University of Pardubice

Faculty of Restoration

Master's degree programme: Restoration and Conservation of Artworks on Textile support

Jiráskova 3, 570 01 Litomyšl

East Asian Paintings on Silk Support: Approaches to Conservation, Materials and Methods

Master Thesis

2021 BcA. Laura Khaindrava

Univerzita Pardubice
Fakulta restaurování
Akademický rok: 2020/2021

ZADÁNÍ DIPLOMOVÉ PRÁCE
(projektu, uměleckého díla, uměleckého výkonu)

Jméno a příjmení:	**Laura Khaindrava**
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Studijní program:	**N8206 Výtvarná umění**
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Téma práce:	**Problematika restaurování maleb na hedvábí asijské provenience**
Zadávající katedra:	**Ateliér restaurování uměleckých děl na papíru**

Zásady pro vypracování

Cílem diplomové práce studentky Laury Khaindrava je shrnutí poznatků o technice malby na hedvábí, typickém poškození, kterému tyto malby podléhají a vhodném způsobu restaurování těchto děl. Součástí diplomové práce bude experimentální část práce, v které diplomantka vyzkouší způsoby scelování trhlin a doplňků ztrát hedvábné podkladu. Poznatky poté uplatní při praktickém komplexním restaurování čínského ručního svitku Vm 972 Čao Po-ťü – Západ slunce na moři ze sbírek umění Asie a Afriky Národní galerie Praha. Součástí práce bude kompletní průzkum a komplexní restaurování malované části díla. Restaurátorský průzkumu popíše stav poškození, materiály a techniku díla, provedení chemicko-technologického průzkumu bude probíhat ve spolupráci s laboratoří NGP. Na základě poznatků průzkumu navrhne diplomantka detailní restaurátorský záměr, který bude schválen vedoucím diplomové práce a kurátorem Sbírky umění Asie a Afriky NGP. Na základě schváleného záměru provede diplomantka restaurování díla, veškeré kroky a zásahy budou průběžně konzultovány s vedoucím diplomové práce. Poznatky z experimentální části DP diplomantka využije při restaurování zadaného díla. Diplomantka také vyhotoví oddělenou restaurátorskou dokumentaci v písemné a elektronické podobě pro uložení v archivu restaurátorského oddělení NGP.

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Seznam doporučené literatury:

An Illustrated Dictionary of Japanese-Style Painting Terminology NIHONGA, Tokyo University of Arts 2010 Yu Feian, Chinese Painting Colors: Studies on Their Preparation and Application in Traditional and Modern Time, University of Washington Press, 1988 Robert Hans van Gulik, Chinese Pictorial Art as Viewed by the Connoisseur: Notes on the Means and Methods of Traditional Chinese Connoisseurship of Pictorial Art, Based Upon a Study of the Art of Mounting Scrolls in China and Japan, SMC Publishing Incorporated, 1993 John Winter, East Asian Paintings: Materials, Structures and Deterioration Mechanism, Archetype Books, 2008 Agnes Timar-Balazsy, Dinah Eastop, Chemical Principles of Textile Conservation, Routledge, 2012 The Paper Conservator, vol. 30, ICON 2006 Scientific Research on the Pictorial Arts of Asia, Proceedings of the Second Forbes Symposium at the Freer Gallery of Art, 2005 Conservation Of Papers And Textiles, National Research Institute of Cultural Heritage South Korea, 2016

Vedoucí diplomové práce: **MgA. Barbora Bartyzalová**
Ateliér restaurování uměleckých děl na papíru

Datum zadání diplomové práce: **15. listopadu 2020**
Termín odevzdání diplomové práce: **8. září 2021**

L.S.

Mgr. BcA. Radomír Slovik
děkan

Mgr. art. Luboš Machačko
vedoucí ateliéru

V Litomyšli dne 30. srpna 2021

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V Litomyšli dne

Laura Khaindrava

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I would like to express my deepest appreciation to my thesis supervisor MgA. Barbora Bartyzalová, restorer of Asian art at the National Gallery Prague for her invaluable support and patience throughout the duration of my master's thesis. I am extremely grateful for her unwavering guidance and enormous amount of assistance, without which this project would not have been possible or completed.

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Annotation

This master's thesis presents the results of a comprehensive conservation treatment of the silk component of a Chinese handscroll with a traditional painted scene of a Chinese landscape on a silk support lined with Chinese paper. In the theoretical section, the final master's thesis examines in more detail the topics of damage, materials used for the conservation and mounting of Asian handscrolls on silk, and correct storage and handling conditions. The work also contains an experimental section investigating methods mending tears in unlined Asian paintings on silk.

Keywords

Chinese handscroll, Chinese art, Asian scrolls, deterioration of Asian scrolls, handling and storage

Anotace

Tato magisterské diplomová práce prezentuje výsledky komplexního restaurátorského zásahů na hedvábné časti Čínského podélného svítku s malovaným výjevem tradiční čínské krajiny na hedvábné podložce podlepené čínským papírem. Závěrečná magisterská práce se ve své teoretické části podrobněji zabývá problematikou poškození, materiály používané k restaurování a montáží Asijských podélných svitku na hedvábí a jejích správnými podmínkami uložení. Práce obsahuje i experimentální část zabývající se problematikou zacelení trhlin nepodlepených asijských maleb na hedvábí.

Klíčová slova

restaurování, čínský podélný svitek, čínské umění, asijské svitky, asijské umění, poškození asijských svitků, údržba a uložení

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INTRODUCTION

This thesis examines the comprehensive conservation treatment of a Chinese handscroll with a painting titled *"Sunset on the Sea"* on silk support with a paper lining, from the collection of National Gallery Prague. The conservation process was conducted in the conservation studio of the Department of Asian and African Art at the National Gallery Prague.

The conservation report includes invasive and non-invasive surveys, a detailed description of the treated work, and a photographic report. The aim of the work was to reduce the process of gradual degradation and retrieve the object with its original function and aesthetic value.

During the conservation process, special attention was given to the differences in approach and philosophy of conservation in Europe and Asia. The theoretical section of this master's thesis was developed in connection with this topic. The aim of the theoretical section is to describe the traditional materials used in scroll mounting and the characteristics of these materials, and to provide a closer acquaintance with the problem of deterioration in Asian handscrolls and the care, handling and storage required for proper preventive conservation.

The work consists of three main sections: (i) a conservation report for the treated object, (ii) a theoretical section, and (iii) an experiment investigating the problem of repairs applied to tears in Asian paintings on silk. Each section has its own content, a photographic report and appendices. Finally, a list of figures, list of reproductions, list of literature and sources is provided.

CONSERVATION REPORT

Comprehensive conservation of a painting on silk on a Chinese handscroll

"*Sunset on the Sea*"

Thesis Supervisor: MgA. Barbora Bartyzalová
Conservation Consultant: Mgr. art Luboš Machačko
Chemical Technology Consultant: Ing. Radka Šefců
Art History Consultant: Mgr. Michaela Pejčochová, PhD

Author of the Conservation Report: BcA. Laura Khaindrava

Litomyšl 2021

Number of copies of the Conservation Report: 3

Storage location of the Conservation Report:

1) University of Pardubice, Faculty of Restoration,
   Jiráskova 3, 570 01 Litomyšl
2) National Gallery in Prague, Archive of Conservation Department, Convent of St. Agnese, U Milosrdných 17, 110 00 Prague
3) Personal archive of Laura Khaindrava

Author of the Conservation Report: Laura Khaindrava

Prohlašuji, že jsem použila při restaurování pouze materiálů a postupů uvedených v této restaurátorské dokumentaci. Nejsem si vědoma nových zjištění a skutečností na restaurované památce, které by nebyly uvedeny v této dokumentaci.

Prohlašuji, že restaurátorský zásah byl proveden v mezích určených zadáním.

I declare that during the conservation treatment, I used only the materials and methods mentioned in this conservation report. I am not aware of any new findings or facts concerning the treated object that would not be included in this documentation.

I declare that the conservation intervention was performed within the limits specified in the assignment.

In Litomyšl on ……

……	……
Conservator	Thesis Supervisor
BcA. Laura Khaindrava	MgA. Barbora Bartyzalová

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Total number of pages: 76

Total number of pages of photographs: 54

Authors of photography: Laura Khaindrava; Department of Asian Art National Gallery Prague; Photography Department National Gallery Prague

1 IDENTIFICATION OF THE TREATED OBJECT

Title:	Chinese handscroll on silk support *"Sunset on the Sea"*
Painter:	Unknown (attributed to Zhao Boju)
Period:	Unknown
Accession no.:	Vm 972
Media:	Pigment painting on silk support with paper lining
Size:	2465 × 354 mm (w. × h.)
Contracting authority/Owner:	National Gallery Prague
Contractor:	University of Pardubice. Address of residence: Studentská 95, 532 10 Pardubice, represented by the Dean of the Faculty of Restoration and Conservation, Jiráskova 3, 570 01 Litomyšl
Thesis supervisor:	MgA. Barbora Bartyzalová
Consultant:	Mgr. art. Luboš Machačko, Supervisor at the University of Pardubice, Faculty of Restoration, Studio of Restoration and Conservation of Artworks on Paper, Textile and Related Materials
Restorer:	BcA. Laura Khaindrava, student of the II. year undertaking a master's degree programme at the University of Pardubice, Faculty of Restoration, Studio of Restoration and Conservation of Artworks on Textile support
Duration:	February – August 2021

2 DESCRIPTION OF THE ART PIECE

2.1 Typological description

The subject of conservation treatment is a Chinese handscroll with a painting titled *"Sunset on the Sea"*, attributed to the painter Zhao Boju, on a silk support with paper lining. The painting was executed with pigments bonded with animal glue, which is a traditional Chinese painting technique.

The four parts of the handscroll have been preserved: the painting on silk, the paper colophon, the front part (on the right) with silk, and a fragment of the back part with silk (on the left). No clear proof of the date of origin of this art piece is available, but according to the preserved materials, we can assume that the mounting parts originated approximately in the 1950s and are therefore from a later remounting and probably secondary. The thesis examines the process of conserving the silk part of the scroll, i.e., the painting. Conservation of the other parts will be performed by the Conservation Department of the National Gallery Prague.

The painting represents a landscape of mountains, and water (probably the sea, according to the title) executed in blue and green colours graduating from lighter tints to more intense darker shades. The exact place of the landscape is unknown, although it may be an imaginary, idealized scene rather than a real location.

The scenery unfolds from the right side of the scroll, depicting a landscape with water interrupted by sections of mountains and other elements, such as architecture and vegetation. Small groups of houses surrounded by mountains and hills with trees occur throughout the painting from the right to left sides. A closer inspection of the painting reveals subtle figures in houses and boats, especially at the left side of the painting. A group of figures carrying white and greenish flags with red circles is gathered on the rock shore.

The middle of the painting depicts the central part of the landscape and contains the most intense scenery which expresses the life of the people who live there. A monastery is displayed as a place probably situated high in the mountains according to the clouds painted above. A pagoda can be seen on the right upper side of the central scene, and a small gateway can be seen on the left. All of the buildings are probably a continuation of a monastic complex and illustrate an idealized landscape. Below the

monastery are small groups of buildings, villages surrounded by nature and blossoming plum trees, which suggests that the scene takes place in spring. Closer inspection reveals subtle figures inside the houses. A decoratively painted river flows through the entire scene, including small areas of the central section. A detailed bridge painted in the middle of the central scene might be a reminiscence of the well-known Chinese painting of Zhang Zeduan *"Along the River during the Spring Festival"*. Nearby elements resembling honeycombs probably represent rice fields and are surrounded by mountains, hills and houses. The unusual stylization of the fields may indicate that the painting is relatively new, as old masters would have used a more naturalistic and realistic painting method. The small figures located in some of the houses and outside on the rocks appear to be conversing in a meditative manner. Several ports depicted two-thirds and three-thirds along the painting may indicate that the location is in South China (though it does not mean that we are dealing with a real, existing place). The river is painted in a decorative manner and is composed of various wavy lines adjusted closely to each other, referencing the oldest technique of water painting, done perhaps to express a feeling of "antiquity" in the painting. Across the river are some boats.

