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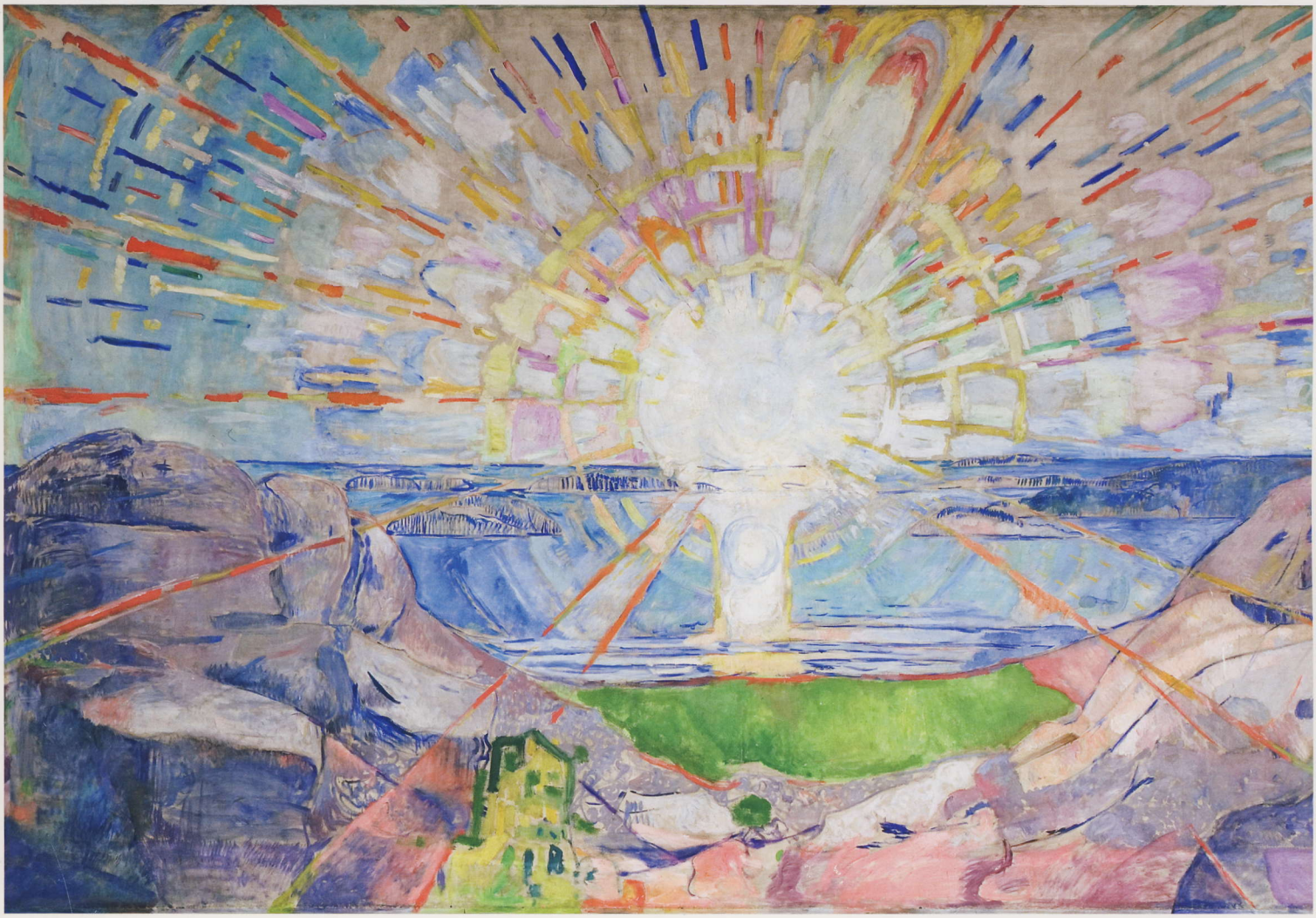
PASSIVE UND AKTIVE KLIMATISIERUNG

EDVARD MUNCH AND THE AULA-PROJECT

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Juni 2007

Tine Frøysaker

The paintings of Edvard Munch in the Assembly Hall of Oslo University

Their treatment history and the Aula-project

Between 1909 and 1916 Edvard Munch created eleven large canvas paintings for the Assembly Hall of Oslo University. The Hall or Aula – is the most important auditorium of the University. The paintings are internationally known, in part as they have formed the backdrop for many Nobel Peace Prize celebrations. The paintings are vulnerable due to the accumulation of airborne dirt and to its frequent removal by restorers and conservators.
A preliminary study of their history shows that they have been cleaned up to five times during the first 70 years of their existence. The last cleaning tests were done in 2001 and it is now obvious that they should be cleaned again. This brief cycle of soiling and frequent cleaning has subjected the works to very undesirable wear and stress. Clearly, neither soiling nor cleaning should be permitted to occur at such short intervals. Therefore, the Conservation Studies of the Oslo University has started a three year research project (2005–2008) which seeks to first define the extant problems and thereafter suggest solutions.

The author is the leader of the Aula project.[1] She works as Associate Professor and Coordinator of the Conservation Studies, University of Oslo (UiO), Department of Archaeology, Conservation and Historic Studies (IAKH), Norway. Selected parts of this paper were presented at the NKF XVII Congress in Stockholm on November 30, 2006

Introduction

Between 1909 and 1916, Edvard Munch made several drafts and sketches for his Aula decorations.[2] During the summer 1916, the painter completed eleven large-scale canvas paintings on site in the new Assembly Hall of the Oslo University's Domus Media (Ill. 1).[3] The building is situated on Karl Johan's Street, the main street of the capital, which ends at the entrance to the Royal Palace. On September 11th the same year as the completion, the Aula paintings were formally presented to the University (UiO) as a gift from a group of private donors together with the city council of Oslo.[4]

The Assembly Hall of Oslo University is an important site for public functions and performances of both national and international significance.[5] For many years the celebration of The Nobel Peace Prize was broadcasted worldwide from the stage below the central paintings in the room. Today, Munch's Aula paintings are the painter's only program of wall decoration that is still preserved *in situ*.[6] In Oslo, the firm Krafts Food Norge AS[7] also owns a complete room decoration by Munch. This consists of twelve canvas paintings known as "The Freia Frieze".[8] In 1934, however, these paintings were moved to a new room, another dining hall in a different building.

At present, the Aula paintings and the marble walls that surround them suffer from severe soiling by airborne dirt that has darkened and blurred all of the colours. The need of surface cleaning is striking. In addition, a comprehensive renovation is being planned for both the room and the building itself; the scheduled interventions will introduce a new hazard, that of vast quantities of composite pollution.

Based on these present damage and future risks, The Conservation Studies of the Oslo University has launched a three year research project with the aim to propose a preservation plan for the Aula paintings.[9] The Aula project will involve examination of the original techniques and materials of the paintings, their history and changes, their environment as well as the most significant dangers posed to the works. First, in order to establish relevant limitations and possibilities regarding control of the soiling in the Aula, it is essential to achieve an initial understanding of original materials, as well as knowledge of the past dirt accumulation, including previous removals and other related structural treatments undertaken on the paintings.



