FORENSIC ART HISTORY: THE ÄDEL PAINTING DISPUTE 1839-1841

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1. Introduction

The overall purpose of this article is to show how cross-disciplinary collaboration can contribute to new knowledge and new interpretations of written sources and historic objects. Our team consists of researchers with expertise in the broad conservation field: conservation scientists, conservators, art historians and ethnologists. Together we have gone through the sources relating to the legal case and performed qualitative analyses of the paint - pigments, lakes and binders - of three pieces of furniture - a table, a chest and a casket - related to the case (Figure 1).

Figure 1. Three of the pieces of furniture that Anders Erik Ädel decorated for his client Erik Olofsson, 1839. The large chest has a secondary varnish and some other later additions such as the external red strip at the bottom. Photograph: Anders Assis.

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The historic sources contain, in addition to judicial protocols, receipts of purchased pigments and written comments on the artist's materials used for the commission. Key research questions are: How can court documents and scientific analyses contribute to the understanding of a 180-year-old court case, and how can this research contribute to the understanding of folk painters' crafts, choice of materials, processes and skills as well as the economy of the region in the 19th century?

2. The dispute and the judicial protocol

The dispute between painter Anders Erik Ädel and his client, farmer Erik Olofsson ran from the autumn '*ting*' (district court assembly) in December 1839, to the spring district court assembly in March 1841. The two parties met before the district court on four different occasions over the course of 15 months. It began with Ädel taking legal action against Olofsson when he claimed the client paid too little for the painting of ca. 30 pieces of furniture. Central to the case is the interpretation of the terms of the contract, that is, whether Olofsson should have paid for the 'time and materials used' or only a pre-agreed fee. Through presentations and testimonies, details of the circumstances were clarified: who had paid for the purchased artist's materials; independent valuation of the work and the conditions for Ädel to undertake the commission. An expert witness, the painter Blombertsson, was also called to give a statement. This witness stated that Ädel must have used more pigments than those reported by Olofsson in the receipts. Ädel did partly win the dispute, but the parties were to bear their own court costs. Ädel had the opportunity to appeal to a higher court, which he intended to do, but a settlement was reached before the case came up.

The circumstances and origin as well as the settlement of the litigation between Ädel and Olofsson are not clear, but court records show that Ädel had earlier been sued by the pigment merchant Forsberg for an unpaid bill. It might have been Ädel's sudden need of cash, resulting from this dispute with Forsberg, which made Ädel press for increased payment for work rendered to Olofsson.

3. Experimental

The three objects from the legal dispute identified according to provenance - a chest, a casket and a table - were analysed using UV fluorescence imaging, XRF, FT-Raman, FT-IR, and DSA-ToF-MS. GC-MS will be used to add information about binding media. The XRF analysis was performed in situ at Ljusdal Bygdens Museum. UV light examination (also *in situ*) was performed to be able to distinguish later additions from original paint layers and define regions of interest (ROI) for further examination. XRF analyses were performed on the identified ROI. Micro-sampling was then performed for supplemental laboratory analyses. The samples were divided into aliquots for various analyses to identify both binders and pigments. The pigment analyses were performed at the Department of Conservation, University of Gothenburg and the binder analyses with ATR FT-IR at the Archaeological Research laboratory, Department of Archaeology and Classical studies, Stockholm University.

Artax 800 µXRF spectrometer (Bruker) equipped with Mo X-ray tube, polycapillary lens and silicon drift detector was used for elemental analyses of pigments. Analyses were performed as single point analysis (spot size <100 μm) as well as XRF mapping, at a voltage of 50 keV, with a current of 600 μA. Measurements were carried out in situ at the Ljusdal museum. Each individual colour of paint was measured in several positions (front, side, topside or inside depending on object) on each of the three objects resulting in 40 to 90 individual analysis spots on each object. During XRF mapping, scan time per point was 10 s and the total number of points investigated was more than 150.

MultiRAM FT-Raman spectrometer (Bruker) equipped with a 1064 nm Nd: YAG laser was used on the historic samples to identify pigment and lake mixtures in the paint. The spectral resolution was 3 cm^{-1}. The laser power and number of scans varied depending on the pigment type. The brownish red and yellow samples which might contain iron were exposed at a laser power of 2-6 mW for 5000-20000 scans, while the other samples - blue, green, orange red, black and white - were exposed at a laser power of 10-30 mW for 5000-20000 scans. To attain a representative spectrum of each sample, 6-8 spectra were taken on 3-4 different points of the sample.