The last section of the scenery begins with a group of figures carrying flags and banners with an unknown symbol. The group stands at the front of a building which is probably the house of an official – the magistrate (according to the typical hat). The magistrate is surrounded by servants and sits at the centre of the house. He wears red clothes and a black hat. We can therefore presume that the group of figures may be the magistrate's retinue, which includes a figure on horseback that might be the retinue's leader. The red circle, which depicts the sun, occurs at the beginning of the painting's final scene, and is edged with a golden line. All the main elements of the painting, such as mountains, houses and boats etc., are outlined with a subtle black line, while some edges are decorated with golden lines. A small scene of rock formations with a fortification gate encloses the scene.

Eight red seals are located on the painting: four are situated on the right side (two on the upper side, one with a large rectangular shape, the other with a circular stamp, and on the lower side, one with a smaller rectangular shape, and the other with a circular stamp) and four on the left side (a large rectangular stamp on the upper side, a smaller rectangular stamp in the middle, and two stamps on the lower side). A small number *"157"* is written in pencil on the upper right side, situated between the rectangular and

circular stamps. Between the upper and lower stamps on the left side of the painting, we can detect a signature in Chinese characters *"千里伯駒 Qianli Boju"* written in ink. On the back side of the scroll on the paper backing, the inventory number of the National Gallery Prague *"Vm 927"* and *"1151/20"* is written in pencil.

2.2 The painting "Sunset on the Sea"

The handscroll *"Sunset on the Sea"* is probably a copy of the work of Zhao Boju, a Song dynasty painter. The signature at the end of the scroll does not seem to be authentic, and it is not likely that the painter of the scroll was Zhao Boju himself. However, it can be assumed that it is a high quality and convincing copy of the work of this artist or a follower who worked in his style. Some of the painting stylization elements used on the scroll resemble the painting methods from the purported period of its origin.

The painting *"Sunset on the Sea"* represents a typical example executed in the painting style of the "gold and green landscape" (*jinbi shanshui*), which is a variation of the "blue and green landscape" (*qinglü shanshui*), used in the early ages of Chinese painting. Mountains and are executed in blue and green washes which vary from light tints to more intense darker shades. It is unknown whether the landscape represents a real place or an imaginary, idealized scene, which is quite common (see *2,3 Chinese landscape painting*).

The mountains and hills have the most colour layers and are less transparent, while areas with rocks are more transparent and warmer, as the ochre coloured silk background can be partially seen through. A closer look at some mountain areas reveals a visible white background and thicker pigment layers to produce opaque areas.

The green and blue pigments which were used to paint the mountain areas contain the minerals azurite and malachite and are commonly employed in Chinese landscape painting. According to chemical analyses, azurite and atacamite are the main pigments which compose green and blue mountains. If these colour pigments occur in a larger part of the scene, this type of painting is known as "big blue and green landscape", while if they occur in a less significant amount, it is known as "small blue and green landscape". The method of application of these pigments is complex. The upper parts of the mountains and rocks are usually the darkest in tone and become lighter in

a downward direction. Chinese painters often outline mountains with ochre pigment before placing a base of indigo mixed with ink or grass green colour and only then apply layers, one by one, of azurite and malachite. After applying one or two layers of pigment, the paint is sealed with a transparent layer of binder to separate and fix it from other layers. This process is repeated several times to reach the complete impression.[1]

To depict the mountains on the painting "*Sunset on the Sea"*, the painter first applied a basic layer of ochre and then green and blue pigments over the top. As green and blue pigments appear throughout the entire painting, it can be classified as "big green and blue landscape". The subtle lines of gold elegantly decorate the mountains, hills and sun and qualify the painting for the "gold and green landscape" type. The painter applied it on top of the pigment layer as a final touch to complete the composition. The vegetation and trees are composed of numerous "dot-like" brush strokes placed near each other. In some areas, the contrast between the flat painted dotted leaves and bulky flowers, which are formed from a thick layer of a pigment, is especially noticeable.

There are several paintings similar to the "*Sunset on the Sea"* from the National Gallery, and which are also a copy of the works of Zhao Boju.

Here, I would like to mention the painting on silk "*Sea and Sky at Sunrise"* from the collection of the Metropolitan Museum of Art in New York,[2] and *"Sunset on the Sea"* a painting by Giuseppe Castiglione from the Palace Museum's collection.[3] Both paintings are acknowledged by the owners as executed in Zhao Boju's style (Figure 1, 2).

[1] WANG, Yao - T´ing. *Looking at Chinese Painting*. Tokyo, Japan: Nigensha Publishing Co., Ltd., 1995, p. 64.

[2] Unidentified artist. *Sea and Sky at Sunrise*. Metropolitan Museum of Art. THE MET [online][last access 20.08.2021]. Available at: https://www.metmuseum.org/art/collection/search/51564

[3] Castiglione, *Sunset on the Sea* (*Haitian xiri tu*), 93.7 x 182.2 cm, National Palace Museum, Taipei Wencang [online][last access 20.08.2021]. Available at: https://www.wencang.com.cn/201901

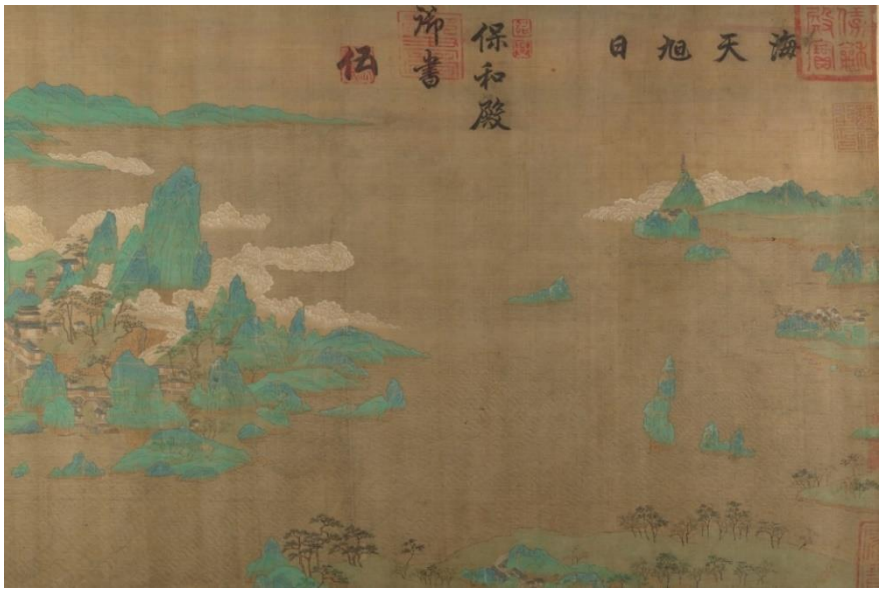

Figure 1. Unidentified artist, fake signature of Zhao Boju. "*Sea and Sky at Sunrise"* from the collection of the Metropolitan Museum of Art, New York. Period: Ming dynasty (1368–1644).

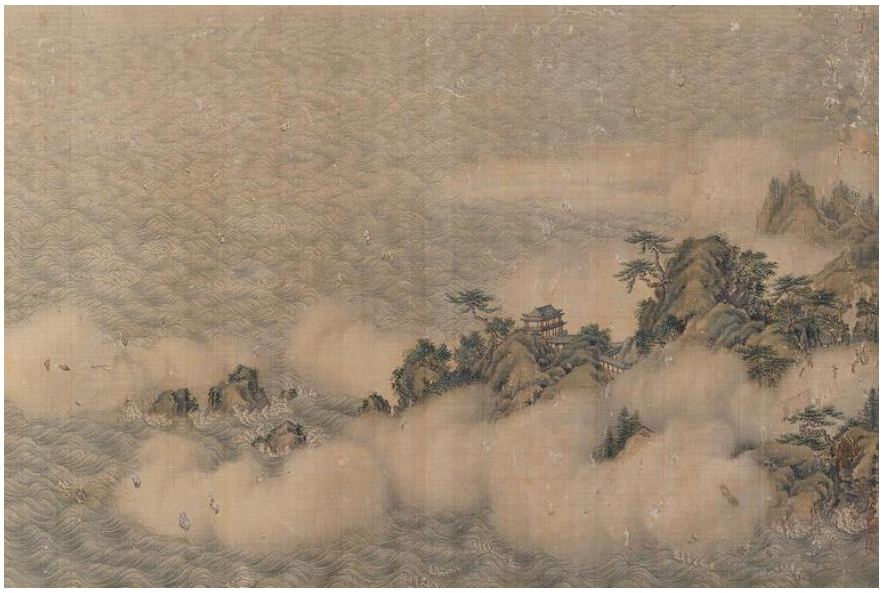

Figure 2. G. Castiglione. *Sunset on the Sea* (Haitian xiri tu), from the collection of the Palace Museum, Taipei. Period: Qing Dynasty.

2.3 Chinese landscape painting

Landscape painting has a major role in Chinese art history. It was traditionally one of the most important genres of Chinese painting. The Chinese term for "landscape" consists of two characters which mean "mountains" and "water" and is in some of its aspects associated with Daoism, Confucianism and Buddhism. Daoist philosophy is related to various naturalistic or mystical beliefs and highlights harmony with nature.[4]

Since China at that time was predominantly ruled by Confucianism, Chinese people longed for an idealized life, which was also reflected in art. Chinese landscape painters generally preferred to paint imaginary, idealized scenes over real, existing places. Chinese people believe that paintings depicting mountainous landscapes have a special meaning, and that looking at them has a beneficial effect on the soul. This relates to the link between religion and the mountains in China, because they reach high up into the sky and heavens.[5] According to Chinese painter and philosopher who wrote the earliest text on landscape painting Zong Bing (375 – 443) – if a painting is executed precisely in both visual and aesthetic aspects, it can be a genuine substitute for real nature since it possesses vital energy (*qi*) from the spirit-filled void (*dao*) just as its real, material counterpart does.[6] Zong believed that that one does not have to rise from bed to know the riches of nature, that one can simply travel through the painted landscapes on the walls of his room.

During the Tang dynasty, landscape painting became recognized as an independent art genre characterized by the desire of educated literati to escape their ordinary routine life and unite with natural world. After the disintegration of the Tang dynasty, the notion of harmony with nature became the main theme of poets and artists.[7]

The treated painting is an exact example of the landscape mentioned earlier in a paragraph *3.3 Chinese Landscape Painting*. Even though the painting is a late

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[4] Stanford Encyclopedia of Philosophy. *Daoism* [online][last access 09.05.2021]. Available at: https://plato.stanford.edu/entries/daoism/

[5] Khan Academy. *Chinese landscape painting*. © Trustees of the British Museum [online][last access 09.05.2021]. Available at: https://www.khanacademy.org/humanities/art-asia/imperial-china/song-dynasty/a/chinese-landscape-painting

[6] Britannica. *Qin and Han dynasties* [online][last access 12.08.2021]. Available at: https://www.britannica.com/topic/Qin-dynasty

[7] The Metropolitan Museum of Art. Landscape Painting in Chinese Art [online][last access 09.05.2021]. Available at: https://www.metmuseum.org/toah/hd/clpg/hd_clpg.htm

variation of an old theme, the depicted landscape has all the mentioned features associated with a typical Chinese landscape painting – the combination of colours, composition and painting stylization.

3 CONDITION REPORT BEFORE TREATMENT

The scroll is considerably embrittled. Creases and cracks all over the artwork have caused various tears and loss of the silk support. These types of deterioration probably occurred during storage when the object was rolled. The vertical creases and tears (the largest are approx. 300 mm and situated midway on the handscroll) which appear throughout the scroll indicate that the paper and silk are severely degraded and fragile. The silk fibres are considerably loosened in the areas with the largest tears. Various scratches and perforations are evident throughout the silk support, caused by inappropriate storage and handling.