1
The Oslo University's Domus Media at Karl Johan's street in Oslo city, Norway. Photographer: Birger Lindstad 2007, © Birger Lindstad/The Munch-Ellingsen-Group/BONO 2007.

Material and methods

The paintings

In the Oslo Aula, Munch's paintings cover c. 223 square meters of three of the Aula's walls; the two larger, side walls, and the end wall behind the stage (north).[10] The wall behind the paintings is made of brick, and the surfaces on either side of the paintings are faced with a light grey marble (the public entrance doors are opposite to "The Sun"). "The Sun" (c. 450 x 785 cm), which is the central motif, occupies the upper part of the northern wall (Ill. 2).[11] Working clockwise to its proper right follow: "Awakening Men in the Flood of Light" (c. 450 x 300 cm), "Women Reaching towards the Light" (c. 450 x 165 cm), "New Rays" (c. 450 x 225 cm), "History" (c. 450 x 1 163 cm) and "Chemistry" (c. 450 x 225 cm) (Ills. 3–7). On the left hand side of "The Sun" are "Spirits in the Flood of Light" (c. 450 x 300 cm), "Men Reaching towards the Light" (c. 450 x 167 cm), "Women Harvesting" (c. 450 x 225 cm), "Alma Mater" (c. 450 x1 163 cm) and "The Fountain" (c. 450 x 225 cm) (Ills. 8–12).[12] All paintings are of the same height and are situated at the same level. The seven middle paintings including "The Sun" adorn the central stage area with c. 288 cm down to the main stage floor. The other four canvases are located c. 337 cm above the lower floor where the audience is seated. None of the eleven paintings can be touched from below by performers or by visitors.

Archives

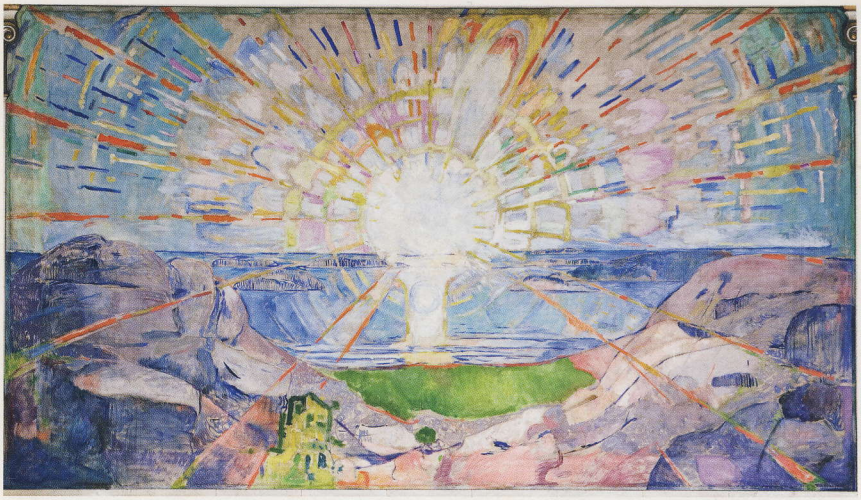
Since late fall 2005, several relevant archives in Oslo have been examined.[13] What still remains to be studied are the documents of UiO (see below), which are kept at the National Archives. Thus far, only a few letters and some newspaper clippings are the only written sources that have been found that describes the condition and restoration treatments of the Aula paintings before 1951. In May the same year, paintings conservator Jan Thurmann-Moe of the Munch-Museum wrote a short report on the previous lining of the Aula paintings in 1946, which included the de-lining of "The Researchers", a different version of "Alma Mater" in 1951 (see below).[14] The subsequent two reports of treatments were written in 1973 and 1986 respectively, by paintings conservator Svein A. Wiik at Museum of Cultural History (KHM), UiO.[15]

Publications

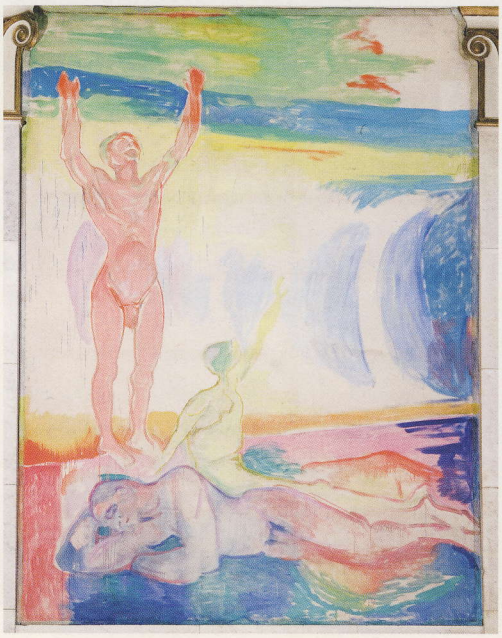
Several art historians have published studies of various aspects of the Aula paintings, but their technique, condition and conservation history have barely been touched upon. Ida Sherman seems to be the only art historian who has taken an interest in the post commission re-mounting of the paintings initiated by Munch himself.[16] In 1960, the scientist Otto Lous Mohr published a book on the unknown archival materials (of UiO) connected to the Aula paintings.[17] Mohr was also interested in the re-mounting of Munch's paintings, and he included comments on aspects of original materials, as well as of past damages and treatments. Conservator Johannes Rød is the last author to have published new information on the treatment history of the murals, which is included in his paper on the work of the restorer Ole Dørje Haug.[18] This study was also based upon archival studies and newspaper clippings.

Recordings and analyses

In this first phase of the Aula project, emphasis has been placed on studies of archives and publications. In addition, monitoring of the environmental conditions in the Aula has begun and a few preliminary analyses have been performed. In January 2006, the physicists Dr. Dag Dysthe, Olav Gundersen and Karen Mair (all UiO) made several IR-recordings of



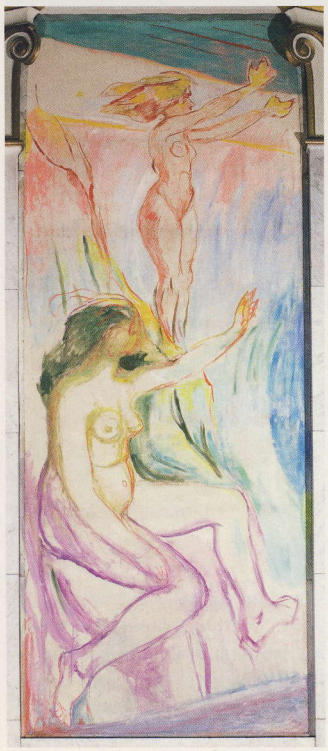
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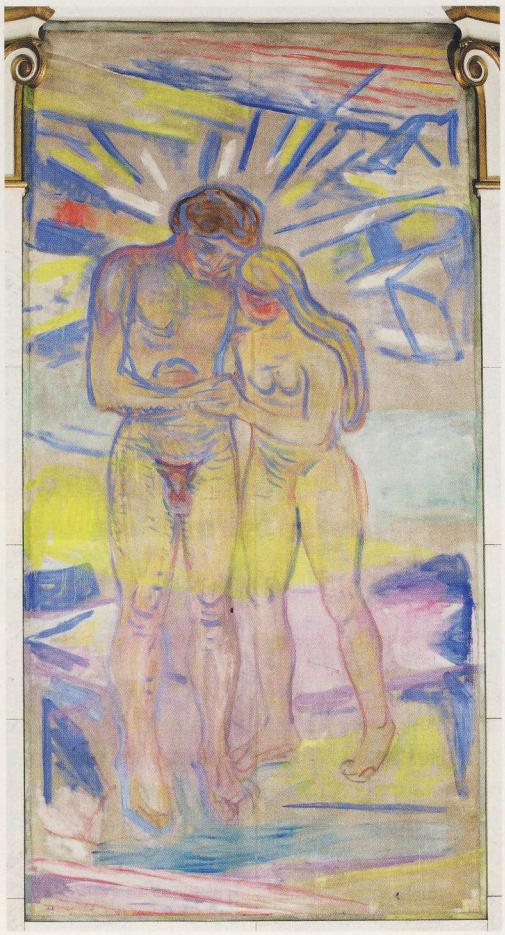