AxION 2 Time of Flight Mass Spectrometer (Perkin Elmer) equipped with a field-free, APCI-like direct sample analysis (DSA) source was used to collect positive mode high resolution mass spectra of the samples suspected of containing indigo. Samples were analysed without extraction or chromatographic separation, with ca. 30 seconds or less needed to collect spectra to identify the primary constituents of the analyte. The Axion DSA conditions are as follows: corona current of 4 μA, heater 250 °C, auxiliary gas (N2) pressure of 80 psi, drying gas (N2) flow of 3 L/min, and drying gas (N2) temperature of 25 °C.

The AxION 2 TOF MS was run in positive ionization mode with a flight tube voltage of -8000 V. The endplate offset was set to -200 V, the capillary entrance was set to -800 V, the capillary exit was set to 120 V for normal MS analysis. Mass spectra were acquired with a range of 100-2000 Da with an acquisition rate of 5 spectra/sec. To maintain mass accuracy, two lock mass ions were used (m/z 121.0514 and m/z 622.0295). All samples were analysed for 30 seconds, and the average mass spectra were calculated during post processing.

NICOLET iS 10 Fourier Transform Infrared Spectrometer (Thermo Scientific) equipped with SMART iTR. A small fragment of the sample was placed directly on the ATR crystal for analysis, which takes about two minutes. The analyses of the samples, when compared with relevant standards, provide an indication of the remaining products of the original binder applied by the artist.

4. Analytical results

The UV-light examination showed that the chest had a secondary varnish and was heavily retouched and repainted. The results from the pigment analyses on all three objects are presented below and followed by the preliminary analyses of the binders.

Blue: The XRF analyses show that the bottom layer of blue paint on all three objects contains lead, with low concentration of calcium and iron. In the Raman spectrum, we can see that the blue pigment is Prussian blue and in some cases Prussian blue mixed with indigo, usually mixed with lead white and chalk (Figure 2). The indigotin peaks are reduced and slightly shifted in the Raman spectrum probably due to deterioration (Figure 3) [1]. DSA-ToF-MS can be used to verify the presence of indigoids. However, in this case the binding media and all the other mixed pigments disturbed the analyses. Indigo is not mentioned in the legal protocols but is mentioned in the merchant Forsberg's bankruptcy documents from 1840 (FIII:1 konkursakter 1840:nr 11). In the blue colour of the chest we can see a large amount of indigo. The casket contains a small amount of indigo and the table contains only Prussian blue. DSA-ToF-MS did not detect any ions with m/z 263 in any of the samples; it is possible that degradation of the indigo reduced the concentration to below the limit of detection of the technique which has not yet been optimised.

Green: According to XRF analyses, the green colour contains copper, arsenic, lead and a small amount of iron in different ratios between samples indicating a mixed green. This is supported by Raman spectra which indicate malachite and emerald green as well as Prussian blue, massicot, lead white and chalk (Figure 4). Due to the high absorbance of the green pigments it was necessary to average many low intensity scans to generate a usable spectrum.

Möngel: Among the painting materials mentioned in the protocols is a pigment called "möngel". This pigment is also called Mengel or Mängel and is litharge, according to Tronner et al. [2-4]. Litharge (*silverglitt*) is mentioned in the legal protocols. Litharge is naturally present in mixed form with different lead oxides giving differences in colour and hue [5]. Depending on the colour, litharge in Swedish can be called *silverglitt* (silver shine) and *guldglitt* (gold shine). The less colourful, *silverglitt* is usually used as a siccative in linseed oil paint [6, 7]. Möngel in this case could refer to a more colourful litharge variant and thus be a synonym for *guldglitt* which is not mentioned in the protocols.

Yellow: XRF indicates iron and lead in various ratios in the yellow ROI. Yellow ochre is difficult to detect with a 1064 nm laser line, thus with FT-Raman we can only detect a mixture of litharge/massicot. We conclude, however, that it is a mixed yellow containing both litharge/massicot and yellow ochre, due to elemental analysis which shows the high content of iron. The legal protocols also disclose that yellow ochre has been used.

