windsor and Newton when he executed his Aula-paintings.⁸⁶ Munch also mentioned his usage of turpentine with no explanation beyond calling it: "in his own distinctive manner."⁸⁷ Above the ground and the underdrawings, the surface characteristics of the four paintings in question bear no signs of other materials than oil colours. Their colours also share many of the same application techniques and successions, the majority of pigments and some more or less similar mixtures of pigments. The only technical difference found so far, is the local white underpaints in "New Rays".⁸⁸

Original appearance

Originally, the paintings were mounted on to stretchers (or strainers), and remained in this state for more than twenty-four years.⁸⁹ A canvas painting that is fastened on to a stretcher looks different when glued on to an additional, rigid support. Solid mountings will lend the appearance that the motif has

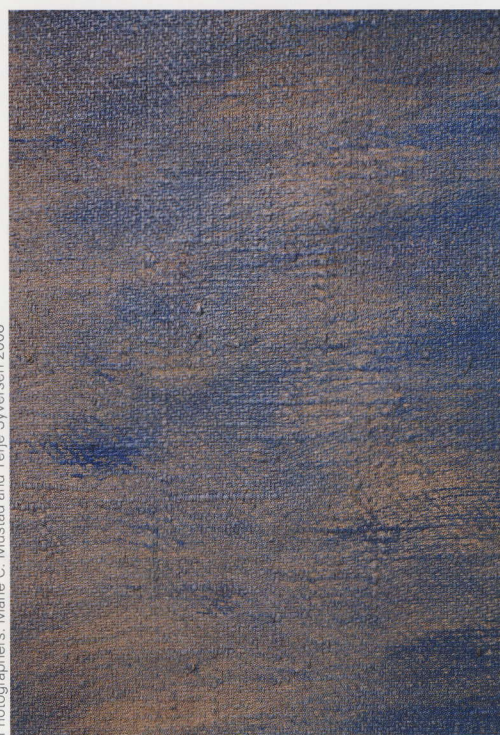
21

Detail of hatched blue brush strokes, "Chemistry"

22

Detail of multi-coloured brush strokes including violet, blue and light red, "Chemistry"

21



Photographers: Marie C. Mustad and Terje Syversen 2008

22



Photographers: Marie C. Mustad and Terje Syversen 2008

been painted directly onto a solid wall, especially when seen from a distance. Munch did make a point of this issue himself when he wrote that he had produced the Aula motifs as easel paintings in the same way as all other easel paintings that he ever made.⁹⁰

At present, there are no known photographs or reports that clearly and with precision demonstrate the manner in which the paintings were installed in the Aula in 1916.⁹¹ Some of the photos taken by the photographer O. Væring can be dated to the same year, e.g. this black and white picture of "Women Harvesting" (Ill. 27).⁹² The photo does not reveal the installation of the painting; it shows, however, that the motif was surrounded by a thin and somewhat rounded frame. The reflections of light visible on the frame suggest that it was covered by a metal foil, or that it was made of solid metal. Anyway, any frame of this type would support the impression of a flexible canvas being stretched.

The latest cleaning tests reveal that both the exposed ground and the colours look very different below the accumulations of air-born dirt, the random splashes of paste and the darkened overpaints along the edges of the paintings. The dirt pollution on the painted surfaces obscures the original variations of saturation and gloss from matt ground to shiny tints. Equally, the soiled condition masks the fact that these paintings never have been varnished. Below the dirt and the non-original materials the colours are still lighter, brighter and their contrasts are more striking than what ordinary viewers can observe.⁹³ The light colours appear to have been more affected than the darker ones. On a general level, the non-original materials on the paintings obscure Munch's depiction of the effect of the Nordic sun on a bright summer day, bathing the coastal landscapes and the figures within it with a sparkling light.

Conclusions

In the case of "Chemistry", "New Rays", "Women Harvesting" and "The Fountain" Munch used twill weave canvases of minor variations; white grounds contain zinc, lead and chalk; greyish black underdrawings of organic material; and colour applications of similar chronology. In all, the XRF-analysis indicates that the various mixtures of colours might contain at least eighteen individual pigments.⁹⁴

The findings of this preliminary study do not support the previous arrangement of these four accompanying paintings into two related pairs. On the contrary, their materials and techniques show more similarities than differences in the artist's choice of execution. Still, the forthcoming examination of the other four side panels⁹⁵ may reveal other technical features that are more suitable for suggestions on chronology and group order amongst the eight lateral motifs.