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2
"The Sun" (c. 450 x 785 cm), the central motif of Edvard Munch's Aula decorations (oil on canvas) from 1909–1916. Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

3
"Awakening Men in the Flood of Light" (c. 450 x 300 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.





4
"Women Reaching towards the Light" (c. 450 x 165 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/ The Munch-Ellingsen-Group/ BONO 2007.

5
"New Rays" (c. 450 x 225 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

the paintings to examine differences in variation of surface temperatures representative for the winter season.[19] This was repeated in October before the heating was switched on. In February same year, Jeremy Hutchings (UiO) started to monitor temperature and relative humidity (RH) at the lower edge of "History" (c. 340 cm above the floor) and on the balcony over the main entrance (c. 450 cm above the floor).[20] Finally, during the spring, Professor Unn Plahter (UiO) conducted a few preliminary FTIR analyses on some of the paint samples collected by Wiik during the cleaning campaign in 1973.

Original features and past treatments

According to Otto Lous Mohr, previous rector of Oslo University (UiO),[21] Munch once said (in 1932) that the salary for the Aula paintings only covered his expenses for canvas and colours.[22]

Original support

In addition, Munch has stated that he used the most expensive canvas available from Holland.[23] In all likelihood, linen is the main component.[24] In 1973, Svein A. Wiik found that the eleven Aula paintings were either made of a single piece of cloth, while in other cases, no more than two or three pieces of fabric were joined together to form the supports.[25] Five paintings are made of one piece of cloth (no seams or joints: "Awakening Men in the Flood of Light", "Women Reaching towards the Light", "History", "Men Reaching towards the Light" and "Alma Mater"); five paintings are comprised of two pieces (one seam: "The Sun", "New Rays", "Chemistry", "Women Harvesting" and "The Fountain"); and one painting is comprised of three pieces ("Spirits in the Flood of Light"). In all, there are 18 individual pieces of canvas that have been cut from eight different textiles. Two types of weave patterns are present, twill (nine pieces) and tabby (nine pieces). Some weaves are fine while others are coarse. The twill pieces have thread counts of 12 x 12, 12 x 13 and 13 x 12 threads per cm^2. The tabby fabrics vary from 6,5 x 7,5 to 16 x 16 threads per cm^2 (including 10 x 8, 12 x 13 and 14 x 16). Thus, the surface texture of the paintings, particularly in the areas of nearly bare canvas (see below), varies throughout the room. Since Munch spent many years on the Aula-paintings, these variations may reflect several individual purchases of support material.

Little is known of the original stretchers, how the canvases were attached to them (or to any prospective working stretches) and how the pictures were mounted to the Aula walls in 1916. According to an interview in 1957 with restorer Martin Haug, who was one of Munch's assistants during the installation in 1916, nobody recorded the methods or materials used.[26] Conservator Johannes Rød has suggested that the paintings were fixed to the wall by a moulding and that the fabric rested against a wooden construction (the wall).[27]

Ground

Prior to Munch's application of colours, the Aula canvases were primed; however, the composition of the priming varied considerably. At present, seven different grounds have been observed.[28] It is still an open question whether the different grounds were applied by the supplier(s) of the canvas or by the painter himself. Large areas of the primed surfaces were left unpainted and remain exposed. Some of the smaller pictures seems to have been primed in pairs: "Chemistry" and "The Fountain" share the same ground, probably a thin, dry, glue with some light grey fillers added; also "New Rays" and "Women Harvesting" have a thin and dry ground, also probably a glue, but this is darker and more yellowish grey. The canvases of "Woman Reaching towards the Light", "Men Reaching towards the Light" as well as "Awakening Men in the Flood of Light" are covered with a thicker, smoother and somewhat fattier, light white ground. A rather different ground has been observed on "Spirits in the Flood of Light", which seems to have a very thin glue priming of a rather dark grey colour. The three large motifs have other preparations: "History" has a rather thick, fatty and solid ground, which varies in colour from light whitish grey to yellowish grey;

"Alma Mater" has a relatively thin, dry, brittle, almost white ground; and finally, "The Sun" is covered by a relatively thin, solid ground, which is dark grey in the areas of the sky (possible use of a local underpainting?) and yellowish grey in the areas of landscape. Wiik has noted that large parts of the sky close to the light sun consist of bare, dark ground that contrasts with the brilliance of the sunlight close to its core.[29]

Colours

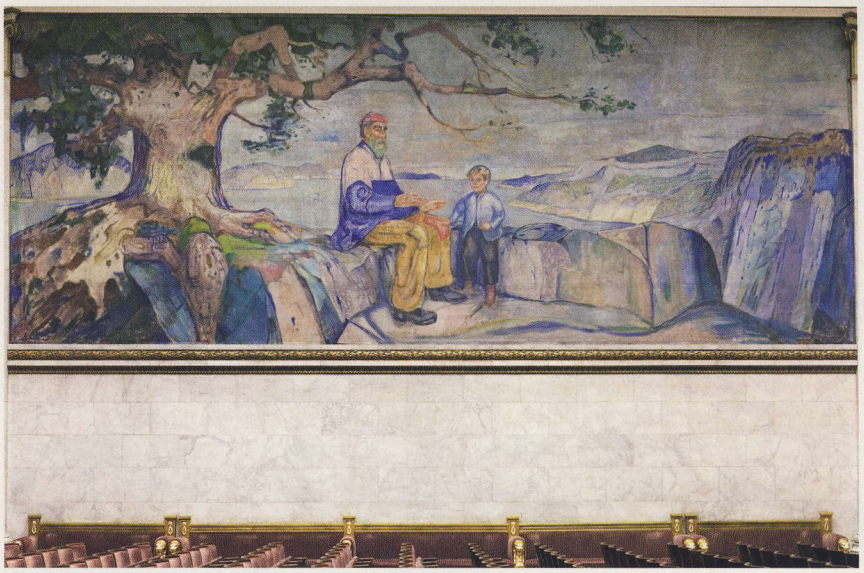
Preliminary analyses of a few paint samples by FTIR microscopy indicate that the binder is a drying oil.[30] An inspection of the paintings from the floor suggests that the colours have been applied in a variety of ways. In general, it seems like most tints have been applied by brush, but Munch may also have used palette knives and other tools.[31] In some areas the paint has been scraped while wet. In several passages (especially "The Sun"), it is clear that sand and hair have been mixed into the paint, probably to provide more bulk to the impasto.[32] The colours vary from thin and translucent, to thick, opaque and paste-like. Some colours have been brushed on wet-in-wet. Sometimes, the brush must have been dipped into several colours before application of the paint,[33] while other areas have been added with clear and separate distinctions between tones. Several thin applications have dripped – rivulets, running downwards are clearly visible – which suggests the use of heavily diluted paint (Ill. 13). Presumably, these tints are very lean. It is also likely that they are rather matte in appearance (below the present accumulation of dirt). In contrast, the disc of the sun and parts of its rays ("The Sun") were rendered with the densest applications of paint (Ill. 14). It is likely that these areas have a higher gloss. When first executed, the paintings must have had a wide variety of saturation of colours and of gloss.