Red: The red painted ROI can either be an orange-red or a brown-red. The orange-red contains mainly lead, mercury and iron, and a smaller amount of calcium. Raman spectra show red lead, cinnabar and massicot together with lead white and chalk in various concentrations. In individual cases there are indications of a red lacquer, possibly carmine. XRF-analysis of the brown-red colour indicates iron and traces of zinc. The Raman spectra show that this red contains red ochre.

Black: The contours, signatures and dates contain a mixture of iron, potassium, copper and arsenic according to the XRF-analyses. Through microscopy, blue particles can be seen in a black matrix. With the Raman analyses we can detect carbon black with traces of Prussian blue. No mineral green has been detected; however, the traces of copper and arsenic can be attributed to underlying paint layers.

White: The white details contain mainly lead. Raman analysis indicates white lead and traces of chalk. In an oil medium the presence of chalk would indicate a filler or extender.

Binders: According to the historical documents (Table 1) linseed oil was used as a binder in the paint of the three objects [7]. Thus, the aim of the preliminary FT-IR analyses was to try to support or reject the hypothesis that linseed oil was used as the main binder component in the Ädel samples. The preliminary FT-IR results are listed in Table 2. Lipid signatures were observed in most of the paint samples supporting the linseed oil hypothesis in the underlying layer of the table and in some of the decorations on both the table and on the casket. The chest did not show any signs of lipids. This might be because the object had been heavily restored and had a secondary varnish on top. However, the XRF-analyses indicate that all ROIs contain some lead, even when the observed pigments do not contain lead. The lead content may be due to the linseed oil having been boiled with a lead siccative such as litharge to make the paint dry more rapidly. This strengthens the assumption that there is oil in the paint on all three objects.

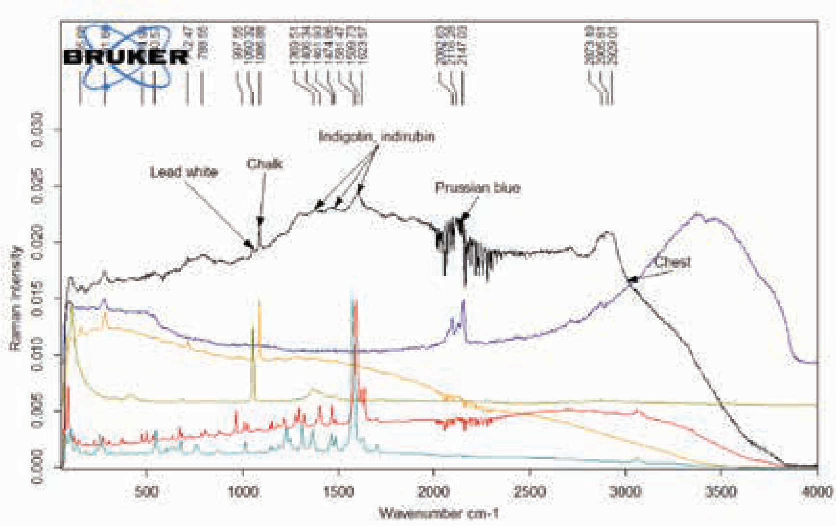

Figure 2. The blue paint contains Prussian blue mixed with lead white and chalk. The casket and the chest also contain some indigo.