The scroll may have been cut from its original format. This conclusion is assumed from the base and where the edges end: the scenes are cut in an unusual manner, some of the characters and subjects have been interrupted, and the edges have not been treated with the usual protective folding, which has caused weaknesses. Some fragments of a bright yellow silk are evident, which may indicate that the mounting we are examining is a secondary one. The largest losses and tears therefore appear in the areas of the frayed edges throughout the entire width of the scroll. As a result of weakened adhesive, the textile support is almost fully delaminated from the lining paper. The silk support is partially deformed, and some parts are folded due to a lack of the lining support and inappropriate storage.

Some of the pigments (mainly green and blue pigments used to paint nature, such as mountains and rocks, and red pigment for the sun) appear susceptible to flaking as a result of deterioration in the binding agents. Brownish stains are visible on the surface of the artwork, the most prominent occurring on the right section of the artwork. The colour of the textile support has altered, darkening over time as a result of photo-oxidation of the silk and other impurities such as dust pollution.

4 SURVEY

Tears and losses originating from creases and cracks on the silk support caused by inappropriate storage and handling have produced the most considerable damage to the painting. The entire painting is significantly embrittled.

As a result of deterioration in the adhesives, the textile support is almost fully delaminated from the lining paper. The silk support is partially deformed, some sections are folded due mainly to a lack of lining support and inappropriate storage. The application of a new lining will therefore be necessary to stabilize the silk support.

The paint layer will need to be consolidated because the green, blue, and red pigments are susceptible to flaking as a result of deterioration of their binding agents. Brownish stains are visible on the surface of the artwork, the most prominent occurring on the right section of the artwork.

Examination of some sections of the painting revealed areas with darker UV luminescence. These were especially areas with green and blue pigments (painted mountains and rocks). Brush strokes around the sun area were not visible in daylight but were detectable as darker UV luminescence (Figure 15, 16).

The morphology of the paint layer and silk support was examined with a stereomicroscope. This provided detailed information about the painting's structure, characteristics and degree of deterioration. The silk support was also examined under a stereomicroscope to identify its structure and enable the selection of a similar type of woven silk for infillings (Figure 17-26).

The chemical technology research included invasive and non-invasive examination. Non-invasive X-ray fluorescence (XRF) was used to analyse the materials and detect the elements and pigments of the painting layer. Three samples were collected for invasive examination to identify the pigment composition. Analysis of the structure was performed using Raman microspectroscopy. Elements were analysed using electron microscopy (SEM). Carbon tape was applied to the coloured layer to obtain pigment particle samples for later analysis.

These methods of analysis detected the following pigments: the blue colour which occurs in the painted mountains consists of azurite, ochre and anatase, which can be obtained from natural ochres; the blue-green colour used to paint the mountains and

rocks is composed of atacamite in combination with azurite; elements of gold were detected in the golden coloured outlines; vermillion pigment was detected in the red coloured sun. Traces of alum are also present on the painting's background and in some of the pigments (see *10. Appendix B – Chemical -Technological Research*).

5 CONSERVATION DRAFT

1. Photo documentation and surveys (in daylight, raking light, UV luminescence photography and optical stereomicroscopy).
2. Collecting samples for analysis and identification of pigments.
3. Abrasion and solubility tests of the paint layer.
4. Mechanical dry cleaning of the surface using soft brushes and soft PU sponges.
5. Removal of the lining paper.
6. Consolidation of pigment layers using *nikawa* animal glue.
7. Wet cleaning of the handscroll using blotting papers. Temporary facing of the painting surface using rayon paper and *funori* adhesive.
8. First Lining. The first layer of lining for the scroll using a suitable type of Chinese paper and wheat starch paste.
9. Removal of the facing.
10. Reinforcement of the vulnerable parts of the scroll with paper strips from the back side of the scroll and starch paste.
11. Infilling missing areas of the silk support with artificially deteriorated silk.
12. Preparation and lining of mounting parts using a suitable type of Chinese paper and wheat starch paste.
13. Second lining using a suitable type of Chinese paper and wheat starch paste.
14. Assembly of the lined artwork and borders into a single object.
15. Final lining using a suitable type of Chinese paper and wheat starch paste.
16. Flattening of the scroll on a board using the *karibari* method.
17. Inpainting using a suitable type of colour media.

6 CONSERVATION TREATMENT PROCESS

6.1 Examination before conservation treatment

The condition and structure of the entire object was documented and recorded with photographs and micrographs. Photographs of the object, including details of damaged areas, were obtained under visible daylight and raking light. Images using a stereomicroscope were also obtained. The object was also subjected to an ultraviolet-induced luminescence examination. The silk structure was examined under a stereomicroscope to identify the character and type of the material and enable the selection of a similar type of woven silk for infillings. The pigments were examined and tested for fugitivity and solubility under a stereomicroscope.

6.2 Mechanical cleaning and removal of the lining papers

The scroll's mounting, including its wooden rods, had been separated in the past and stored in a box, therefore no process of disassembly was required.

Dust deposits were removed gently from the front side of the scroll using a brush and soft polyurethane cleaning rubber.

Each layer of lining paper, including the first layer, was removed from the back side of the painting. As the lining was already partially delaminated from the silk component of the scroll, this process was conducted in a dry manner without adding any moisture.

6.3 Consolidation of the paint layers

The pigments of the painting did not reveal any significant unstable behaviour, although potential future damage caused by physical manipulation during the conservation treatment process and additional rolling and unrolling is a possibility. The surface of the pigments was therefore consolidated with an aqueous solution of 0,5% animal glue (*nikawa*), applied with a small brush. The areas of pigments were first treated with ethanol to allow better penetration of the *nikawa* solution. The process of consolidation was repeated twice.

6.4 Wet cleaning

To remove the residues of old adhesives, stains and other dirt deposits, the Japanese method of wet cleaning was applied. This method is traditionally used for sensitive cleaning of paintings on paper and silk. To protect the silk support and the paint layer, a subtle coating of cyclomethicone was first applied to the painting. The coating hydrophobizes the surface of the painting yet allows effective cleaning and removal of water-soluble impurities. The painting laid on the rayon paper was then placed on top of several layers of thin, dry blotting paper and sprayed from the front side with deionized water. Spraying was repeated several times, and water with dirt was absorbed by blotting papers from the back side. The blotting papers were changed as required.

After completing the washing process, the painting was dried between two sheets of Hollytex and blotting paper held with light weights.

6.5 Facing

The painting was first humidified by spraying with water, then rayon paper was applied to the front side of the artwork to provide protection during the process of further conservation treatment. The facing was applied using a 2 % seaweed mucilage aqueous solution extracted at room temperature (*ma-funori*). The first layer consisted of small rectangles of rayon paper. The second layer was applied in one piece which covered the entire length of the scroll. The layers were applied in different directions to supports the painting's stability during wet conservation treatments.

6.6 Paper toning

Chinese papers *Fine Japanese JinPi* for first backing layer were coloured with a solution from *yasha* cones. The solution was applied to the papers using a big brush with light brush strokes, respecting the direction of the paper's grain.

Dyed sheets of paper were first rinsed in cold water and then washed in a pH 9 solution of water and potash mordant to fix the dye onto the paper's fibrous surface. After drying, the Chinese papers were again rinsed in clean cold water to remove any residues of mordant.

6.7 Application of the first lining and removal of the facing

The painting was placed face down on the mounting table. Chinese paper *Fine Japanese JinPi* was selected for the first layer of lining. The paper was aligned with the direction of fibres parallel to the length of the painting. The paper was prepared with a dye and then cut to the required format.

The paper sheets were humidified slightly by spraying with water and then smoothed with a brush onto a Melinex foil placed on the table beneath the paper. A thin layer of wheat starch paste was then applied evenly to the paper's surface. Supported by the Melinex foil, the pasted lining paper was attached to a wooden rod and then lifted from the table and carefully applied to the painting and smoothed with a brush. This process was repeated with another sheet of lining paper. The paper was then thoroughly brushed through a sheet of Hollytex to ensure the removal of all bubbles and fixing of the joints.

The painting was then turned around, and the rayon paper facing was removed from the front side. It was left to dry between sheets of Hollytex and thick blotting paper held with light weights.

6.8 Application of paper reinforcement strips

To remove existing creases and cracks and to prevent the occurrence of new ones, it was necessary to apply paper reinforcement strips onto vulnerable sections of the scroll. Chinese paper *Red Star JingPi* was cut into 1.5–2.5 mm wide strips. The direction of fibres in the strips ran parallel to the direction fibres in the lining paper to prevent any tension caused by the strips. The width of the strips depended on the type of crease.

First, the painting was placed onto a glass table with a translucent light. The reinforcement strips were applied to creases and cracks and any areas at risk of damage by future creases on the back of the painting. The strips were applied using thin wheat starch paste. Hollytex, blotting paper and alkaline cardboard was then applied to the treated areas and pressed with light weights.

6.9 Infillings

Several types of woven silk fabrics were artificially aged and examined for selection as a material which most closely matched the original silk support.

The silk fabrics were artificially aged using the Chinese method of artificial deterioration, which involves soaking the silk fabric in a 0.1 M potassium permanganate solution for 30 minutes to decrease its mechanical strength.[8] The fabric was then coloured with a *yasha* cone aqueous solution containing potassium carbonate as a mordant. After a final rinse in water, the material was left to dry. Thin Japanese paper (11 g/m2 machine-made Manila-kozo) was pasted to the dyed silk fabric with a thin layer of starch paste for easier manipulation.

The silk material lined with the Japanese paper was applied to the original silk support of the painting to fill losses in the artwork. Patches were carefully cut to match the shape of the loss to prevent any overlap in the two materials. The silk infills were then set into the losses and pasted to the lining paper with wheat starch. Finally, the temporary paper facing was removed from the silk fragments once they had completely dried.

6.10 Application of the second lining

Laid on a flat surface, Chinese paper *Red Star JingPi* was pasted to the scroll using diluted wheat starch paste, and the *karibari* method was applied for drying and straightening. A laser level aided application of the painting to the drying board to ensure straight lines and angles and counter any deformation of the scroll.

6.11 Preparation and assembly of the mounting

In selecting the material for mounting, both the Chinese tradition and Western aesthetics were considered. A simple Chinese silk of golden colour without any pattern was therefore selected. The silk matched the colour of the painting's background and paper colophon, thus non-destructively complementing its historical appearance. Wider side borders were selected to provide an aesthetic and protective function. If the original

[8] DANIELS, Vincent; HACKE, Marei, QIU; Jin Xian and MARABINI, Valentina. A traditional Chinese method for weakening silk for use in the conservation of silk paintings. *The British Museum Technical Research Bulletin.* 2013, **7,** 41-51, pp. 41 – 51.

format of the preserved mounting had been followed, the edges of the painting would not receive sufficient protection.

Silk fabric lined with Chinese paper was cut and prepared for the scroll's side borders. The borders were pasted to the paper's edges with starch paste, leaving a small space between the mounting and the painting. The dimensions of this small spacing were adapted to the painting's uneven edges and the paper colophon's size so that these two components could be joined and framed with equally wide mounting strips. Because the original mounting had not been preserved, literature and several handscrolls from the collection of National Gallery were inspected to obtain more information about assembly. Consequently, the composition of the assembly and the dimensions of the individual components are based on these observations and a sense of aesthetics. The side silk strips, which are designed to frame the painting, form a part of the right and left sections of the scroll (the textile and paper components). Because no larger drying wall is available in National Gallery, other parts of the mounting will be attached later during additional conservation treatment. The edges of the silk strips were folded and sealed from the back side with starch paste.

6.12 Application of the final lining

The final layer of Chinese paper *Red Star JingPi* was applied to the back side of the scroll, including its side borders, with wheat starch paste. The scroll was then laid on a board to dry and straighten for approximately three months.

6.13 Inpainting

Testing was first performed on potential inpainting agents: watercolour, QOR watercolour bonded with aquazole, pigment bonded with animal glue. Watercolour was eventually selected as the simplest and most effective method.

The areas of silk infillings were first slightly toned with suspension from paper extract (see *5.7.2 Toning with paper extract*). Aquarelle inpainting was then applied. Inpainting consists of applying small dots of colour close one another using a thin Japanese retouching brush.

6.14 Additional conservation treatment

Suitable silk fabrics and paper materials were selected for additional conservation treatment and assembly (Fig. 57).