Original varnish?

It is possible that Munch left the Aula paintings unvarnished and intended for them to remain so, although they were varnished as early as 1926 (see below). Neither the paint samples from 1973 nor the accompanying report contain any information on the application of an original varnish. On several occasions Munch expressed his dislike of varnished oil paintings.[34] Only prospective sampling and analysis, however, will be able to determine if the paintings were originally varnished.

Past treatments

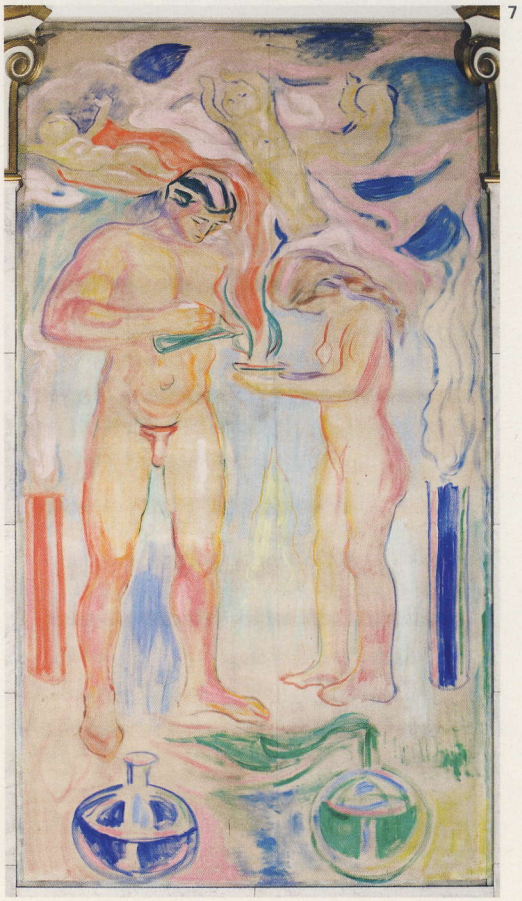
Nowadays, 90 years after the completion, the Aula paintings are still hanging in their original locations as in 1916, but their method of attachment to the wall has been altered. The original stretchers and the original tacking edges are gone, as is all of the information that could have been derived from them.



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In 1926, 10 years after their completion, the paintings were taken down for their first treatment campaign.[35] Surface dirt was removed (I); the reverse sides were coated with unknown materials; the stretchers were replaced by new ones; and finally, varnish was applied on the painted surfaces. The work was performed by restorer Ole Dørje Haug and his brother Martin.

In 1939, Munch returned to the Aula to install a different version of the "Alma Mater" on top of the original composition of 1916.[36] There is no information available on how this was done. Only one



7

6
"History" (c. 450 x 1 163 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

7
"Chemistry" (c. 450 x 225 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

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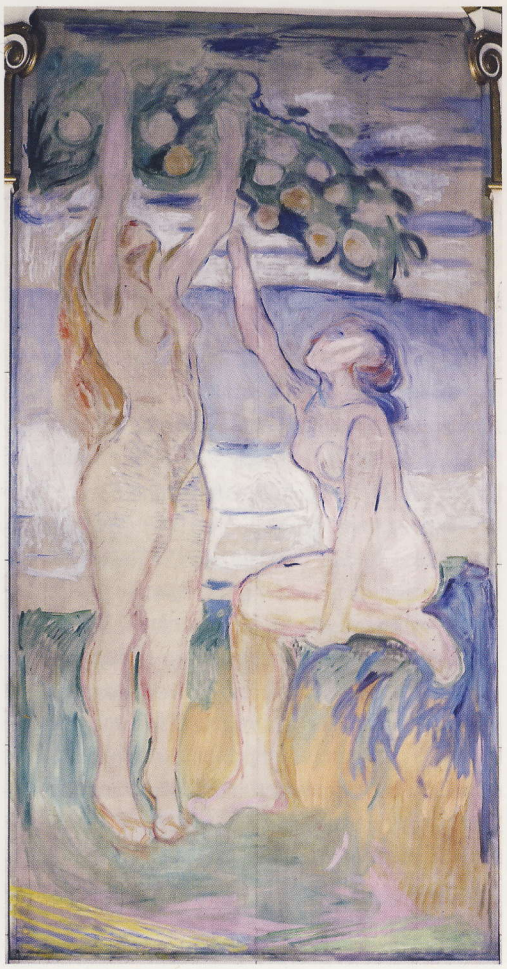
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"Spirits in the Flood of Light" (c. 450 x 300 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

9
"Men Reaching towards the Light" (c. 450 x 167 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

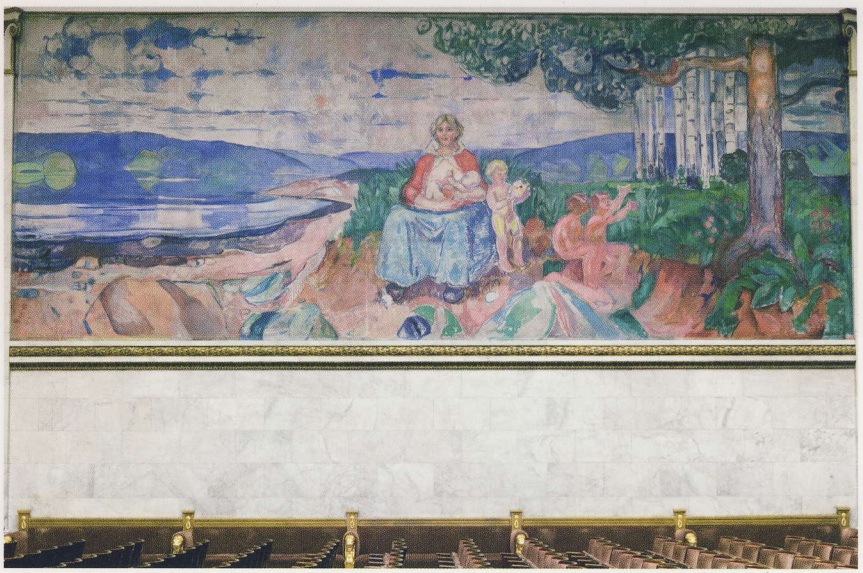
year later, due to the Second World War and the German occupation, all twelve paintings were removed from the room for safe keeping.[37] This was when the eleven paintings from the original hanging lost the majority of their edges. Only the newly mounted picture placed over the original "Alma Mater" was removed by taking out each of the individual nails used to mount it. All the others were cut down in haste.[38] At first, the paintings were placed in the basement of the neighbouring National Gallery (Nasjonalgalleriet) in Oslo. In 1944, the paintings were transported to Kongsberg to be stored in the Kongsberg mines until the end of war.[39] In 1945/46 they were brought back to Oslo and stored in the basement below the Aula.[40] In all likelihood, they were placed on rolls during these six years.[41]