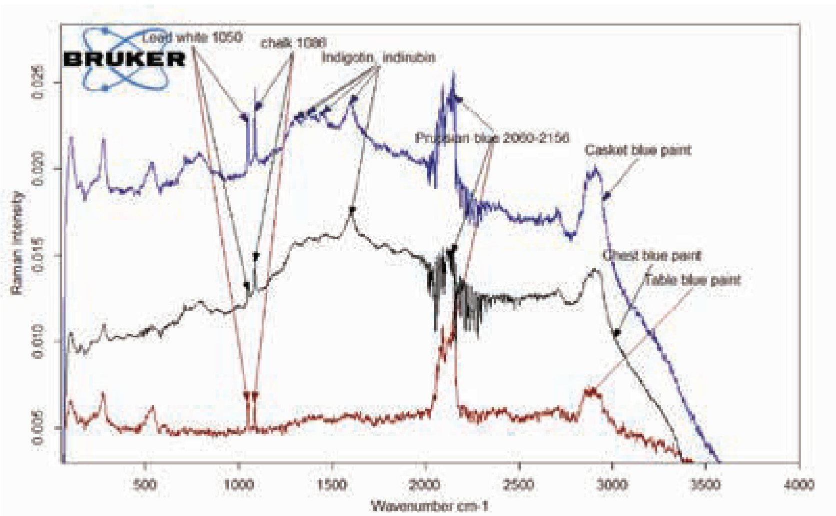

Figure 3. The indigotin peaks are slightly reduced and shifted probably due to deterioration [1]. The blue spectrum is a reference spectrum of Prussian blue pigment. The yellow is a chalk reference spectrum. The olive green is a lead white reference spectrum. The red is an indirubin reference spectrum and the blue green is an indigotin reference spectrum.

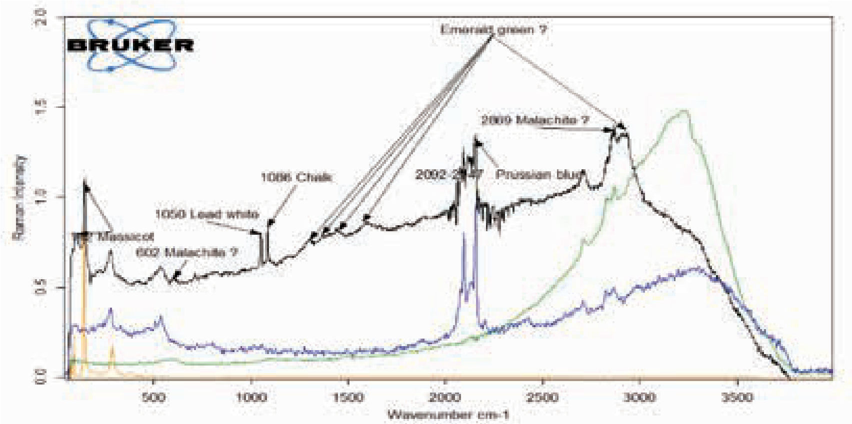

Figure 4. The Raman spectra indicate a mixture of malachite and possibly emerald green as well as Prussian blue, massicot, lead white and chalk. The blue spectrum is Prussian blue. The green is malachite and the yellow is massicot.

Table 1. Quantities and prices in old Swedish currency - Riksdaler Banko - of various artist's materials mentioned in the legal case. The italic text is the original text in Swedish.

Artist's materials	**Chemical name**	**Quantity**	**Price**
Kornmjöl, barley flour	starch	*3 skålpund* / ca 1.3 kg	*0,25 riksdaler*
Linolja, linseed oil	triglyceride: linoleic acid, alpha-linolenic acid and oleic acid	*½ kanna* / ca 1.3 l	*1,50 riksdaler*
Blyhvit, white lead	basic lead carbonate	*3 skålpund* / ca 1.3 kg	*1,46 riksdaler*
Berlinerblått, Prussian blue	hexacyano ferrate	*4 lod* / ca 53 g	*0,59 riksdaler*
Malen krita, chalk	calcium carbonate	*4 skålpund* / ca 1.7 kg	*0,20 riksdaler*
Ljusåker, yellow ochre	iron oxide	*8 lod* / ca 106 g	*0,35 riksdaler*
Mineralgrönt, Mineral green*	copper containing green pigment	*1 lod* / ca 13 g	*0,35 riksdaler*
Linolja, linseed oil	triglyceride: linoleic acid, alpha-linolenic acid and oleic acid	*3 kannor* / ca 7.85 l	*9,00 Riksdaler*
Blyhvit, lead white	lead carbonate hydroxide	*1 lispund* / ca 8.5 kg	*9,83 riksdaler*