7 LIST OF USED MATERIALS

Materials

- CleanMaster – 100% latex cleaning sponge (Deffner & Johann)
- Soft polyurethane (PU) cleaning sponge (Deffner & Johann)
- Blotting papers75 g/m^2, 380 g/m^2, 520 g/m^2 – pH neutral (P-lab)
- Hollytex – non-woven fabric,100 % polyester, 33 g/m^2, 81 g/m^2 (Deffner & Johann)
- Melinex 50 µm – 100% polyester foil (Ceiba)
- Hostaphan – antiadhesive, 100% polyester foil (Deffner & Johann)
- Japanese paper: Mino Tengujo 9 g/m^2 (Deffner & Johann)
- 11 g/m2 machine-made Manila-kozo (Deffner & Johann)
- 100% Rayon paper (Hiromi paper, Deffner & Johann)
- Chinese paper: Japanese Fine JinPi, natural colour paper, handmade, 70 × 138 cm, 100% kozo, 26,4 g/m²; Red Star JingPi *Xuan* Paper, 69 × 138cm (Inkston shop)
- Chinese Painting Silk 89 × 200 cm lined with Chinese paper (Inkston shop)
- Chinese Paintnig Silk (for silk infills) unlined (Inkston shop)

Chemicals

- Demineralized water
- Ethanol (Lachner)
- Cyclomethicone D5 (Kremer Pigmente)
- Japanese wheat starch *Jin Shofu* (Deffner & Johann)
- *Ma-Funori* (Hiromi paper, Deffner & Johann)
- *Nikawa* (Mizokawa Shoten, Kyoto)
- Potash - potassium carbonate (Kremer Pigmente)
- Potassium permanganate
- Paper extract *Susu* (handmade)
- Watercolours Schmincke Horadam (Kremer Pigmente)

8 ENVIRONMENTAL CONDITIONS AND STORAGE

To preserve the treated object, it is necessary to ensure conditions preventing premature degradation. Sudden fluctuations in temperature and relative humidity, which should not exceed 4 % in a single day, should be prevented. The object should not be placed in direct light or other sources of UV radiation or near sources of radiant heat. It is important to avoid any direct contact with water.

According to ISO 11799, the ideal climatic conditions for storing Chinese scrolls are 18 ° C ± 1-2 ° C and 50–55 % RH.

Excessive moisture can cause the material to curl and create a positive environment for microorganisms. Too low humidity and high temperature can cause embrittlement of the pigments and other materials.

According to Asian tradition, the scrolls are intended for short-term exposure. Therefore, after the complete conservation process (after all sections of the scroll are joined together), the scroll should be placed in an alkaline cardboard case with a roller (Fig. 92). It is natural for the scroll paintings to remain in a rolled position in a protective case. Prolonged exposure to a suspended roll causes irreversible deformation. The scroll should not be displayed for more than two weeks, twice a year. Alternatively, it may be exposed for a month, and then be rested for 11 months. It is preferable to leave the scroll unrolled for several days before actual exposure. A detailed description of the methods of handling and storage of handscrolls is given in the thesis (see *4. Display, Storage and Handling).*

The materials used in Asian scrolls are sensitive to light conditions. ICCROM[9] standards recommend a maximum illumination intensity of 50 lux and an annual exposure time of 250 lux/hour.[10]

[9] International Centre for the Study of the Preservation and Restoration of Cultural Property

[10] HARE, Andrew. Guidelines for the care of East Asian paintings: Display, storage and handling, in: *The Paper Conservator*. 2006, **30** (1), pp. 73-92.
Kopsová 2011, pp. 39–41.

9 APPENDIX A – PHOTOGRAPHIC RECORD

Figure 3. Condition of the artwork before treatment, front side, daylight photography. Author: Photography Department National Gallery Prague.

Figure 4. Condition of the artwork before treatment, front side, daylight photography. Author: Photography Department National Gallery Prague.

Figure 5. Condition of the artwork before treatment, front side, racking light photography. Author: Photography Department National Gallery Prague.

Figure 6. Condition of the artwork after treatment, front side, racking light photography. Author: Photography Department National Gallery Prague.

Figure 7. Condition of the artwork before treatment, back side, racking light photography. Author: Photography Department National Gallery Prague.

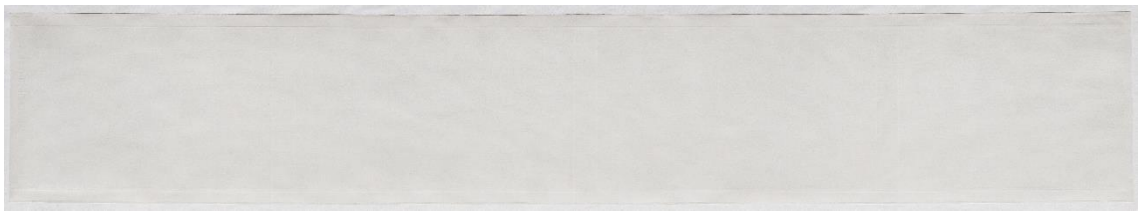

Figure 8. Condition of the artwork after treatment, back side, racking light photography. Author: Photography Department National Gallery Prague.

Figure 9. Condition of the artwork before treatment, detail, mechanical deterioration of the silk support, cracks and losses, racking light photography.

Figure 10. Condition of the artwork after treatment, detail, racking light photography.

Figure 11. Condition of the artwork before treatment, detail, mechanical deterioration of the silk support, losses of the silk support, racking light photography.

Figure 12. Condition of the artwork after treatment, detail, racking light photography.

Figure 13. Condition of the artwork before treatment, detail, mechanical deterioration of the silk support, losses of the silk support, racking light photography.

Figure 14. Condition of the artwork after treatment, detail, racking light photography.

Figure 15. Condition of the artwork before treatment, detail, UV luminescence photography.

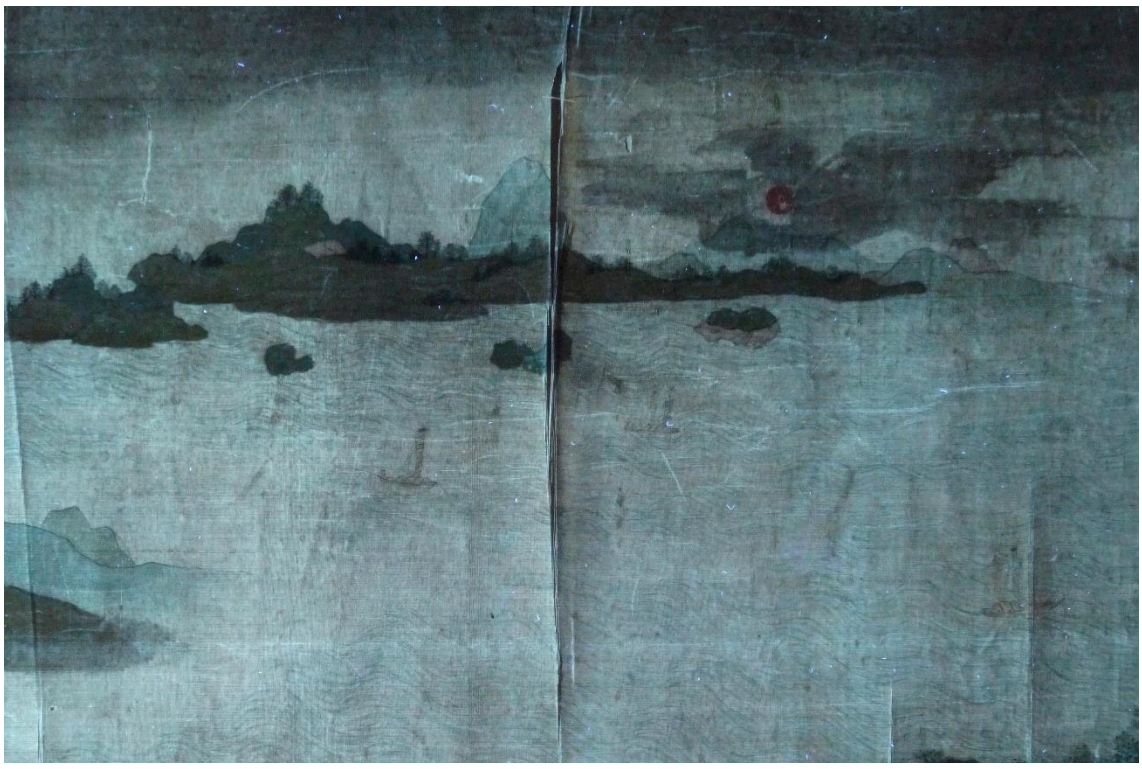

Figure 16. Condition of the artwork before treatment, detail, UV luminescence photography.

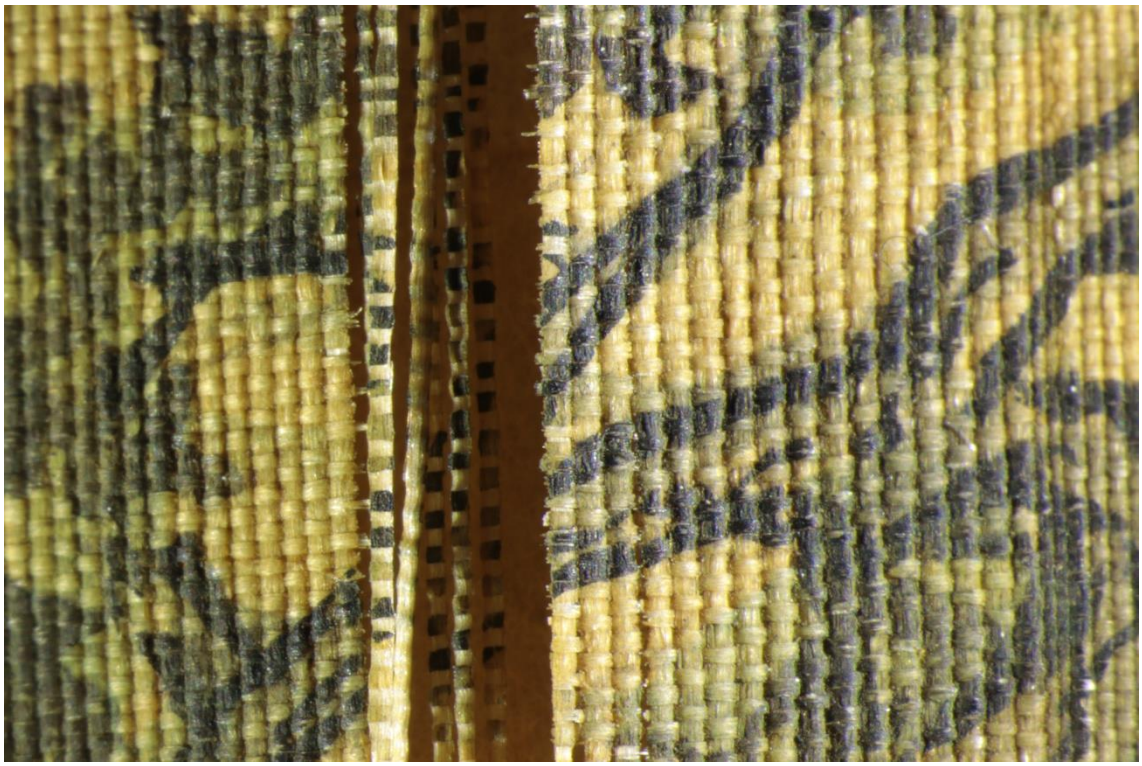

Figure 17. Condition of the artwork before treatment, detail, structure and mechanical deterioration of the silk support, detail of the painting, stereomicroscope photography.