During the summer in 1946, the twelve paintings were reinstalled in the Aula.[42] Because most canvas edges had been cut off, and since the post war supply of materials was poor, Ole Dørje Haug sought the advice and help of a colleague, restorer Gustav Jänsson of the National Museum of Sweden in Stockholm.[43] The restorers were worried that the paintings could no longer support their own weight. Therefore it was decided to glue the paintings onto a solid support consisting of c. 6 mm thick sheets of 'Masonite', which had been invented c. 1924[44] The first product contained fibres of wood that were bonded together by natural lignin.[45] From 1931, wood oil from Scotch pine (in Swedish: *tallolja*) was also used in the fabrication of some types of Masonite. Neither Haug nor Jänsson have mentioned which type they used for the Aula paintings. However, the lining adhesive is known: the paintings were attached to the Masonite with a rye floor paste.[46] The sheets of Masonite were fixed to a wooden framework (Ill. 15), which was then anchored to the brick wall.[47] Finally, the paintings were cleaned (II),[48] and the missing outer edges were covered with painted strips of zinc (Ill. 16).[49] Only a few years later, during 1951, the second, later version of "Alma Mater" ("The Researchers") was taken down and given to the Munch-Museum in Oslo.[50] Since then, the original eleven pictures comprising the original scheme of 1916 have been displayed in the Aula.

After five more years, a new cleaning programme (III) was launched during the summer 1957.[51] The work was undertaken by the restorers Martin Haug and Inger Davidsen. A dark, strongly adhered deposition of dirt was removed; it was believed to have been caused by the heating system of the Aula. The heat was distributed by the ovens below the couches in the audience area (below "History", "Chemistry", "Alma Mater" and "The Fountain"). It seems as though nothing was done to prevent



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11

further soiling, and in 1973, another programme of dirt removal (IV) was performed by conservator Svein A. Wiik and his assistants.[52] For the first time, the treatment included examination of canvas support, the ground and the colours (including sampling), documentation and a written report that presented proposals for future care.[53] Suggestions included the replacement of the ovens, installation of dirt filter on the air inlets, frequent cleaning of the floor and furniture; and improvement of the insulation between the paintings' reverse sides and the brick wall.

The subsequent and most recent treatment was likewise undertaken by Wiik, in 1986.[54] It included an examination of the structural features behind the zinc strips and the reattachment of two paintings, "History" and "Awakening Men in the Flood of Light", whose edges had separated from the wall. In spite of the installation of air filters and improvement of the cleaning routines of the room that followed the major campaign in 1973, severe dirt accumulation on the paintings was once again reported. This last treatment involved cleaning (V) of "The Sun" and "History" including a partial cleaning of "Awakening Men in the Flood of Light".

Finally, during the fall 2001, cleaning tests (VI) were carried out by the second class of conservation students from the University of Oslo (under Wiik's instruction).[55] The tests were undertaken on small areas, measuring c. 5 x 5 cm square, along the lower sides of "History", "New Rays", and "Awakening Men in the Flood of Light", "Women Harvesting" and "Alma Mater". At present, the cleaned squares are visible due to their distinctly lighter tones than the surrounding, un-cleaned areas (Ill. 17).



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"Women Harvesting" (c. 450 x 225 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

11
"Alma Mater" (c. 450 x 1163 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

12
"The Fountain" (c. 450 x 225 cm). Photographers: Svein Andresen and Sissel de Jong 2005, The Munch-Museum. © The Munch-Museum/The Munch-Ellingsen-Group/BONO 2007.

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13
Detail of drips from very dilute paint, "Awakening Men in the Flood of Light". Photographer: Birger Lindstad 2006, © Birger Lindstad/The Munch-Ellingsen-Group/BONO 2007.

Cleaning methods and materials

Since 1916, the restorers and conservators have used several cleaning methods and materials during the six separate known programs of cleaning undertaken in the Aula. No documentation was produced for the first and second cleanings of 1926 and 1946. During the third cleaning program, however, the restorers were interviewed by a newspaper; the article records the use of bread dough (1957).[56] The procedure was explained as follows: first, the paintings were cleaned with a small vacuum cleaner using low suction; next, a hand-sized lump of dough was rolled back and forth over the surface until it turned dark grey, at which time it was replaced with a fresh lump. The effect of the cleaning was described as fantastic ('*fantastisk*').

The fourth dirt removal was also published by a newspaper.[57] As mentioned above, for the first time, a conservation report was also prepared (1973).[58] After an initial cleaning test with solvents, the dirt was removed by a two-step procedure: loose dust was vacuumed away (this step alone lightened the hue of the paintings) then, the adhered dirt was cleaned by means of gentle pressure and rubbing with white bread dough. In some areas, cotton swabs dipped in fast-evaporating petrol-ether (boiling point 45–60 °C) were used. In others, cotton swabs dipped in distilled water were employed. In addition, common erasers (for school purposes) were utilised on areas of bare ground where water staining was visible. It was reported that "The Sun" was partly covered by uneven and yellowed varnish (possibly the remnants of the varnish applied in 1926). These yellow layers were reduced (not completely removed) with cotton swabs dipped in acetone and petrol ether (1:1). Finally, all surfaces were vacuumed once more to remove any residual traces of dough and eraser. When finished, all colours appeared brighter and high surface gloss was noted in the smooth passages of opaque paint.

The fifth treatment was confined to three paintings (1986).[59] The following materials were utilized: for mechanical removal – 'Wish ab' and fresh white bread; for solvent cleaning – ammonia and water (mixed in different concentrations); acetone, alcohol, white spirit and petrol ether (likewise mixed in different proportions) and 'Winton Picture Cleaner'.

In 2001, the students' small cleaning tests were undertaken with micro fibre rags, fresh dough from white bread made without butter or fat, water, 2 % triamonium citrate, ammonia water with a pH of 9 and water with a small percentage of 'Sunlight' soap.[60]

Limitations and possibilities

General context

The Domus Media is a listed building and any alterations to it must be approved by the Norwegian Directorate for Cultural Heritage.[61] The Assembly Hall is in constant use by the University and others – thus, by many people with diverse requirements. The acoustics of the room are especially good for concerts.[62] Hence, the prospective renovation will have to take into consideration both restrictions set by the preservation authorities and by specialists on acoustics in order to maintain the special qualities of both the building and the room. It is possible, for instance, that they might dismiss proposals such as installation of glazing in front of the paintings (which would amount to 223 square meters of glass) in order to protect them from dirt.