Mönja, red lead	lead (II,IV) oxide	*2 skålpund* / 850 g	*0,83 riksdaler*
Cinnober, cinnabar	mercury (II) sulphide	*3 lod* / 425 g	*0,19 riksdaler*
Berlineblått, Prussian blue	hexacyano ferrate	*½ skålpund* / ca 212 g	*1,50 riksdaler*
Möngel, litharge	tetragonal lead (II) oxide	*1 skålpund* / 425 g	*0,75 riksdaler*
Silfverglitt, litharge	tetragonal lead (II) oxide	*½ skålpund* / ca 212 g	*0,22 riksdaler*
Möngel, litharge	tetragonal lead (II) oxide	*½ skålpund* / ca 212 g	*0,50 riksdaler*
Mönja, red lead	lead (II,IV) oxide	*1 skålpund* / 425 g	*0,50 riksdaler*
Silfverglitt, litharge	tetragonal lead (II) oxide		*0,25 riksdaler*
Berlineblått, Prussian blue	iron(III) hexacyanoferrate(II)	*4 lod* / ca 53 g	*0,50 riksdaler*
Wecktriol, vitriol	iron(II) sulfate	*4 lod* / ca 53 g	*0,13 riksdaler*
Krita, chalk	calcium carbonate	*4 skålpund* / 10.2 kg	*0,88 riksdaler*
Linolja, linseed oil	triglyceride: linoleic acid, alpha-linolenic acid and oleic acid	*1 kanna* / ca 2.6 l	*3,00 riksdaler*
Hvitmjöl, white flour	starch	*1 lispund* / ca 8.5 kg	*3,33 riksdaler*
Linolja, linseed oil	triglyceride: linoleic acid, alpha-linolenic acid and oleic acid	*3/8 kanna* / ca 0.98 l	*1,13 riksdaler*

**The term "Mineral green" has been applied for various copper mineral pigments [5].*

Table 2. Preliminarily FT-IR analyses to support or reject the hypothesis that linseed oil was used as the main binder component in the Ädel samples. Lipid signatures were observed in some of the paint samples supporting the linseed oil hypothesis. The chest was substantially restored and varnished which may have affected the analyses.

Sample Number	Object/Position	Colour of sample	Linseed oil
AA 1839-1b	table/underlying paint layer	blue	likely
AA 1839-2b	table/right side	red-brown	weak resemblance
AA 1839-3b	table/table top	red-orange	weak resemblance

AA 1839-4b	table/left side	red-orange	weak resemblance
AA 1839-5b	table/flower on table top	red-brown	likely
AA 1839-6b	table/flower left side	red-brown	weak resemblance
AA 1839-7b	table/table top	green	likely
AA 1839-8b	table/leaf left side	green	weak resemblance
AA 1839-9b	table/table top	black	likely
AA 1839-10b	table/left side	black	likely
AA 1939-11b	table/table top	yellow	-
AA 1839-12b	table/table top	white	unlikely
AA 1839-13b	table/left side	white	weak resemblance
AA BED-1b	casket/ground colour	blue	weak resemblance
AA BED-2b	casket/border	red	likely
AA BED-3b	casket/flower	orange	unlikely
AA BED-4b	casket/flower	yellow-green	weak resemblance
AA BED-5b	casket/leaf	green	unlikely
AA BED-6b	casket/plant	black	likely
AA KST-1b	Chest/ground colour	blue	unlikely
AA KST/1c	Chest	blue	unlikely

5. Conclusion

The historical documents and the protocols of this court case are a rich source of information for art technical studies. Receipts for the purchased pigments and the comments on the materials used by the artist for the painted furniture in this case give an indication of the materials Ädel had access to and what he might have used in his painting. By means of scientific analyses, the pigments that Ädel actually used can be identified and compared with written sources from the period. The documents have been used as guidance for the interpretation of the results from the scientific analyses. Moreover, the scientific analyses have shown that other pigments were used in addition to those mentioned in the dispute. This is an indication that the testimony may contain inaccurate information and that the court records must be interpreted critically. According to the results of the analyses relating to the three objects - the chest, the casket and the table - the paint layers contain the following pigments:

- White colour in the details and highlights consists of lead white and some chalk as a filler/extender.