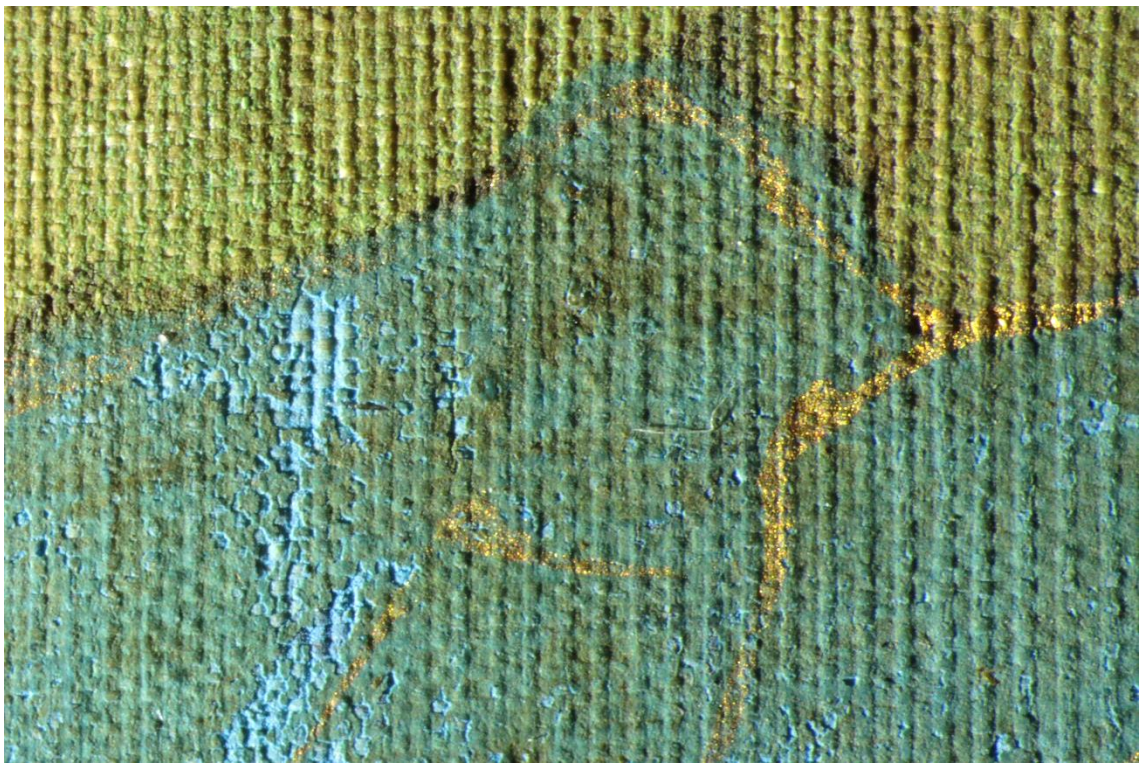

Figure 18. Condition of the artwork before treatment, detail, deterioration of the paint layer – flaking, detail of the painting with golden outlines and green and blue pigents, stereomicroscope photography.

Figure 19. Condition of the artwork before treatment, detail of the painting, stereomicroscope photography.

Figure 20. Condition of the artwork before treatment, detail of the painting, structure of the silk support, stereomicroscope photography.

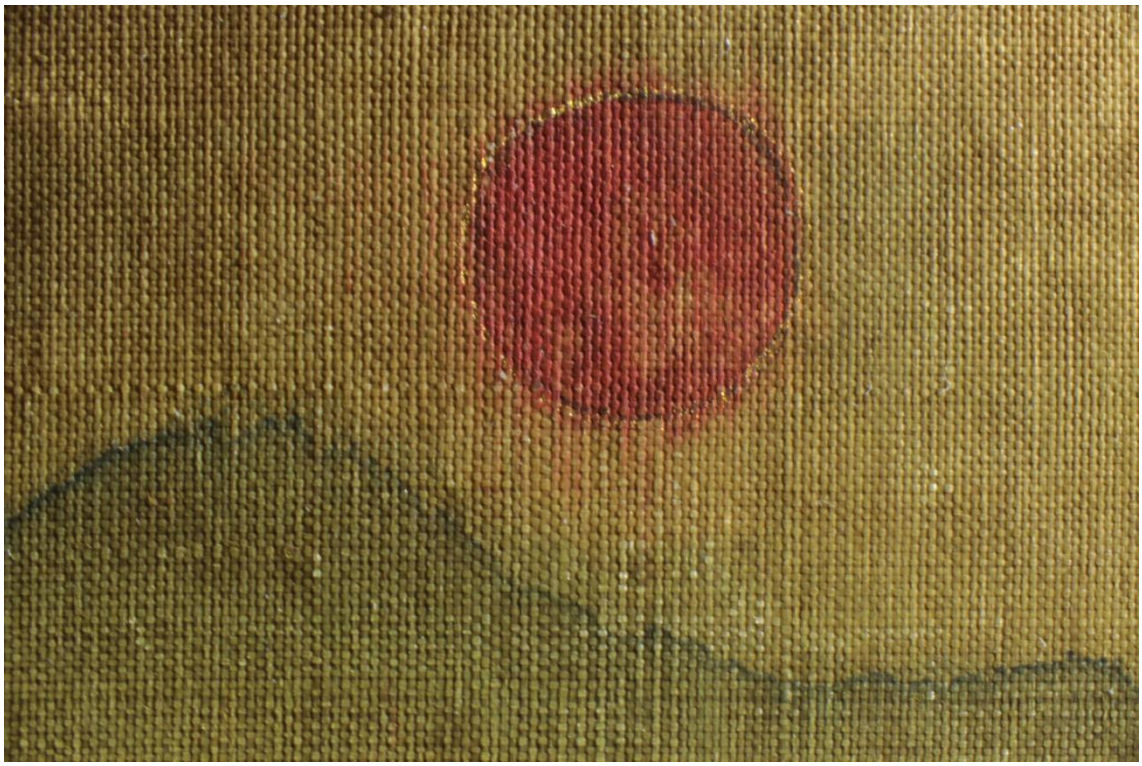

Figure 21. Condition of the artwork before treatment, detail, deterioration of the paint layer – flaking of the red pigment, stereomicroscope photography.

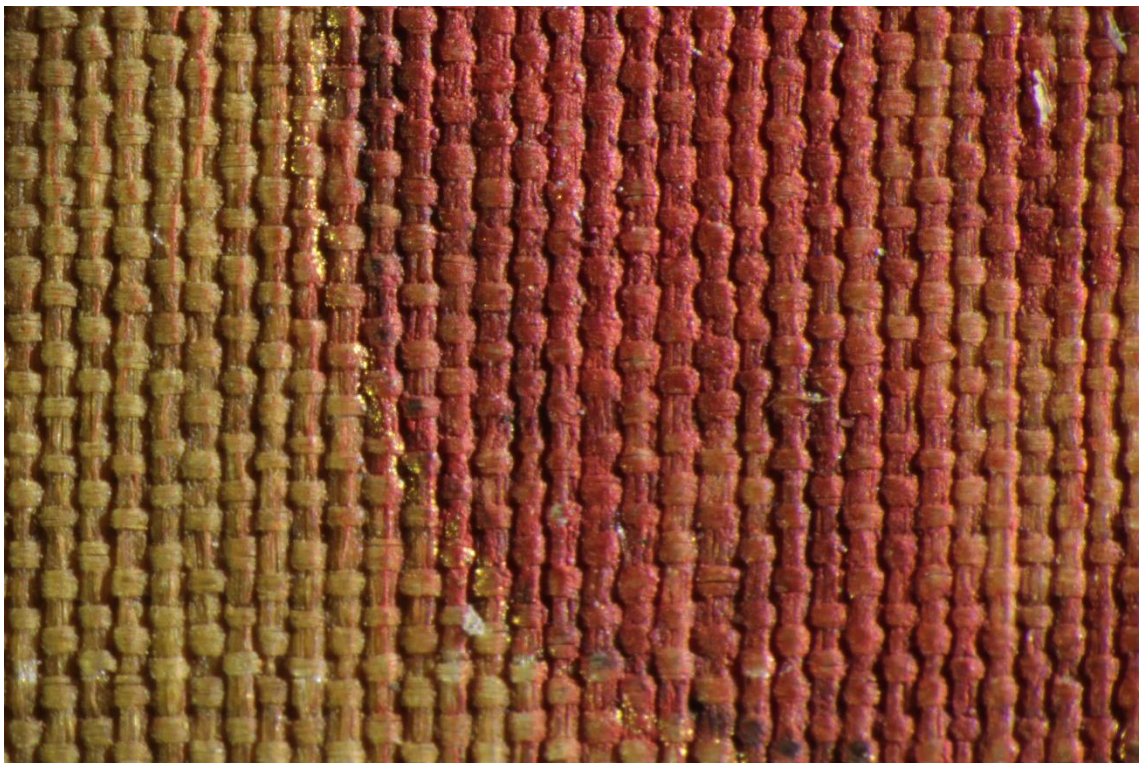

Figure 22. Condition of the artwork before treatment, detail of the painting and silk structure, the sun painted with red pigments outlined with golden paint, stereomicroscope photography.

Figure 23. Condition of the artwork before treatment, detail of the painting – blooming tree painted in relief, stereomicroscope photography.

Figure 24. Condition of the artwork before treatment, detail, deterioration of the paint layer –- peeling stereomicroscope photography.

Figure 25. Condition of the artwork before treatment, uneaven structure of the blue pigment, stereomicroscope photography.

Figure 26. Condition of the artwork before treatment, uneaven structure of the blue pigment, stereomicroscope photography.

Figure 27. Process of the treatment, mechanical dry cleaning.

Figure 28. Process of the treatment, removal of the lining paper.

Figure 29. Process of the treatment, consolidation of pigment layers using animal glue *nikawa*.

Figure 30. Process of the treatment, wet cleaning of the hand scroll using blotting papers.

Figure 31. Process of the treatment, wet cleaning of the hand scroll using blotting papers.

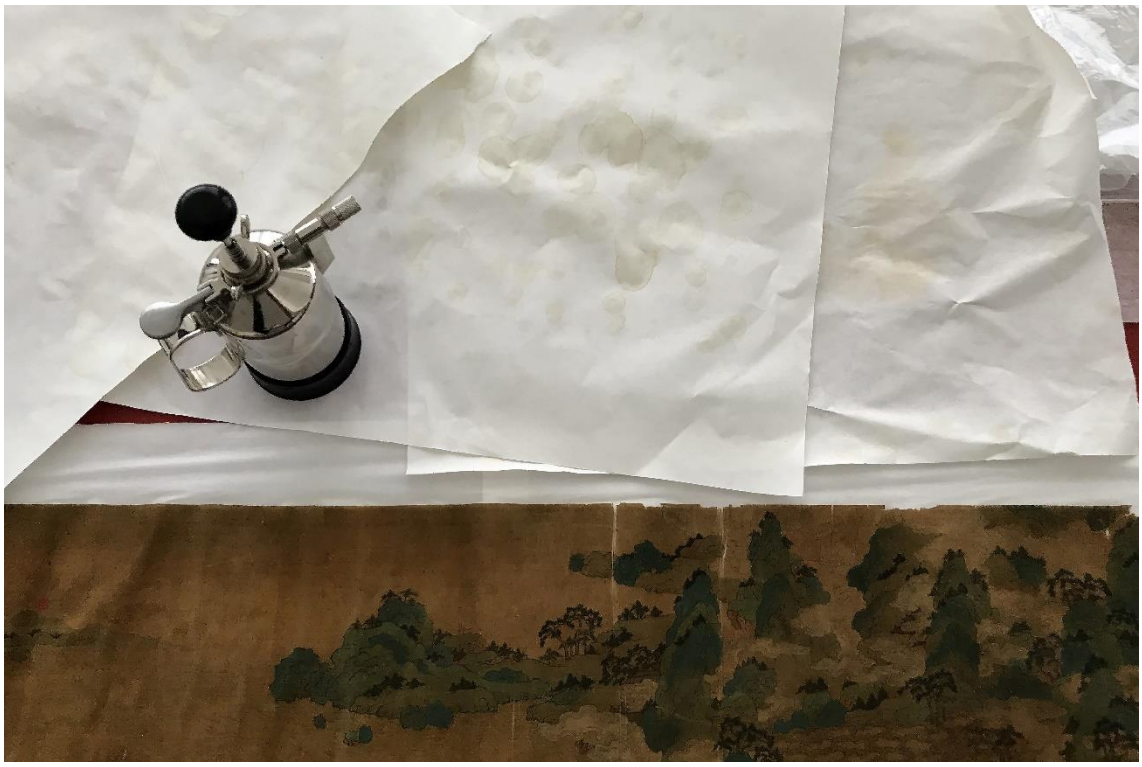

Figure 32. Process of the treatment, wet cleaning of the hand scroll using blotting papers.