Photographers: Marie C. Mustad and Terje Syversen 2008



Photographers: Marie C. Mustad and Terje Syversen 2008

23
Detail of diluted paint, "Chemistry"

24
Detail of light red impasto, "Chemistry"

The previous structural interventions have partly altered the textural surface of "Chemistry". In addition, at least one of the cleaning campaigns removed parts of original colours and ground from "New Rays". These changes are not striking when viewed from a normal distance at the Aula floor, but others are: All materials added during the treatments of the past century along with the vast accumulation of air-born pollutants do conceal the artist's original intent. Most viewers do not realize that they are looking at unvarnished oil paintings on canvas.⁹⁶

Acknowledgements

Dr. Jilleen Nadolny and Dr. Hartmut Kutzke for valuable comments and suggestions to the text.

25



Photographers: Marie C. Mustad and Terje Syversen 2008

25

Detail of semi-solid strokes,
"Chemistry"

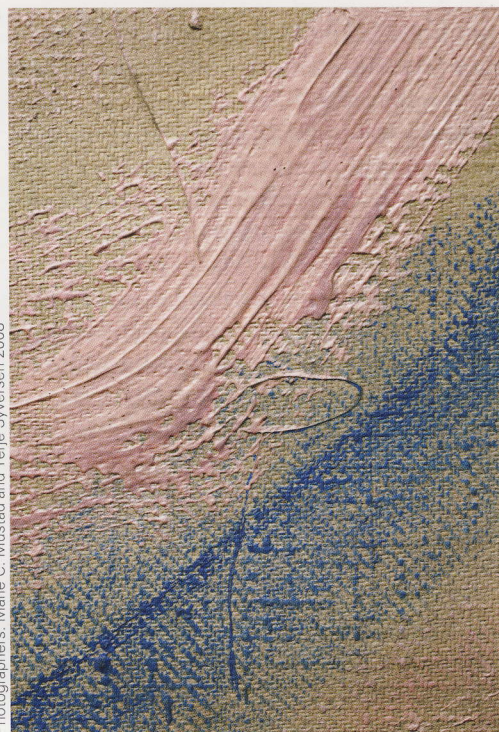
26

Detail of imbedded hairs from the
artist's brush, "Chemistry"

27

Detail of a black and white photo
of "Women Harvesting" and its
gilded frame

26



Photographers: Marie C. Mustad and Terje Syversen 2008

References

¹ Apart from Munch's first large scale decorative project in 1896 for the hallway in the "Franzebråten" villa at Sandvika (outside Oslo), which consisted of a single painting only. Berman 1989: p. 94, 95, 106. The painting was commissioned to occupy a trapezoidal space beneath the rafters in the room, but was removed from the house in 1938. Tucker and Penn 2005: p. 48

² A freeze of paintings for the children's room in Max Linde's house in Lübeck in 1904, and drafts for stage settings and a frieze of paintings for the Max Reinhart's theatre in Berlin in

1906. Bøe 1986: p. 22. Their installations were temporary. Berman 1989: pp. 37–38, 64–65

³ A freeze of paintings for the Assembly Hall of Oslo University in 1916 and the Freia Freeze for a dining hall in the Freia Chocolate factory in 1923. Lundmark 1917: p. 13. Rolfsen 1955 (not paginated). Hougen 1962

⁴ The Aula is the most prominent hall owned by the University of Oslo. It is in constant use for celebrations and concerts, and its acoustics are considered to be especially good. Frøysaker 2007: pp. 246, 252

⁵ In 1934, the Freia Freeze was moved to another dining hall in another building at the Freia factory. Rolfsen 1955 (not paginated)

⁶ Frøysaker 2007: p. 247

⁷ "Chemistry" was measured manually from a scaffold in 2007. The measures include the zinc stripes added in 1946.

⁸ The other three accompanying paintings were measured from the Aula floor in 2007 by means of a theodolite Leica TPS1203. They also include the zinc stripes, and thus the exact measures cannot be determined before all paintings are detached from the Aula walls.