- Yellow colour in the painted petals consists of a mixture of litharge/massicot and light ochre, sometimes only litharge/massicot, depending on the shade.
- Red and orange colour in borders and petals consists of red ochre and a mixture of red lead, cinnabar and some lead white, and possibly carmine lacquer.
- Blue underpaint consists of Prussian blue mixed with lead white and chalk, occasionally mixed with indigo.
- Green colour in the leaves and stems in the motif are a mixture of mineral green containing copper, possibly malachite, mixed with emerald green containing copper and arsenic. Sometimes the green pigment is also mixed with Prussian blue and massicot.
- Black colour in contours and monograms consists of a mixture of carbon black and Prussian blue.

The receipts and invoices also give insight into what the different pigments cost during the decades prior to the mid-1800s. They also show, along with the legal protocols, the quantities of the different pigments used for the painting. The quantities have been recalculated into a contemporary unit of measurement (Table 1) which can be used to understand the possible usage of each material. When combined with the price of each material a picture of high status objects prepared with costly materials emerges.

An example of the type of information that can be extracted is that *silverglitt* (litharge) was probably used as a drier, siccative, while *möngel* (litharge) would have been used as a yellow pigment. This interpretation is based on the quantity and the price difference between *silverglitt* (210 g, 10 Skilling) and *möngel* (425 g, 36 Skilling). Only a small amount of litharge is needed in the boiling of linseed oil compared to the production of yellow paint. Furthermore, as litharge/massicot has been detected in the yellow paint, we suggest that the pigment *möngel* (also named *mengel* in Swedish), is the yellow litharge/massicot in paint.[1]

In the legal protocol, it is mentioned that Ädel worked for five and a half days painting about 30 items including the above-mentioned furniture. The time spent on painting these objects shows that Ädel was an experienced painter and that he must have been working quickly and efficiently. The paint on the chest, casket and table indicates that the light blue colour is painted only in one layer, since it is partially transparent and that the wood beneath can be distinguished. As it seems to be oil paint (lipids were indicated in some samples), the layer should have been allowed to dry at least one to two days before decorative painting could begin on top. One can imagine that Ädel began by painting all the blue coloured furniture at the same time. He then decorated them all once they were dry. Through the pigment analyses, however, we note that Ädel has used indigo in different amounts on the chest and the casket and not at all on the table. As indigo is not mentioned in the protocols from the court case, Ädel might have brought this pigment along with other pigments, as well as painting materials himself (i.e. these artist's materials were not bought by the client). Could it be that Ädel prepared different batches of blue paint; one with indigo mixed with the Prussian blue and another with only Prussian blue? One can imagine a scenario where Ädel was using a 'remainder' of blue paint containing indigo to which he added Prussian blue, and when this paint ran out he prepared a new blue paint using only Prussian blue. If so, then perhaps, the chest which contains the most indigo (of the three items analysed) would have been painted blue earlier than the table which contains only Prussian blue.

Through scientific analysis, we can demonstrate and support what the expert witness Blombertsson stated, that Ädel used more pigments than those which Olofsson reports in the receipts (Table 1). Examples of such pigments are chalk, carbon black, red ochre, two different coppers containing green pigments and indigo. There are possibly other pigments, such as iron oxide black, not mentioned in the receipt. In regard to the analyses, we also see that Ädel frequently mixed his pigments. This is relatively rare in a Swedish folk art context, at least if compared to Southern Swedish painted wall-hangings from the same period. Typically, Swedish folk painters used one brush for each paint and seldom mixed the different paints to achieve a particular hue. Ädel, on the other hand, rather seems to search for the right hue and thus mixes several paints to achieve it.

As a conclusion from this study, we believe that cooperation between different disciplines is crucial to tackle and interpret this kind of empirical material which contains both historical sources that require transcriptions and interpretations, and material characterization and scientific interpretation of the results. When different skills and various perspectives come together, new interpretations and knowledge can be obtained. The gathered knowledge can also be crucial for future conservation and preservation, as some of the pigments in the objects contain toxic arsenic, lead and copper. It is therefore important to take into account this factor when conservators and curators handle this type of object during their work.