Figure 33. Process of the treatment, application of the first temporary facing layer on the painting surface using rayon paper and funori adhesive.

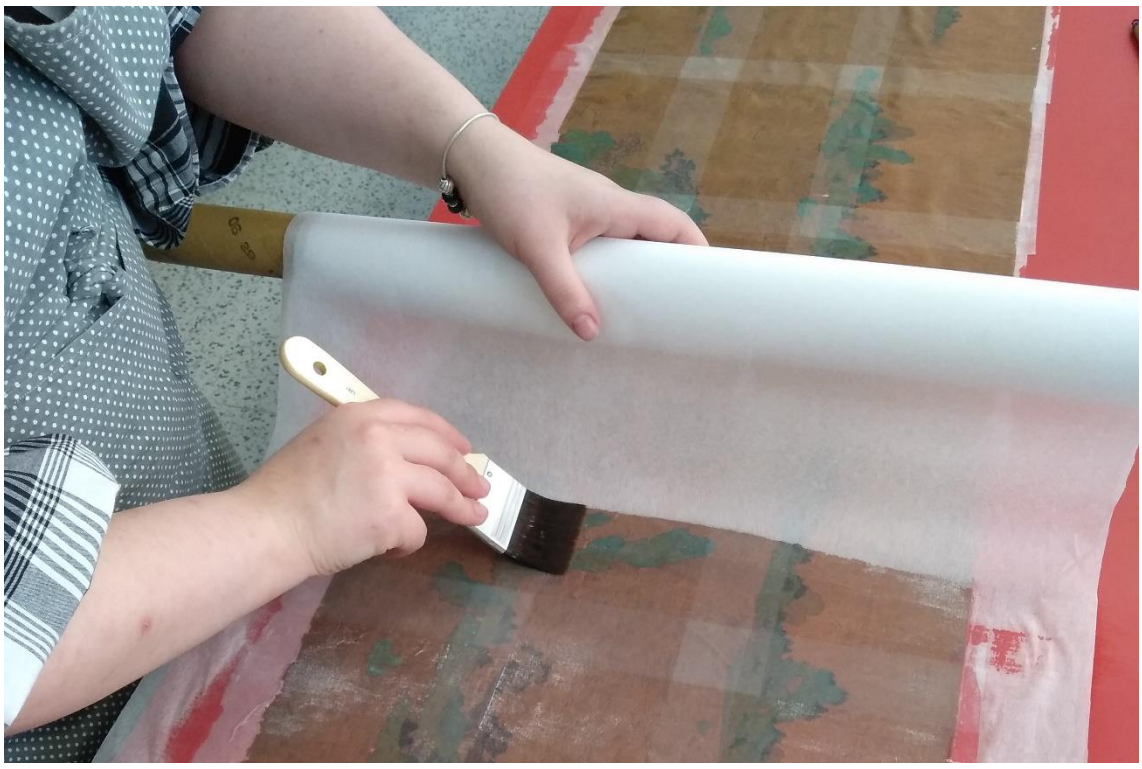

Figure 34. Process of the treatment, application of the second temporary facing layer on the painting surface using rayon paper and funori adhesive.

Figure 35. Process of the treatment, process of toning paper using dye from *yasha* cones, rinsing toned paper in clean water.

Figure 36. Process of the treatment, process of toning paper using dye from *yasha* cones, drying paper.

Figure 37. Process of the treatment, application of the first layer of toned lining paper

Figure 38. Process of the treatment, removal of the facing.

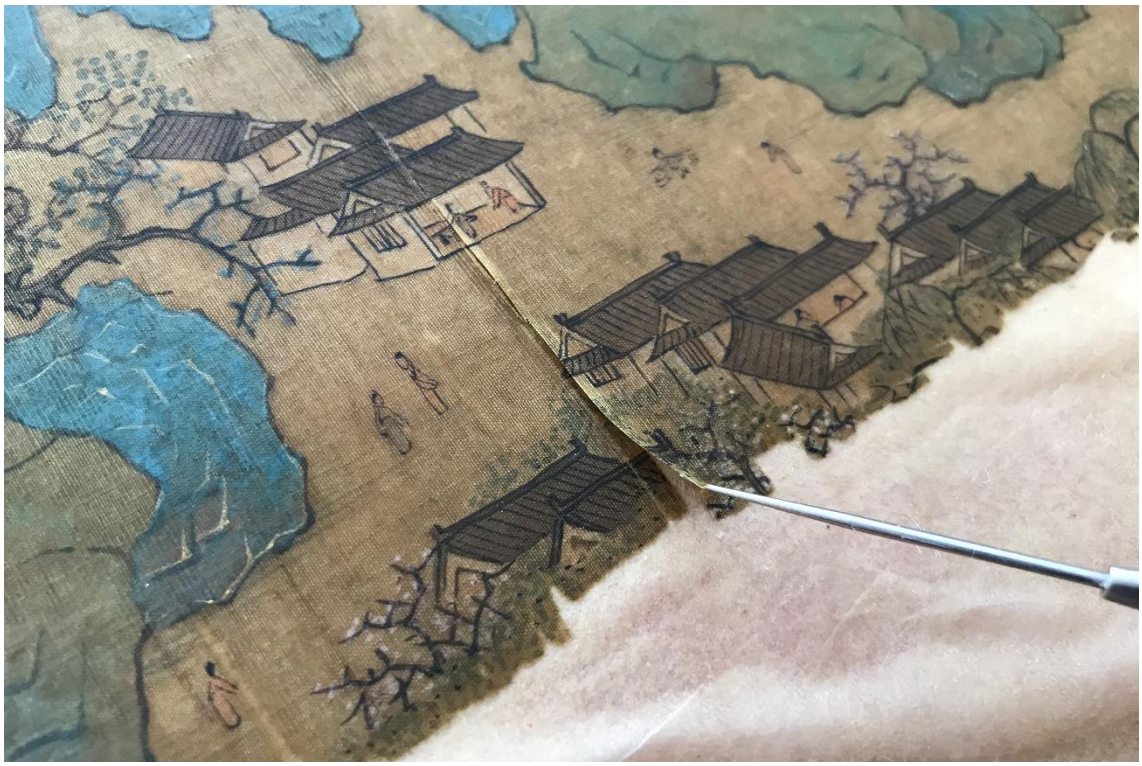

Figure 39. Process of the treatment, detail of the joint of the painitng.

Figure 40. Process of the treatment, process of flattening the lined painting on the drying board using the karibari method.

Figure 41. Process of the treatment, application of the reinforcement strips on the back side of the painting.

Figure 42. Process of the treatment, application of the reinforcement strips.

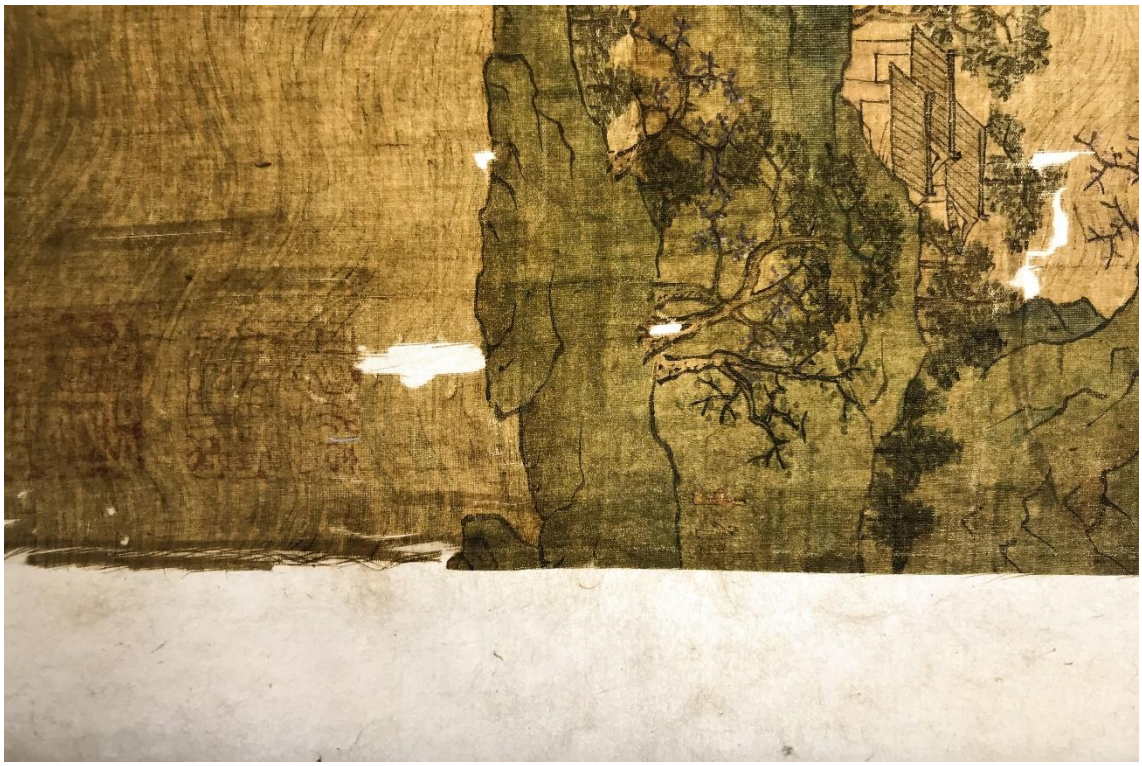

Figure 43. Process of the treatment, infilling the missing areas of a silk support with artificially deteriorated silk, detail of deterioration in transmitted light.

Figure 44. Process of the treatment, infilling the missing areas of a silk support with artificially deteriorated silk, process of cutting out the silk infillings.

Figure 45. Process of the treatment, detail of the painting before application of the silk infillings.

Figure 46. Process of the treatment, detail of the painting after application of the silk infillings.

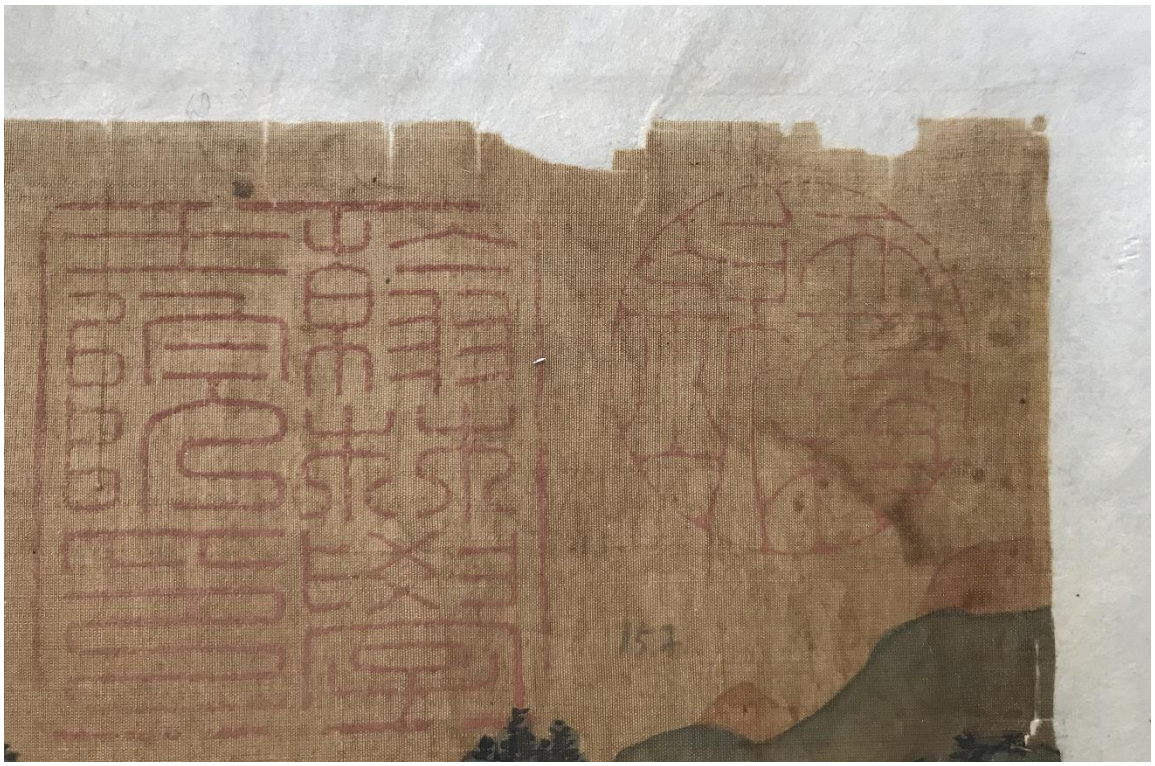

Figure 47. Process of the treatment, detail of the painting before application of the silk infillings.