⁹ The report contains no information on the examination methods. Wiik 1973

¹⁰ Wiik 1973

¹¹ Three paintings have 12 x 12 threads pr. cm², and "Women Harvesting" has 13 x 12. Wiik 1973

¹² Wiik 1973

¹³ "The Fountain": Thin and lean paint with areas of bare ground. *Pastose* and opaque paint was found only in one head (of the left figure). The figures are modelled with transparent flesh colours towards light and shade, including full outlines. The landscape is made by transparent, hatched strokes. "Chemistry": Mainly as "The Fountain", except that the areas around the two main figures have fewer hatched strokes. "Women Harvesting": In general, the colours were applied

27



Photographer: O. Væring c. 1916

in lean, short strokes with some *pastosity*. Main parts of figures and landscape contain bare ground. The figures have full outlines. The modelling of forms is made by sparse hatchings in dark and light paints. The use of colours is restricted and effective. "New Rays": As "Women Harvesting" with large areas of bare ground and the figures in hatched forms with full outlines, although with a richer use of local flesh colour. Their surrounding environment contains tints and lines of thin, lean layers of colours. Some are transparent with light, strong values of complementary colours (translation by the authors). Wiik 1973

¹⁴ The paintings were cleaned in 1926, 1937, 1946, 1957 and 1973. In 1926, the paintings might also have been varnished (but no remnants or traces have been found during our examinations). Three of the cleaning campaigns involved structural treatments: In 1926, the original stretchers were replaced by new ones; in 1940, the paintings were cut down and the outer edges of their motifs and their tacking edges were lost; in 1946 the paintings were glued on to Masonite boards. Frøysaker 2007: pp. 249–250, 252

¹⁵ The paintings will be reinstalled in the Aula before the 200 years anniversary of Oslo University in 2011.

¹⁶ Frøysaker 2008(I): p. 3. Frøysaker 2008(II): pp. 7–9

¹⁷ Frøysaker 2008(I): p. 4

¹⁸ Thurmann-Moe 1963. This report also includes notes on interventions in 1946 and 1951.

¹⁹ Wiik 1986

²⁰ The Jaensson report is dated September 28th 1943, and it also includes contemporary correspondence on lining techniques and materials from German and Dutch museums including their recommendations on the use of wax, resin and canvas as lining materials. Thanks to archivist Gertrud Nord for this find.

²¹ Particularly letters and invoices in the Aula accounts of Oslo University's which are being kept at Riksarkivet. Frøysaker 2008(I): pp. 8, 9, 16

²² Dørje Haug 1945

²³ Mohr 1960

²⁴ In his paper Rød mentioned Ole Dørje Haug's tasks in the Aula during 1916, 1926, 1940, 1946 and 1951. Rød 1997: pp. 59–62

²⁵ Frøysaker 2007

²⁶ Frøysaker 2008(I): pp. 8, 16

²⁷ Frøysaker 2008(II): p. 8

²⁸ Svenæus 1953: pp. 87–90, 98; Mohr 1960: pp. 55, 85, 88, 90

²⁹ Tøjner 2000

³⁰ Frøysaker 2007: esp. pp. 248, 249; Frøysaker 2008(I): esp. pp. 5–7. In fall 2008 Gerd Woll (ed.) at The Munch-Museum will publish a catalogue raisonné of Munch's paintings including his Aula decorations.

³¹ The scaffold had to be small and easily removable since the Aula still was in use, e. g. for concerts. On the other hand, it could be moved around by a single person.

³² Underneath "New Rays" and "Women Harvesting" there is a stage floor which is 50 cm higher than the lower floor underneath the two other paintings. The extent of examination of the latter two was restricted accordingly.

³³ The planning for the building renovation necessitated access to the brick wall behind the painting. Frøysaker 2008(II): p. 8

³⁴ The XRF (a handheld Niton XLt 898DHeW) with Helium flush can detect elements from Mg (12) to U (92): www.niton.com/Default.aspx (August 2008)

³⁵ The Artist PRO camera: www.art-innovation.nl (August 2008)

³⁶ See www.fokus-gmbh-leipzig.de/metigo_map.php?lang=en (August 2008)

³⁷ Ferretti 1993: pp. 11–17

³⁸ Ferretti 1993: pp. 11–17

³⁹ Stuart 2007: pp. 234–237

⁴⁰ When the present examination of the entire Aula decoration is finished, selected sampling for cross-sections will take place. Intended analysis methods are: SEM-EDX, FTIR and micro-XRD. During the first week of July 2008, "Chemistry" and "Women Harvesting" was examined by MOLAB with their non-invasive equipment, but this is yet to be published.