Structural issues

During last century (with the exception of the changing back and forth of the "Alma Mater" motifs), the eleven Munch paintings from 1916 underwent three structural interventions (1926, 1940 and 1946). In addition, two of these paintings received a fourth treatment that was intended to improve their attachment to the wall (1986). All these treatments were performed in the Aula (very little is known about handling and storage during the war). Since 1926, a substantial quantity of their original material has been removed and thrown away (stretchers, outer edges of the painted surfaces, tacking edges of canvas), and new material has been added (on the surface: varnish, painted zinc strips; on the reverse: priming, rye flour paste, Masonite boards, wooden framework and various metal attachments).[63] It is clear that more material has been added than taken away; inevitably, the thickness and weight of the paintings has increased. In 1946, Ole Dørje Haug referred to the weight of the largest paintings on two occasions. In one interview he estimated it at 50–60 kilograms, in another interview during the lining process;[64] he suggested an increase to a 1/2 ton.[65] Although, Dørje Haug might have exaggerated (there is no mention of the actual use of scale), any prospective dismounting must include means to compensate for the weight that the paintings have gained.

If the Masonite boards are retained, other consequences must be considered. If circumstances would require evacuation of the paintings, the three largest segments, mounted on their Masonite supports, are too tall and too wide to leave the room.[66] The balcony above the exit on the wall opposite "The Sun" is c. 4 m above the floor. The height of the doorway is c. 3.90 m (as is the main entrance to the building). These dimensions are sufficient to allow only the eight smaller paintings to be lifted through. Once clear of the Aula itself, an additional obstacle which would block the passage of two of the eight smaller paintings.[67] Two glass doors between the hallway and the main entrance are only c. 2.65 m high (if their glass windows above are retained). Thus, only six of the eleven paintings could be safely evacuated in their current condition, with their solid mountings.

At present, several reasons for future remounting of the Aula paintings can be suggested: the forthcoming renovation of the building (protection); improvement of the paintings' attachment to the wall; removal of the Masonite support as it currently prevents evacuation of the paintings; and finally, the need to install insulation between the paintings and the brick wall behind them in order to avoid damaging changes and irregularities of temperature. The renovation will involve major work on the entire building structure surrounding the paintings – above: on the roof, the attic and the glass ceiling; behind: the walls; and below. The hazards posed by airborne dust and dirt and vibration will be difficult to control if the paintings remain at the wall. Equally, the brick walls cannot be examined or improved unless the paintings are removed.

As mentioned above, in 1986 the buckled edges of "History" and "Awakening Men in the Flood of Light" were repaired.[68] The upper edge of "History" was loose because of a previous water leakage, but the reason for the other detachment was not noted. On 1 March, 2006, the mechanical attachment of one of the lower corners of "Spirits in the Flood of Light" failed and the corner of this support buckled outward (Ill. 18). Ongoing recordings of temperature and relative humidity (RH) showed RH levels of 15 %.[69] The wooden plug (holding a screw inserted from the front side of the painting) had shrunk because of the low humidity, and thus fallen out of its hole in the mortar between the bricks. Only a couple of weeks later, the RH in the Aula had increased to 50 %, whereupon the bent corner relaxed and it went back to its 'normal' position. Other corners on the upper sides on some of the other paintings are also bent, but to a lesser degree. The current mounting system of 1946 has begun to fail and it does not seem compatible with the current seasonal, climatic fluctuations that occur in the room.



14

14
Detail of pastose paint applications, "The Sun". Photographer: Birger Lindstad 2006, © Birger Lindstad/The Munch-Ellingsen-Group/BONO 2007.

A common characteristic of ageing canvases is a rise of acidity due to the natural decomposition of the cellulose, which weakens the overall strength of the canvas.[70] In the case of such large paintings, which must support their own weight, maintenance of a strong support is critically important. In some museums, a canvas which is found to have a pH at c. 4 will be treated by de-acidification.[71] If the forthcoming pH measurements on the Aula paintings prove to be alarming, the current Masonite support and its wooden framework prevent access to their reverse sides. In addition, Masonite can become quite acidic as it ages. Masonite contains cellulose and lignin (and possibly wood oil), and thus may itself be negatively influence the pH of the canvases. The sealant on the reverse side of the canvas (from 1926) could possibly have had an insulation or neutralisation effect, but only to a certain degree. The rye floor paste adhesive (from 1946) most likely contains cellulose which may now be as pH negative as the Masonite itself. Therefore, any future need for access to the reverse side of the paintings or for remounting them will necessarily involve taking them down and devising a new system of installation.

It is also likely that the wall behind the paintings will need to work in order to improve its insulating capacity so that it will distribute heat more evenly. Already in 1957, only eleven years after the postwar remounting of the paintings, Martin Haug recognised the connection between the wooden framework at the reverse of the paintings and the preferential accumulation of dirt in bands which formed a dark grid on its surface.[72] Svein A. Wiik observed the same phenomenon both in 1973 and in 1986. He also made two further observations regarding the deposition of surface dirt:[73] less dirt had gathered on areas with glass wadding at the reverse (in squares between the framework) while the light, almost whitish stripes (with very little dirt) seemed

15



15
Infrared recoding showing the wooden framework behind the Masonite sheets as a red grid (attached in 1946), "The Sun". Rows of single and double nails and the gaps between the Masonite sheets are visible when the original digital photo is magnified. Photographers: Dag Dysthe, Olav Gundersen and Karen Mair 2006, The University of Oslo, © Dag Dysthe/The Munch-Ellingsen-Group/BONO 2007.

16
Detail of the painted strip of zinc (attached in 1946) which surround the painting, "History". Photographer: Birger Lindstad 2006, © Birger Lindstad/ The Munch-Ellingsen-Group/ BONO 2007.

to correspond to some small gaps between the sheets of Masonite.

The same phenomena are easily observed today (notably the coincidence between the dark grid and the framework visible on IR images taken of the paintings in situ).[74] These patterns of dirt deposition are similar on all paintings, whether they are placed towards inner walls (facing only slightly colder rooms behind the stage area)[75] or towards outer walls, as well as of the placement of the heating system.

Cleaning regime

The present study suggests that the Aula paintings have been cleaned up to five times during their first 70 years, with the intervals of 10, 20, 11, 16 and 13 years respectively between the known cleaning campaigns. Any other unreported dirt removal cannot be ruled out completely because it was not usual to provide written documentation of conservation treatments in the Aula until relatively recently. It has been 20 years since the last dirt removal of "The Sun", "History" and "Awakening Men in a Flood of Light", and 33 years since the other paintings were cleaned. At present, the cleaning tests from 2001 and the general soiling clearly show that another program of dirt removal is necessary.

16



In 1957, in the interview during the third cleaning, Martin Haug claimed that the paintings should be cleaned every decade.[76] In 1973 during the fourth programme of cleaning, this period of time was again mentioned in another interview.[77] However, in Wiik's report from the same year, an opposing opinion was expressed.[78] Wiik suggested that the time intervals between future cleanings should be increased to avoid the inevitable hazards associated with all of the available cleaning methods. To protect the paintings, removals of surface dirt should be undertaken as infrequently as possible. As mentioned, filters on air inlets and better and more frequent house-keeping routines have since been employed. Unfortunately, these measures have not been sufficient; the paintings are still being soiled at an unacceptably rapid rate.