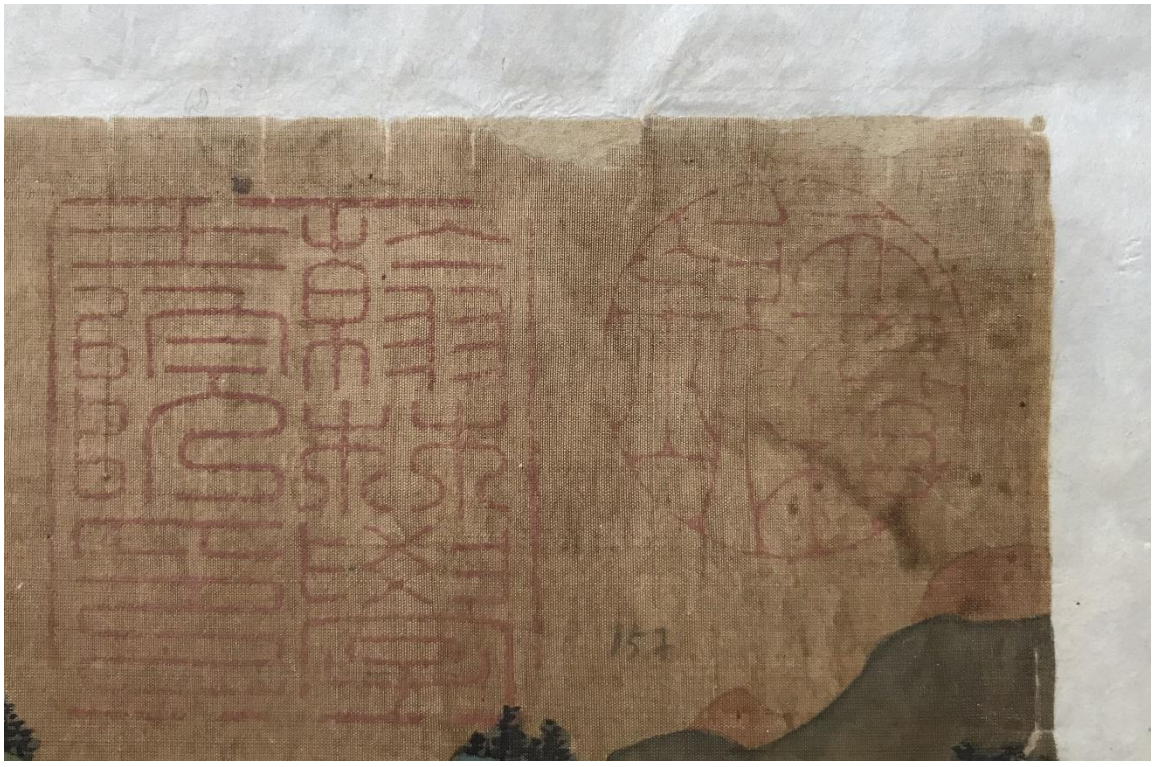

Figure 48. Process of the treatment, detail of the painting after application of the silk infillings.

Figure 49. Process of the treatment, detail of the painting before application of the silk infillings.

Figure 50. Process of the treatment, detail of the painting after application of the silk infillings.

Figure 51. Process of the treatment, application of starch paste on the folded section of the side boarders of the painting.

Figure 52. Process of the treatment, painting with side boarders lined with the third layer of Chinese paper.

Figure 53. Process of the treatment, before inpainting.

Figure 54. Process of the treatment, after inpainting.

Figure 55. Process of the treatment, before inpainting.

Figure 56. Process of the treatment, before inpainting.

Figure 57. Materials selected for the following conservation and mounting of the handscroll.

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10 APPENDIX B – CHEMICAL-TECHNOLOGICAL RESEARCH

Author of the Chemical – Technological Research: Ing. Radka Šefců, Head of the Chemical-Technological Laboratory National Gallery Prague.

NÁRODNÍ GALERIE PRAHA

LABORATORNÍ ZPRÁVA 21/7

Laboratorní zpráva č.21/7

Autor:	**Po-ťü Čao**
Název díla:	**Západ slunce na moři**
Datace:	**2. pol. 12. stol., dynastie Ťin (1115-1234)**
Rozměry:	**35,8 × 247 cm**
Majitel:	**Národní galerie v Praze**
Inv. č.:	**Vm 927**

V rámci materiálové analýzy byl proveden neinvazívní průzkum prvkového složení.

1. Použitá metoda a specifikace přístroje

– neinvazivní rentgenfluorescenční analýza (XRF) byla provedena přenosným přístrojem NITON XL3t GOLDD+ od firmy Thermo Scientific, zdroj záření, minirentgenka s Ag anodou, max. napětí, 50 kV, velkoplošný SDD+ detektor, čtyři filtry (rozsahy – main, low, high, light range), integrovaná CCD kamera pro zobrazení měřené plochy, měřená plocha cca Ø 0,3-0,5 cm, doba jednoho měření cca 120 s. Měření byla provedena bezkontaktně ze vzdálenosti do cca 0,5 cm. Ve spektrech nebyly označovány pásy prvků, které jsou přítomny v aparatuře a ve filtrech (např. stříbro, molybden, nikl)

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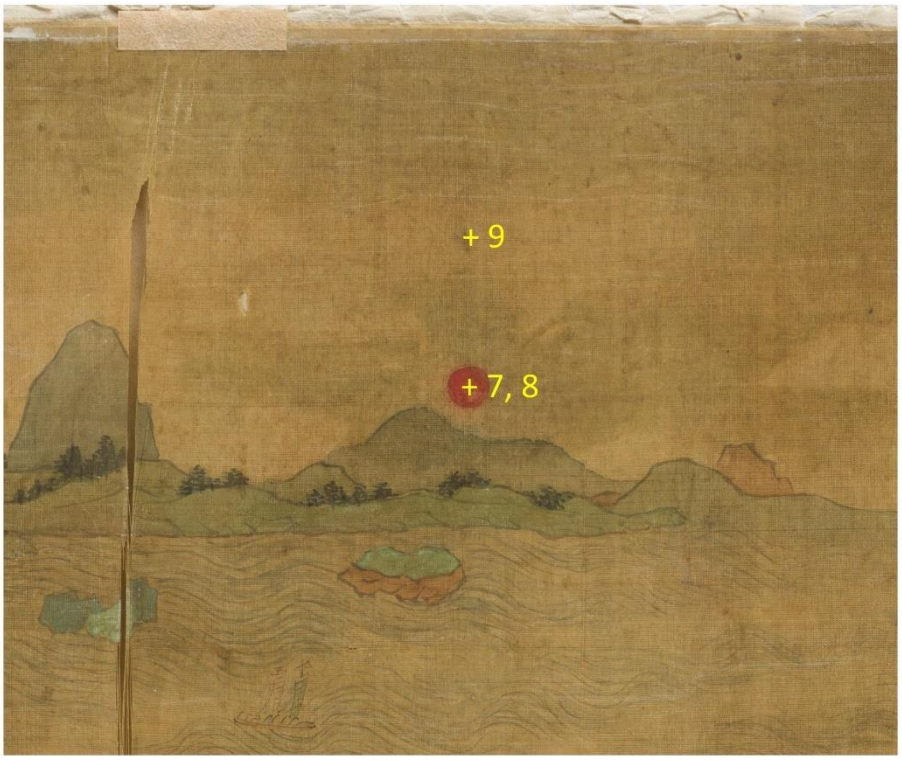
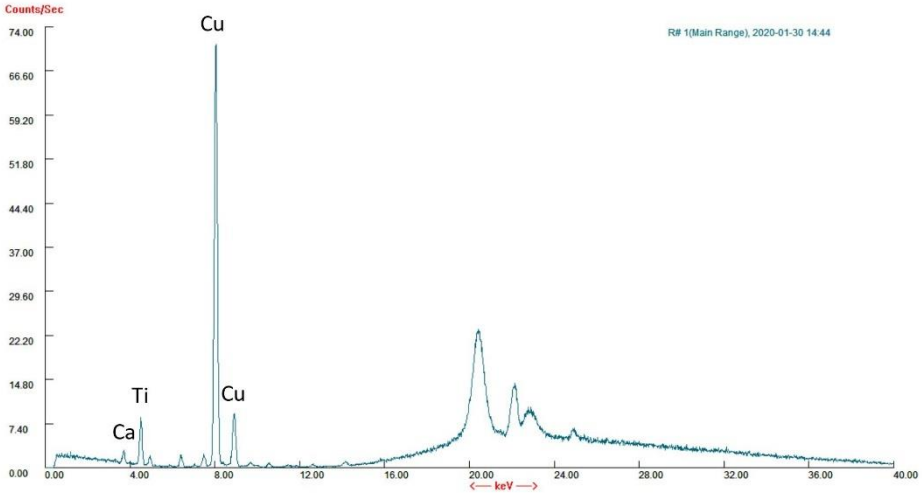
2. . Zákres měřených ploch rentgenové fluorescenční analýzy

Deatily

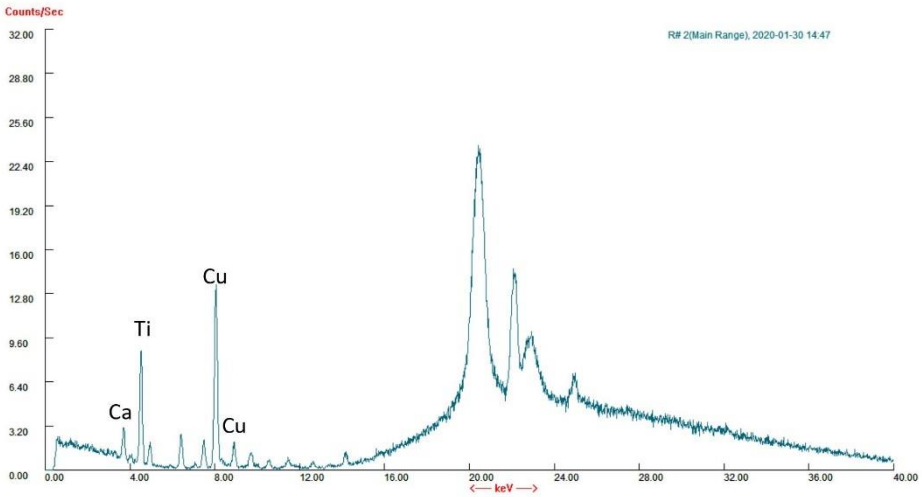

6+
5+


+ 9
+ 7, 8

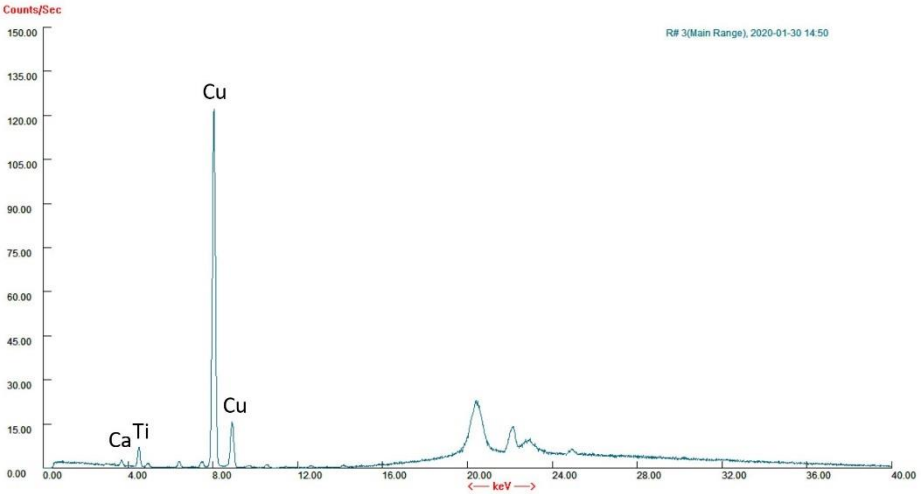
3. Výsledky rentgenové fluorescenční analýzy