⁴¹ The function of these zinc strips was to cover the gap between the marble wall and the painting.

⁴² And by the use of the laboratory microscope

⁴³ And by the use of the laboratory microscope

⁴⁴ For the history on previous treatments see Frøysaker 2007 and 2008 (I)

⁴⁵ The raised nails are also visible in ordinary light because they have accumulated more dust than their surroundings.

⁴⁶ In 1943, Jaensson reported that he had thirty-five year of experience in the field of painting restoration and that he had used Masonite for the last twelve years. He described his lining onto Masonite by the use of low heat and light pressure: The iron shall be moved around back and forth in a careful manner over several layers of soft paper above the painted surface without the flattening of brushstrokes. He also added that the Masonite could be removed as easy as a cardboard disk. In Swedish: "Men en rentoilering skall icke ske med hårdt tryck och stark värme, utan med svag värme och lätt hand. Järnet skall försiktigt föras fram och åter över tavlan och flera lager mjukt papper bör under strykningen skydda penseltagen i färghinnan från att plattas till. [...] Masoniten kan avspjälkas i skikt lika lätt som en pappskiva." Jaensson 1943

⁴⁷ Wiik however observed some de-laminations during the cleaning of 1973. Personal communication with Svein A. Wiik (June 2008)

⁴⁸ The present survey of the painted surfaces also revealed some small areas of flattened impasto. Usually, this is regarded as a damage caused by exaggerated pressure and heat during lining. In this case however, the flattened impasto can also be a result of the artist's own handling: When freshly painted, Munch must have transported them on rolls between his studios and the Aula. In addition, only twenty-four years after execution the paintings were kept on rolls for at least five years during the Second World War.

⁴⁹ During a year, the relative humidity fluctuates between 8 to 80 %. Frøysaker 2008 (I): p. 12

⁵⁰ Rød 1997: p. 59

⁵¹ Rød 1997: p. 59; Tøjner 2000: p. 153

⁵² UV-lamp examinations on "History" and "The Sun" revealed green fluorescence in a few limited areas. This indicates a possible varnish of natural resin.

⁵³ Or the hems were cut away prior to the lining onto Masonite.

Literature and unpublished reports

– Berman 1989

Berman, Patricia Gray: Monumentality and historicism in Edvard Munch's University of Oslo Festival Hall Paintings, New York University, New York, 1989 (= unpublished PhD dissertation, New York University)

– Bomford et al. 1990

Bomford, David; Kirby, Jo; Leighton, John and Roy, Ashok: Art in the Making. Impressionism; Yale University Press, New Haven and London 1990

– Bøe 1986

Bøe, Alf: Edvard Munch and his Art after 1900; in: Scandinavian Review, Spring 1986; pp. 19–32

– Dørje Haug 1945

Dørje Haug, Ole: Munchs Aula-bilder reddet fra eksplosjonen, in: Dagbladet, 14.11. 1945

– Eastaugh et al. 2004

Eastaugh, Nicholas; Walsh, Valentine; Chaplin, Tracey and Siddall, Ruth: Pigment Compendium. A Dictionary of Historic Pigments; Elsevier, Butterworth-Heinemann, Oxford 2004

– Ferretti 1993

Ferretti, Marco: Scientific Investigation of Works of Art; ICCROM, Rome 1993

– Frøysaker 2007

Frøysaker, Tine: The paintings of Edvard Munch in the Assembly Hall of Oslo University. Their treatment history and the Aula-project; in: RESTAURO 4/2007; pp. 246–257, 266

– Frøysaker 2008 (I)

Frøysaker, Tine: Bevaring av Edvard Munchs Aulamalerier før og nå; in: Kunst og Kultur, 2008; pp. 2–17

– Frøysaker 2008 (II)

Frøysaker, Tine: Konserveringsstudiets Aulaprojekt; in: Norske Konserver NKF-N, 2008; pp. 7–9