Acknowledgements

The presented study is part of a larger interdisciplinary project "Decorated Farmhouses of Hälsingland: A holistic study of a world heritage site", in which methods from natural and historical sciences are applied to the decorative folk arts and crafts in the farmhouses of Hälsingland, UNESCO World Heritage. The project is four years long and funded by the Swedish Research Council (VR). The study is a collaboration between different researchers: conservation scientists, chemists, physicists, conservators, art historians and ethnologists and the project participants are:

Ingalill Nyström, project leader, PhD conservation science, Dep. of Conservation, University of Gothenburg; Anneli Palmsköld, assistant professor, ethnology, Dep. of Conservation, University of Gothenburg; Jacob Thomas, PhD conservation science, Dep. of Conservation, University of Gothenburg; Yvonne Fors, PhD chemistry, Dep. of Conservation, University of Gothenburg/ The Swedish National Heritage Board; Johan Knutsson professor, art history, Carl Malmsten furniture studies, Linköping University; Kaj Thuresson, PhD chemistry, The Swedish National Heritage Board; Thomas Zack, assistant professor, geology, Earth Science, University of Gothenburg; Aleksandar Matic professor, physics, Applied Physics, Chalmers; Liv Friis, BSc, paper conservation, Dep. of Conservation, University of Gothenburg; Anders Assis, antiquarian, Ljusdalsbygdens museum.

The project is also collaborating with other experts who include:

Sven Isaksson, assistant professor, archaeological science, Archaeological Research Laboratory, Stockholm University; Lars Nylander BSc art history, antiquarian, Hälsinglands museum, Hudiksvall; Mélanie Platzgummer BSc, World heritage coordinator Bollnäs county, Culture department.

Notes

[1] The word *möngel* could be a name for yellow *mönja* (red lead), where the prefix "*mön*" is used in combination with the suffix "gel" from the German term for yellow *gelb*. The other name *mengel* could originate from Dutch, where red lead is called *mennia* and yellow is *gel*. Whatever the derivation of the name, *möngel* is a yellow lead oxide.

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Archive sources

Landsarkivet Härnösand (HLa):
Domstolsarkiv:
Hälsingland, Ljusdals tingslags häradsrättsarkiv

A1a:17 Dombok 1838-1839	Vårting 1839, §67
A1a:17 Dombok 1838-1839	Höstting 1839, §45
A1a:18 Dombok 1840	Vårting 1840, §55
A1a:18 Dombok 1840	Höstting 1840, §48
A1a:19 Dombok 1841	Vårting 1841, §48
FIII:1 konkursakter	Konkurs nr 11, år 1840

Västernorrlands lagmansrätt:

Akter 1841 för Hälsingland och Härjedalen	Stämningslista

Biographical notes

Ingalill Nyström is an associated professor and researcher at the Department of Conservation, Gothenburg University. She is the project leader of the project Decorated Farmhouses of Hälsingland: A holistic study of a World Heritage site, founded by the National Research Council in Sweden (Vetenskaps Rådet). She received her master's degree in conservation in 2003 and her PhD degree in 2012 on the thesis "Spectroscopic Analysis of Paint and Technique in Southern Swedish Painted Wall-hangings 1700-1870" at the Conservation Department, Faculty of Science, Gothenburg University. Nyström has studied analytical chemistry and she has long experience as a painting conservator. Her main focus is historic art technology using spectroscopic analytical methods such as FT-Raman, FTIR, SEM-EDX and Multispectral Imaging.

Jacob Thomas is an assistant professor researcher in heritage science at the Department of Conservation, Gothenburg University. His PhD in sustainable heritage from University College London with the Tate Gallery focused on how the oxygen-free display of works on paper can be used to meet preservation targets and how to evaluate this with instrumental analysis: headspace GC-MS, XAS, UV-Vis-FORS, and chemiluminometry. He has also worked in a research team developing multifunctional nanocomposite packaging materials. He is generally interested in developing both 'high' and 'low' tech diagnostic methods for the heritage sector. In this project, Thomas works with ambient pressure chemical ionisation mass spectrometry to identify organic colorants in heritage materials.

Liv Friis is a research engineer, conservator and master student at the Department of Conservation at Gothenburg University. She has an undergraduate degree in Conservation from Gothenburg University (2014), with a specialization in paper objects. Her previous studies focus on light fastness of ink on prints using micro fading testing. Since January 2016, Friis has been assisting the research project. She manages the projects database and runs pigment analysis using Raman spectroscopy.