The decision to remove surface dirt from the Aula paintings cannot be based strictly on aesthetic considerations. Cleaning procedures invariably involve the risk of loss of original material.[79] Munch's paintings are vulnerable, due especially to his technique; he employed highly diluted colours to lean, absorbent grounds. Tiny fragments of paint can easily be lost if mechanical friction is used and the lean binders may loose coherence if solvents are utilized. The use of solvents involves some degree of risk. Even the richly bound colours may suffer from the loss of migrating particles and leaching of soluble components during solvent cleaning. Thus, the risks presented must be balanced against the risk of surface degradation caused by the accumulation of airborne pollutants on the paintings' surfaces. Equally, the unequal thickness of the support and the mounting system results in an unequal distribution of the dirt and the formation of a dark, grid pattern. The need to clean the paintings preferentially poses further risks to its overall coherence, in addition the fact that the 'patterned' staining is highly visually disruptive.[80] It is hoped that in the future, the insulation capacity of the walls will be regularised and that the surface temperature of the paintings will remain relatively consistent so that preferential deposition of dirt resulting in grid patterns will not continue.

Closing remarks

The treatment history of the Aula paintings includes comprehensive structural interventions and repeatedly removals of dirt. Only twice (1957 and 1973), have the five known cleaning programs been performed without structural procedures. In order to prevent this cycle of soiling and cleaning from continuing indefinitely, future treatments must in-

clude study of the rate of dirt accumulation and of the affects of its removal, as well as analysis of necessary structural improvements to be made to the room itself. The upcoming renovation of the building presents a significant opportunity to achieve a better control of the degradation agents and to establish a suitable long term preservation regime. Obviously, there is a need for further research in order to raise the standard of the conservation and maintenance of the Aula paintings. There are gaps in the present knowledge of Munch's painting techniques and materials (particularly of this period), the changes they have undergone and their vulnerabilities. The aim of the current Aula project is to fill some of these gaps so that any future interventions will be as well-founded and sympathetic to the needs of these paintings as possible.

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[2] The Munch-Museum owns ca. 100 of Munch's studies for the Aula paintings (paintings, drawings etc.) of which 36 depict "Alma Mater" and 18 "The Sun". The numbers have kindly been provided by Dr. Biljana Topalova-Casadiego at the Munch-Museum. The University of Oslo owns a study for "History". I am grateful to Ulla Uberg for this information.

[3] Lundmark 1917, esp. 13. Because of Munch's last re-hanging in 1939 (when "Alma Mater" was covered by another painting called "The Researchers"), other authors claim a longer span. Sherman 1975. Also, Munch did another re-hanging earlier (1925/1926). Mohr 1960, p. 93

[4] Verdens Gang (VG) 14. 07. 1916. Dagbladet 19. 09. 1916. Boe 1960, esp. 233

[5] The Aula can seat a maximum of 600 individuals

[6] Prior to the Aula paintings, Munch made two series of interior decorations outside of Norway: a frieze of paintings for the childrens' room in Max Linde's house in Lübeck in 1904, and drafts for stage settings and a frieze of paintings for the Max Reinhardt's theater in Berlin in 1906. The first was never installed, and the second two were temporary. Bøe 1986, esp. 22

[7] The direction of the former Freia chocolate factory was the commissioner and first owner. Hougen 1962

[8] Rolfsen 1955. The 'Freia Frieze' was finished in 1923. The tallest of these paintings is 136 cm high and the widest is 400 cm

[9] The Aula project is financed from fall 2005 to fall 2008 by a University grant provided by The Department of Archaeology, Conservation and Historical Studies (IAKH) and The Humanistic Faculty (HF), UiO

[10] In comparison, 1158 Munch paintings in the Munch-Museum (including the Aula-drafts) measures 1764 square meters (only 20 % of these paintings are signed and 7 % are dated). Stein 2005, esp. 170, 176, 182. Fortunately, the recent return of "Scream" and "Madonna" increases the museum' inventory of Munch paintings to 1160

[11] An image of "The Sun" embellishes the reverse of the Norwegian 1000 kroner bill

[12] For the paintings' locations in the room see http://folk.uio.no/jeremyhu/aula/aulapaintings.htm (August 2006)

[13] Archives in seven institutions: Museum of Cultural History, University of Oslo (KHM); the Munch-Museum; Nasjonalmuseet; the Directorate for Cultural Heritage (in Norwegian: Riksantikvaren); Byantikvaren; Byarkivet (the city archive of Oslo) and The Oslo City Museum

[14] Unpublished report by Jan Thurmann-Moe, dated May 1951, the Munch-Museum, Oslo

[15] Wiik 1973, 1986

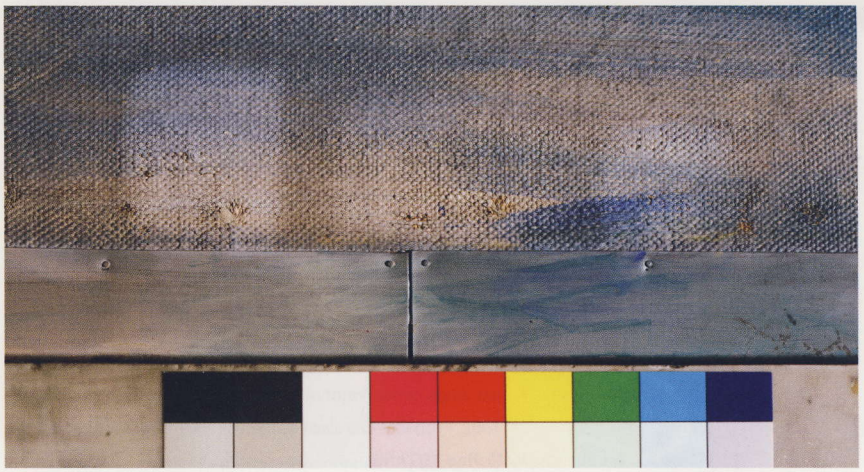
[16] Sherman 1975

[17] Mohr 1960

[18] Rød 1997

[19] The IR camera can record down to 0,1 degree Celcius

[20] Temperature and RH will be recorded for more than a year. It is being performed by the use of Hanwell Humbug data loggers



17

Detail of the cleaning tests (c. 10 x 10 cm) from 2001, "History". Photographer: Birger Lindstad 2006, © Birger Lindstad/The Munch-Ellingsen-Group/BONO 2007.

18

Detail of "Spirits in the Flood of Light" showing the lower left corner which buckled outward in March 2006. Photographer: Ulla Uberg 2006, The Univeristy of Oslo, © Ulla Uberg/The Munch-Ellingsen-Group/BONO 2007.