– Hougen 1962

Hougen, Pål: Langaards og Revolds bok om Aula dekorasjonene; in: Aftenposten 16. 06. 1962

– Jaensson 1943

Jaensson, Gustav: Bilaga från konservatorn vid nationalmusei nämnds sammanträde onsdag den 29 september 1943; dated September 28th 1943; Stockholm Nationalmusei arkiv, Stockholm (unpublished report)

– Lundmark 1917

Lundmark, Ephraim: Edvard Munchs väggmålningar i Kristiania universitet och nutida norsk konst i Stockholm; in: Konst, 1917; pp. 12–17

– Mecklenburg 2007

Mecklenburg, Marion F.: Micro climates and moisture induced damage to paintings; in:

Museum Microclimates, Contributions to the conference in Copenhagen, 19.–27. November 2007; pp. 19–25

– Mohr 1960

Mohr, Otto Lous: Edvard Munchs aula-dekorasjoner i lys av ukjente utkast og sakens akter; Gyldendal norsk forlag, Oslo 1960

– Rolfsen 1955

Rolfsen, Alf: Konst hos Freia och Marabou, Oslo, Stockholm, 1955 (not paginated).

– Rød 1997

Rød, Johannes: "Hestekur", Aulamalerier og Nasjonalgalleriet. Om kunstneren og konserveratoren Dørje Haug; in: Kunst og Kultur, 1997; pp. 54–66

– Schaefer et al. 2008

Schaefer, Iris; Saint-George, Caroline von, and Lewerentz, Katja: Painting Light. The Hidden Techniques of the Impressionists; Skira Editore S.p.A, Milan 2008

– Stuart 2007

Stuart, Barbara: Analytical techniques in materials conservation; John Wiley and Sons, Ltd., Chichester 2007.

– Svenæus 1953

Svenæus, Gösta: Idé och innehåll i Edvard Munchs konst. En analys av aulamålningarna; Gyldendal norsk forlag, Oslo 1953

– Thurmann-Moe 1963

Thurmann-Moe, Jan: Unpublished report dated 1963; Munch-Museum, Oslo.

– Topalova-Casadiago

Topalova-Casadiago, Biljana: De to malte versjonene av Skrik; in: Skrik; Munch-Museet, Vigmostad & Bjørke AS; Oslo, Bergen 2008; pp. 87–99

– Tucker and Penn

Tucker, Mark S. and Penn, Suzanne: The 1938 alteration of Edvard Munch's Mermaid: Circumstances, implications and challenges; in: Edvard Munch's Mermaid, Philadelphia Museum of Art Bulletin, Vol. 93, No. 393–94, 2005; pp. 48–53

– Tøjner 2000

Tøjner, Poul Erik: Munch med egne ord. Forlaget Press a.s., Forlaget Søren Fogtdal a.s, Oslo, København 2000.

– Wiik 1973

Wiik, Svein A.: Restaureringsrapport. Rensing av Aula-dekorasjonene, 1973. Museum of Cultural History, University of Oslo (KHM), Restaureringsatelierets arkiv, Oslo

(unpublished report).

– Wiik 1986

Wiik, Svein A.: Aula-dekorasjonene juni 1986 rapport, Museum of Cultural History, University of Oslo (KHM), Restaureringsatelierets arkiv, Oslo. (unpublished report)