Yvonne Fors is a chemist and works as a scientist at the Department of Conservation, University of Gothenburg and as a project manager concerning preservation issues at the Swedish National Heritage Board. Fors had her doctoral degree in structural chemistry at Stockholm University in 2008 with a thesis about preservation challenges with marine archaeological wood. Fors' part in the project is to analyze the binders used in the paintings. FT-IR (Fourier Transform Infrared Spectroscopy) offers a general idea about the basic compounds of the samples, such as lipids, carbohydrates, starch or protein. Thereafter the samples are analyzed with GC-MS (gas chromatography-mass spectrometry) to gain more detailed information about what binder/binders has/have been used. The analyses are carried out at the Archaeological Research Laboratory, Stockholm University.

Anders Assis is an antiquarian at Ljusdalsbygdens museum in Hälsingland. The institution has been working with research about the regional painting traditions in decorated farmhouses in the region and its practitioners since 1985. Assis has been responsible for this work since 2005. His main work for the project is historical source research in archives and stylistic analyses of painted objects. Assis puts the research objects in their local and cultural context and assists the project in contact with the stake holders at the world heritage sites, Decorated Farmhouses of Hälsingland.

Kaj Thuresson is employed as a researcher and chemist at the Department of Conservation Science, National Heritage Board. Thuresson received his PhD degree in Environmental Chemistry at Stockholm University. For eight years Thuresson has been working with conservation science in the cultural conservation sector. His expertise is in chemical analysis and materials. In the project Thuresson assists with sampling and sample analysis using techniques such as µXRF and µRaman.

Summary

This article concerns a 19th century dispute about twenty pieces of decorated furniture painted by the 19th century painter Anders Erik Ädel (1809-1888) from Söderhamn, Hälsingland, Sweden. Ädel is considered to be one of the foremost painters in Hälsingland. His art works - painted furniture and interiors - are displayed in museums and can also be found in the Decorated Farmhouses of Hälsingland, UNESCO World Heritage. In 1839, Ädel accused his client, the farmer Erik Olofsson, in court of having paid too little for the objects he had painted as he had used more pigments than those for which he had been paid. Almost 180 years later scientific methods combined with historic source research were used to understand what pigments Ädel actually used. Through this study we demonstrate how multidisciplinary collaboration between sciences and humanities can contribute to deeper knowledge and new interpretations. The scientific analyses were preceded by analyses of the judicial protocols found. Non-invasive analyses using XRF instruments were conducted in situ, supplemented by other spectroscopic methods in the lab. The judicial protocols give an insight into what pigments Ädel had access to, and when combined with the scientific analyses, this information provides historic evidence of the artist's materials and painting technique.

Riassunto

Il presente articolo riguarda una disputa del XIX secolo riguardo circa venti oggetti di arredo dipinti da un pittore del XIX secolo Anders Erik Ädel (1809-1888) da Söderhamn, Hälsingland, Svezia. Ädel è considerato uno dei più importanti pittori in Hälsingland. Le sue opere, costituite da oggetti di arredo e interni dipinti, sono esposte nei musei ed è possibile fruirle nelle Decorated Farmhouses of Hälsingland, UNESCO World Heritage. Nel 1839, Ädel accusò un suo cliente il fattore Erik Olofsson in tribunale, per averlo retribuito troppo poco per gli oggetti che egli aveva dipinto, in quanto aveva utilizzato più pigmenti rispetto a quelli per i quali egli era stato pagato. Quasi 180 anni più tardi, le metodologie scientifiche insieme con la ricerca delle fonti storiche, hanno permesso di conoscere quali pigmenti Ädel effettivamente utilizzò. Con questo studio si fa presente come la collaborazione interdisciplinare tra le scienze e gli studi umanistici possano contribuire ad una conoscenza più approfondita e a nuove interpretazioni. Le indagini scientifiche, precedute dallo studio dei protocolli giuridici ritrovati, sono state condotte in situ mediante XRF e in laboratorio con altri metodi spettroscopici. I protocolli giuridici con la ricerca scientifica forniscono informazioni su quali pigmenti Ädel abbia impiegato, costituendo in tal maniera testimonianza storica dei materiali e della tecnica pittorica dell'artista.