[21] His tenure as rector was 1945–1952. http://www.caplex.no/Web/ArticleView.aspx?id=9323421 (August 2006)

[22] If so, also Munch could be included in the group of donors. Mohr 1960:104

[23] Mohr 1960:104

[24] Also in other cases Munch preferred linen. Becker 1988, esp. p. 52

[25] Wiik 1973

[26] Munch renses med brød-deig. Under storvasken i Aulaen. Alt er blitt svart av fyringen. In: Dagbladet 22.07.1957. Martin Haug was the younger brother of Ole Dørje Haug, who was the paintings conservator at Nasjonalgalleriet between 1923 and 1952. Probably, Ole also assisted during the installation in 1916

[27] Rød 1997:59

[28] Wiik 1973

[29] Wiik has also pointed out that the sides (proper right: c. 30 cm wide and left: c. 12 cm wide) and the lower edge (c. 35–29 cm high) of "The Sun" seems to have been painted in a more indistinct and less precise technique. Therefore, he has suggested that these areas were applied subsequent to the central motif. Wiik 1973

[30] Personal communication with Unn Plahter, October 2006

[31] Munch's use of various tools for paint application has been observed by other authors. Plahter 1992, esp. p. 94. Aslaksby 1999. Buchart 2003, esp. p. 23

[32] Wiik 1973

[33] Wiik 1973

[34] Thurmann-Moe 1995, pp. 47–49, 61–62

[35] Rød 1997:59

[36] Sherman 1975:137

[37] Dørje Haug 1945. Rød 1997:59–63. Although both Dørje Haug and Rød have claimed that Ole Dørje Haug cut the paintings out while standing on a scaffold, there is a chance that this was actually done by Martin Haug, Ole's younger brother, and from a shorter ladder, presumably leaving the upper canvas edges behind. Personal communication with Reidun Margot Bjørgaas (wife of Martin Haug's nephew), (07. 11. 2006)

[38] On November the 28th in 1943 there was a fire in the Aula. If the paintings had been there, at least "The Sun" and the paintings directly adjacent to it would have been destroyed. Mohr 1960: 95

[39] Kongssund 2006, esp. 109

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[42] Unknown newspaper from the summer 1946 with the signature "Gro". Rød 1997:62

[43] Dørje Haug 1945

[44] In Norwegian: 'Masonitt'. Rød 1997:61–62

[45] Masonite was invented by William H. Mason in USA. In 1929, the first Swedish factory was built in Rundvik. http://www.masonite.se/ (August 2006)

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[60] See note 55. 'Sunlight' soap is a common, commercial dishwashing soap

[61] The Domus Media and its surrounding buildings became a listed site 04.15.2001. Riksantikvarens arkiv, Oslo

[62] Unpublished report by Tor Halmrast on the Aula acoustics, No. 121/95, 23. 08. 1995. Riksantikvarens arkiv, Oslo

[63] Since there are no reports from the first three programs, the possibility of retouching and in-painting cannot be ruled out

[64] Munchs aulabilder på plass igjen. In: Dagbladet, 14. 08. 1946

[65] Unknown newspaper from the summer 1946 with the signature "Gro"

[66] "The Sun" (c. 450 x 785 cm), "History" (c. 450 x 1 163 cm) and "Alma Mater" (c. 450 x 1 163 cm)

[67] "Awakening Men in the Flood of Light" (c. 450 x 300 cm) and "Spirits in the Flood of Light" (c. 450 x 300 cm)

[68] Wiik 1986

[69] See note 20

[70] Ricco/Burnstock 2003, esp. 49–50

[71] http://www.tate.org.uk/research (August 2006)

[72] Dagbladet 22. 07. 1957

[73] Wiik 1986

[74] This effect is most likely caused by thermophoresis, a process by which small particles in a temperature gradient are driven from the region of higher temperature towards the lower temperature region. Phenix/Burnstock 1990, esp. p. 11

[75] Four paintings are mounted on walls towards two backstage rooms: "Women Reaching towards the Light", "Awakening Men in the Flood of Light", "Spirits in the Flood of Light" and "Men Reaching towards the Light"

[76] Dagbladet, 22. 07. 1973

[77] Dagbladet, 11. 07. 1973

[78] Wiik 1973

[79] Perry 1990, esp. p. 4

[80] Already in 1977, the dark grid had become visible again, only four years after the cleaning in 1973. Unpublished report by paintings conservator Leif Einar Plahter: NG Inv.nr. 776 Krohg, Chr.: Albertine, dated March 11th, 1977, Nasjonalgalleriet, Oslo

Summaries

page 236
Katalin Görbe
The Completion of Paintings – Conservation-Restoration Training and Practice in Budapest
The Institute of Conservation-Restoration Studies was established in 1948 at the Academy of Fine Arts, now the University of Fine Arts in Budapest. The five-year master's program combines technical and art practice with the study of the humanities and natural science. The first phase focuses on copying paintings to learn fundamental historical painting techniques. The paper then discusses the complexity of objects of art and the restorer's responsibility to seek an appropriate approach for authentic restoration of losses. The author describes various methods ranging from retouching to reconstruction, presenting examples of students' work and from her own practice.
Keywords: Hungary, conservation-restoration training, copy of a painting, copying, restoration, retouching, reconstruction, tratteggio, the Liptószentmária altarpiece

Seite 246
Tine Frøysaker
Edvard Munchs Gemälde in der Aula der Universität von Oslo – Der Umgang mit ihnen und das Aula Project
Zwischen 1909 and 1916 schuf Edvard Munch elf große Leinwandgemälde für die Aula der Universität von Oslo. Die Aula stellt den wichtigsten Saal der Universität dar. Da die Gemälde den Hintergrund für einige Nobel-Preis Festlichkeiten bildeten, sind sie weltbekannt.

Die Bilder sind akut gefährdet, durch die Ansammlung von Schmutz aus der Luft und durch dessen wiederholte Entfernung durch Konservatoren und Restauratoren.

Eine Voruntersuchung zeigte, dass die Gemälde während ihrer 70-jährigen Existenz bis zu fünf Mal gereinigt wurden. Die letzten Reinigungsproben wurden in 2001 durchgeführt, und jetzt ist es eindeutig wieder an der Zeit, sie zu reinigen. Dieser kurze Abstand wiederholter Verschmutzung und Reinigung hat den Bildern zugesetzt. Es ist klar, dass solch ein kurzer Verschmutzungs- und Reinigungsabstand nicht tragbar ist.

Mit den restauratorischen Untersuchungen der Universität von Oslo wurde ein dreijähriges Projekt (2005–2008) begonnen, um die Probleme zu definieren and dann Lösungen vorzuschlagen.
Keywords: Schmutzentfernung, Oberflächenreinigung, ohne Firnis, großformatig, Leinwandgemälde, strukturelle Eingriffe

page 258
Eve Begov, Lutz Kuschel
Measuring Shock and Vibration When Transporting Works of Art
Although it is not new that there is nothing that damages art more than frequent transport and rapid environmental changes, there is a tremendous increase in museum lending. In view of a museum's obligation to protect and preserve a work of art to the best of its ability, apart from discussing the lendability of an object objectively, it is essential to learn more about the transport itself. As a consequence it is important to determine and evaluate the important physical factors, i.e. temperature, moisture, shock, vibration and incline, prevailing during transport in order to be able to determine sources of danger and to resort to appropriate measures. Since 2004, the Staatlichen Kuntsammlungen Dresden has, therefore, been using a transport data logger MONI LOG, EnDaL curve to monitor some of their art transports. After describing how to use the device, the authors present selected transport results as well as a series of tests conducted in the institute. The tests brought to light new aspects relating to measuring jarring and vibrations, for example using the master-slave circuit of two devices also allowed checking the Grüne Gewölbe's packaging concept. The article concludes with a discussion of the results' applicability for future transports.
Keywords: measuring shock, transporting works of art, incline, knocking, acceleration time, acceleration course, monitoring climate, transport data logger, transport stress, transport monitoring, risk assessment, dampening properties of packaging materials, lendability of objects

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