- ⁵⁴ The measures include the zinc stripes. The numbers are not exact because the canvas seams are irregular; it is very unlikely that a ruler was used when the paintings were cut down in 1940.
- ⁵⁵ Since all weaves differ in density throughout, the counting of threads was performed at least three times or more in different places on all eight textiles to find an average for each piece of cloth.
- ⁵⁶ The first numbers represent the horizontal threads and the lasts the vertical ones.
- ⁵⁷ Mecklenburg 2007: p. 20
- ⁵⁸ In "Alma Mater", all exposed areas of bare ground have bare knots in the canvas weave due to sanding.
- ⁵⁹ Preliminary drawings in other colours were found in the contemporary "Scream" owned by The Munch-Museum. Topolava-Casadiago 2008: pp. 91–92
- ⁶⁰ Eastaugh et al. 2004: pp. 82–85
- ⁶¹ Zinc white is suggested where the XRF indicated zinc, e. g. zinc oxide (ZnO) or zinc sulphate (ZnSO_4). Eastaugh, et al. 2004: pp. 406–408
- ⁶² Lead white is suggested where the XRF indicated lead, e. g. lead carbonate hydroxide ($2\text{PbCO}_3 \cdot \text{Pb}(\text{OH})_2$) or lead sulphate ($\text{PbSO}_4 \cdot \text{PbO}$). Eastaugh, et al. 2004: pp. 230–235
- ⁶³ Chrome yellow is suggested where the XRF indicated chrome, barium and lead, e. g. barium chromate (BaCrO_4), lead chromate (PbCrO_4) or zinc dichromate ($\text{ZnCr}_2\text{O}_7 \cdot 3\text{H}_2\text{O}$). Eastaugh, et al. 2004: pp. 36, 99–100, 404
- ⁶⁴ This is also supported by some preliminary analyses of a few paint samples by FTIR microscopy by Professor Unn Plahter. Frøysaker 2007: p. 249
- ⁶⁵ Cerulean blue is suggested where the XRF indicated cobalt and tin (CoSnO_3). Eastaugh, et al. 2004: pp. 90–91, 116
- ⁶⁶ Organic red is suggested where the XRF indicated a lack of any common red.
- ⁶⁷ Cadmium yellow is suggested where the XRF indicated cadmium and sulphur (CdS). Eastaugh, et al. 2004: pp. 70–72.
- ⁶⁸ Copper green is suggested where the XRF indicated copper, e. g. copper acetate hydroxide hydrate ($[\text{Cu}(\text{CH}_3\text{COO})_2]_2 \cdot \text{Cu}(\text{OH})_2 \cdot 5\text{H}_2\text{O}$), copper diarsenite ($2\text{CuO} \cdot \text{As}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$) or copper carbonate hydroxide ($\text{Cu}_2\text{CO}_3(\text{OH})_2$). Eastaugh, et al. 2004: pp. 121–123
- ⁶⁹ Chrome green is suggested where the XRF indicated chrome, e. g. chromium oxide (Cr_2O_3) or hydrated chromium sesquioxide ($\text{Cr}_2(\text{OH})_4$). Eastaugh, et al. 2004: pp. 97–98, pp. 101–102
- ⁷⁰ Emerald ($\text{Cu}_4(\text{OAc})_2(\text{AsO}_2)_6$) or Scheele's green ($2\text{CuO} \cdot \text{As}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$) are suggested where the XRF indicated copper and arsenic. Eastaugh, et al. 2004: pp. 122, 149, 335
- ⁷¹ Cobalt blue (CoAl_2O_4) is suggested where the XRF indicated cobalt. Eastaugh, et al. 2004: pp. 111–113. Cobalt blue also contains aluminium, but this is difficult to detect with a portable XRF.
- ⁷² Vermilion (HgS) is suggested where the XRF indicated mercury and sulphur. Eastaugh, et al. 2004: pp. 386–387
- ⁷³ Manganese violet ($(\text{NH}_4)_2\text{Mn}_2(\text{P}_2\text{O}_7)_2$) is suggested where the XRF indicated manganese and phosphor. Eastaugh, et al. 2004: pp. 241–251
- ⁷⁴ Ultramarine ($\text{Na}_7\text{Al}_6\text{Si}_6\text{O}_{24}\text{S}_3$) is suggested where the XRF indicated aluminium, silicon and sulphur. Eastaugh, et al. 2004: pp. 375–376
- ⁷⁵ Prussian blue (compound based around $[\text{Fe}(\text{II})(\text{CN})_6]^{4-}$) is suggested where the XRF indicated iron. Eastaugh, et al. 2004: pp. 308–309
- ⁷⁶ Green earth is suggested where the XRF indicated iron. Eastaugh, et al. 2004: pp. 174–175. Green earth also contains silicates, but these are difficult to detect with a portable XRF.
- ⁷⁷ Yellow ochre is suggested where the XRF indicated iron. Eastaugh, et al. 2004: pp. 401–402. Ochres also contain silicates, but these are difficult to detect with a portable XRF.
- ⁷⁸ Ochre is suggested where the XRF indicated iron. Eastaugh, et al. 2004: pp. 320–321. Ochres also contain silicates, but these are difficult to detect with a portable XRF.
- ⁷⁹ Organic black is suggested where the XRF has a lack of any elements that would suggest other blacks.
- ⁸⁰ "Jeg lod det bedste lærred komme fra Holland". Tøjner 2000: p. 153
- ⁸¹ "De er malte på Block-Bryssel kæmpelærred og som efter krigen ikke mer er at få". Tøjner 2000: p. 163
- ⁸² From the 1840s, also hemp was recommended for large size paintings. Bomford et al. 1990: p. 46
- ⁸³ Fibre origins of the Aula canvases will be identified by microscopy subsequent to their forthcoming evacuation.
- ⁸⁴ The Munch-Museum in Oslo owns c. hundred of Munch's Aula studies on various supports.
- ⁸⁵ Frøysaker 2007: p. 248
- ⁸⁶ Tøjner 2000: p. 163
- ⁸⁷ Tøjner 2000: p. 162
- ⁸⁸ And some minor differences in its ground mentioned above, see the XRF-spectrum of "New Rays" III. 17
- ⁸⁹ Until the paintings were cut down in 1940. Dørje Haug 1945. Mohr 1960: pp. 95, 96
- ⁹⁰ "Billederne er malt som alle mine billeder [...] som staffelmalerier." Tøjner 2000: p. 162
- ⁹¹ Frøysaker 2007: p. 248
- ⁹² Because it belongs to a group of similar photos which shares some of the same features as the photos in a contemporary Norwegian journal called 'Arkitektur og Dekorativ kunst 8', 1916: pp. 129–134
- ⁹³ For other examples on the effect of dirt on an Impressionist painting see Schaefer et al. 2008: pp. 188–189, 202–203
- ⁹⁴ The XRF-analysis suggested the following pigments: Manganese violet, ultramarine, Prussian blue, cobalt blue, Cerulean blue, Emerald or Scheele's green, chrome green, green earth, cadmium yellow, chrome yellow, yellow ochre, vermilion, organic red, red ochre, organic black, lead white, zinc white and chalk.
- ⁹⁵ "Women Reaching towards the Light", "Men Reaching towards the Light", "Awakening Men in the Food of Light" and "Spirits in the Flood of light".
- ⁹⁶ Even a contemporary Norwegian novel from 2007 refers to the Aula paintings as frescos: In Henrik H. Langeland's book entitled "Francis Meyers lidenskap", the author lets the guest lecturer (Umberto Eco at page 384) use the word fresco by saying: "Og quarto vil jeg takke det store geni Eduardo Munch for disse praktfulle freskene!"

Abstracts

page 30

Paul-Bernhard Eipper

The problem of surfaces containing acrylic paint – Part 1: Background information about the resistance of acrylic paint

The first part of the article summarizes the history and composition of acrylic paint. Different surfaces of oil and acrylic colours are presented. The cleaning of surfaces containing acrylic paint is very difficult due to their complex composition, and grime and dirt are a greater hazard to soft and sticky surfaces containing acrylic paint than to surfaces composed of oil colours. The application of the painting technique and different mixtures and additions to acrylic paint by the artists can disturb the drying process and affect the lifetime and resistance of the vulnerable surfaces. It is not possible to adapt cleaning techniques, which are successful on oil colours to acrylic paints because the latter react more sensitively to every dry and wet surface cleaning.

Keywords: surface cleaning, binding systems, artist paints, resistance and composition of acrylic paint, paintings, varnish, 3D examination, 3D profiles, MicroCAD

page 36

Wolfgang Neustadt

»The Miracle at Cana. Originality of reproduction« – On the exhibition of the Giorgio Cini Foundation, Isle of San Giorgio Maggiore, Venice

In the autumn of 2007, the Giorgio Cini Foundation organized a special exhibition on the Isle of San Giorgio Maggiore in Venice. In this exhibition was displayed a 1:1 copy of Veronese's painting »The Wedding at Cana«. This essay on the one hand describes the historical as well as the spatial circumstances of this reproduction, which caught a lot of

attention among Italian specialists and beyond. It furthermore gives a detailed discussion of the production of this facsimile by the studio Factum Arte.

In conclusion an attempt is undertaken to further examine the aesthetic-theoretical effects of this reproduction on the museum- and exhibition-business as well as on aesthetics and art history and the science of conservation. Those effects are to be expected in the light of the opposition »original-reproduction«, which up to the present day excludes itself, as well as of Walter Benjamin's essay »The work of art in the age of mechanical reproduction«.

Keywords: San Giorgio Maggiore, digital high-tech copy, facsimile, Veronese, Wedding at Cana, Factum Arte, Adam Lowe, 3D scanning, photo-scanning, colour matching, print, Walter Benjamin

page 44

Tine Frøysaker und Mirjam Liu

Vier (von elf) ungefirnissten Ölgemälden auf Leinwand von Edvard Munch in der Aula der Universität Oslo – Erste Notizen zu ihren Materialien, Techniken und ihr ursprüngliches Aussehen

Bisher ist nur wenig über Edvard Munchs Maltechniken der ersten Jahrzehnte des 20. Jahrhunderts veröffentlicht worden. Diese einleitende Studie, die mit zerstörungsfreien Untersuchungsmethoden erfolgte, stellt des Künstlers Materialauswahl und Anwendungstechniken für vier der kleineren Motive seiner großformatigen Raumdekoration in der Aula der Universität Oslo dar. Auch Bemerkungen über frühere Eingriffe, den gegenwärtigen Zustand und die Veränderungen gegenüber dem ursprünglichen Erscheinungsbild fließen mit ein.

Keywords: optischer Befund, tragbare Röntgenlampe, Untergrund, Grundierung, Unterzeichnungen, Pigmente

Autoren

Paul-Bernhard Eipper, Head of Conservation Department, Alte Galerie am Landesmuseum Joanneum, Schloss Eggenberg, Eggenberger Allee 90, A-8020 Graz, Austria, www.museum-joanneum.at, paul-bernhard.eipper@museum-joanneum.at, Tel. Neutorgasse: 00 43 (0) 3 16 80 17 97 74, Tel. Schloss Eggenberg: 00 43 (0) 3 16 58 32 64 95 80, Mobil: 06 64/80 17 95 61, www.eipper-restaurierungen.de

Tine Frøysaker, PhD, painting conservator. Associate Professor and Coordinator of the Conservation Studies, University

of Oslo (UiO), Department of Archaeology, Conservation and History (IAKH), Frederiksgate 3, 0164 Oslo, Norway, tine.froysaker@iakh.uio.no

Mirjam Liu, MA, painting conservator. Scientific Assistant, University of Oslo (UiO), Department of Archaeology, Conservation and History (IAKH), Frederiksgate 3, 0164 Oslo, Norway, mirjam.liu@iakh.uio.no

Wolfgang Neustadt M.A., marmorino52, Gertraudenstr. 10/Innenhof, 96050 Bamberg, Tel. 09 51/9 23 05 06, Fax 09 51/9 71 07 53, info@marmorino52.com, www.marmorino52.com

Weitere Termine finden Sie unter www.restauro.de**Januar 2009****Kurs »Sanierungsmöglichkeiten bei feuchte- und salzbelastetem Mauerwerk«**

20. 01. 2009, Fulda

Veranstalter und Info: Propstei Johannisberg GmbH, 36041 Fulda, Tel. 06 61/9 41 81 3-0, Fax -15, info@propstei-johannesberg.de, www.propstei-johannesberg.de

Vorlesung »Die Kunstversicherung und die Relativität der Werte«

21. 01. 2009, Kassel

Veranstaltungsort: Kunsthochschule Kassel, Hörsaal, Menzelstraße 13 (Eingang A), 34109 Kassel, (19 Uhr)
Info: ulli.seegers@uni-kassel.de, www.kunsthochschule-kassel.de

Workshop »Partielles Färben von Protein- und Cellulosefasern«

23.-24. 01. 2009, München

Veranstaltungsort: Textilatelier Bayerisches Nationalmuseum, Oettingenstraße 15, 80538 München
Veranstalter und Info: VDR, Fachgruppe Textil
Ansprechpartner: Cornelia Hornig, Schweizerisches Landesmuseum, Lindenmoosstraße 1, CH-8910 Affoltern a. Albis, Tel./Fax 00 41/44/76 21-3 85, carolin.hornig@slm.admin.ch

E-learning-Kurs »Conservation of Globes«

26. 01.-22. 03. 2009

Sprache: Englisch