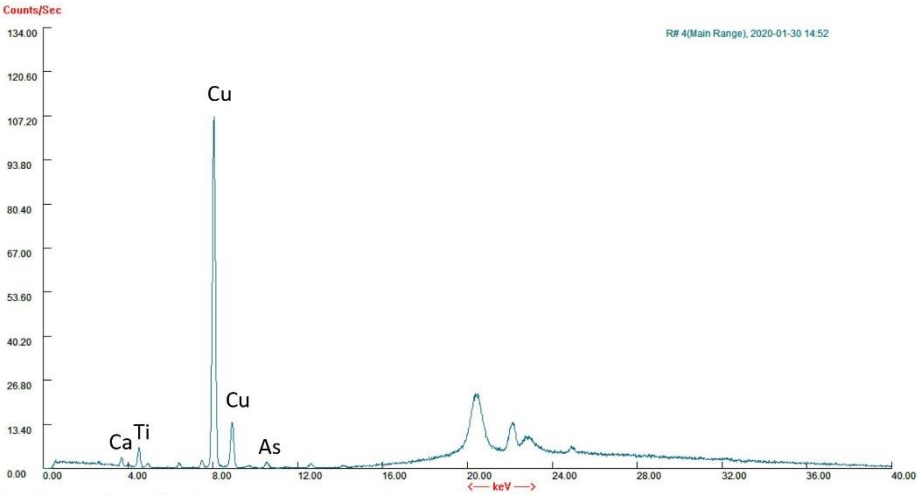
Spektrum 1 – zelená, světlá



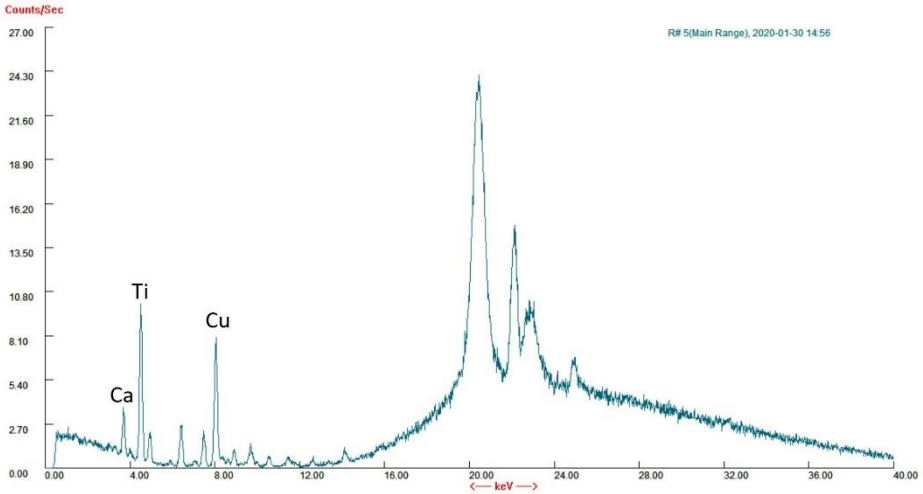
Spektrum 2 – pokovení, kámen



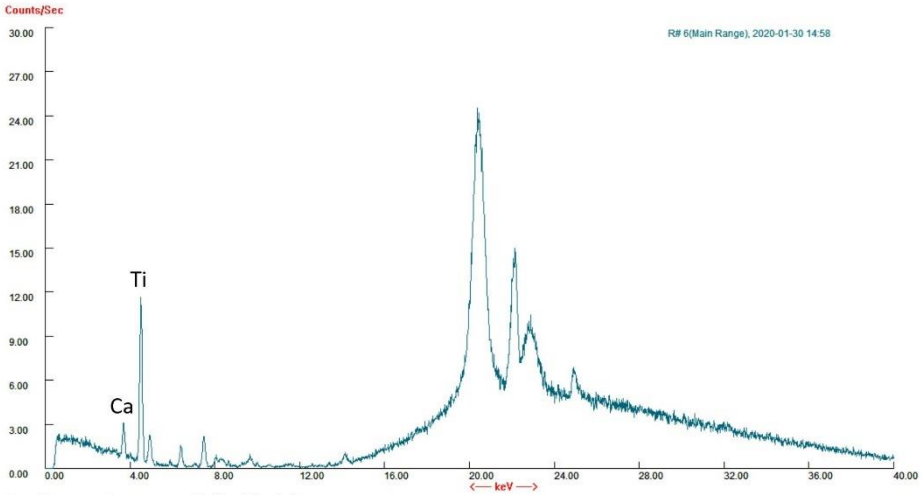
Spektrum 3 – zelená, tmavá



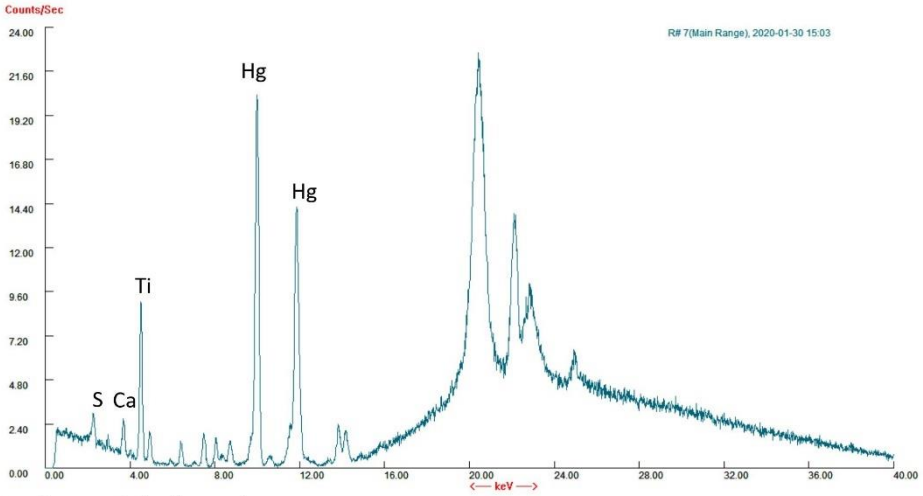
Spektrum 4 – zelená



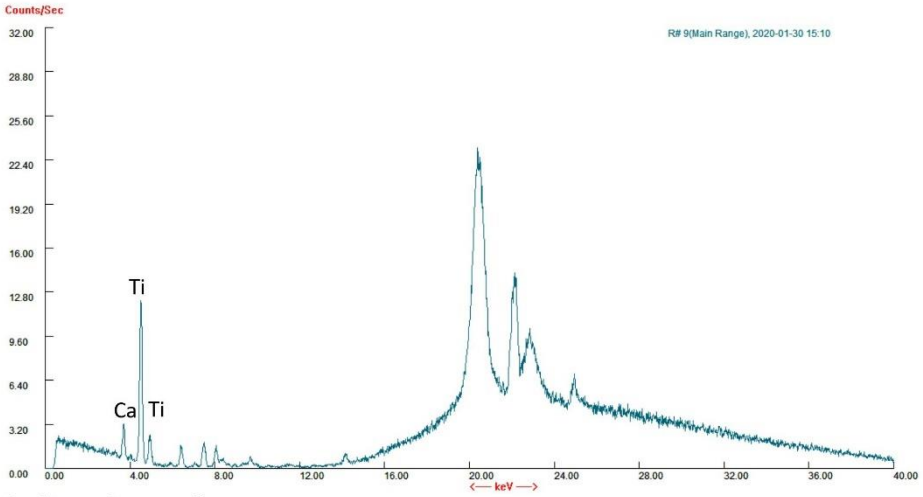
Spektrum 5 – kámen



Spektrum 6 – pozadí, šedé vlnky



Spektrum 7 (8) – červená



Spektrum 9 – pozadí

4. Souhrn výsledků XRF

Přehled prvků naměřených na jednotlivých místech s navrženými možnými použitými pigmenty na základě signifikantních prvků. Marginálně zastoupené prvky jsou uvedeny v závorkách, dominantě zastoupené prvky jsou zvýrazněny tučně.

Lokace	Spektrum	Chemické prvky	Navržené pigmenty
zelená, světlá	1	S, Cl, **Cu** (Al, Si, K, Ca, Ti)	Cu – zelený mědnatý pigment, např. malachit ($2\ CuCO_3 \cdot Cu\ (OH)_2$), atakamit ($Cu_2(OH)_3Cl$), brochantit ($Cu_4[(OH)_6\|SO_4]$) Al, Si, K – kamenec ($KAl(SO_4)_2$) Ca, Ti – pravděpodobně z podložky při měření
kámen	2	Al, Si, S, K, Cl, Cu (Ca, Ti)	slabý signál organické barvivo ? Al, Si, K – kamenec ($KAl(SO_4)_2$) Ca, Ti – pravděpodobně z podložky při měření
zelená, tmavá	3	S, Cl, **Cu** (Si, K, Ca, Ti)	Cu – zelený mědnatý pigment, např. malachit ($2\ CuCO_3 \cdot Cu\ (OH)_2$), atakamit ($Cu_2(OH)_3Cl$), brochantit ($Cu_4[(OH)_6\|SO_4]$) Al, Si, K – kamenec ($KAl(SO_4)_2$) Ca, Ti – pravděpodobně z podložky při měření
zelená	4	S, **Cl**, **Cu** (Al, Si, K, Ca, Ti, As)	Cu – zelený mědnatý pigment, např. malachit ($2\ CuCO_3 \cdot Cu\ (OH)_2$), atakamit ($Cu_2(OH)_3Cl$), brochantit ($Cu_4[(OH)_6\|SO_4]$) Al, Si, K – kamenec ($KAl(SO_4)_2$) Ca, Ti – pravděpodobně z podložky při měření
kámen	5	Al, Si, S, K, Cl, Cu (Ca, Ti)	slabý signál organické barvivo ? Al, Si, K – kamenec ($KAl(SO_4)_2$) Ca, Ti – pravděpodobně z podložky při měření
pozadí, šedé vlnky	6	Al, Si, S, P, K, Cl (Ca, Ti)	slabý signál Al, Si, K – kamenec ($KAl(SO_4)_2$) Ca, Ti – pravděpodobně z podložky při měření

červená	7, 8	S, **Hg** (Al, Si, Cl, K, Ca, Ti)	Hg, S – rumělka (HgS) Al, Si, K – kamenec ($KAl(SO_4)_2$) Ca, Ti – pravděpodobně z podložky při měření
pozadí	9	Ca, Ti (Al, Si, S, Cl, K)	Ca, Ti – pravděpodobně z podložky při měření

V Praze 25. ledna 2021

ing. Radka Šefců
vedoucí chemicko-technologické laboratoře
Národní galerie v Praze

Kontakt: Národní galerie v Praze
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110 00 Praha 1
Tel: 773 770 063, 221 879 281
E-mail: radka.sefcu@ngprague.cz

Rozsah laboratorní zprávy: 9 stran

Dodatek č. 1 – laboratorní zpráva č.21/7

Autor:	**Po-ťü Čao**
Název díla:	**Západ slunce na moři**
Datace:	**2. pol. 12. stol., dynastie Ťin (1115-1234)**
Rozměry:	**35,8 × 247 cm**
Majitel:	**Národní galerie v Praze**
Inv. č.:	**Vm 927**

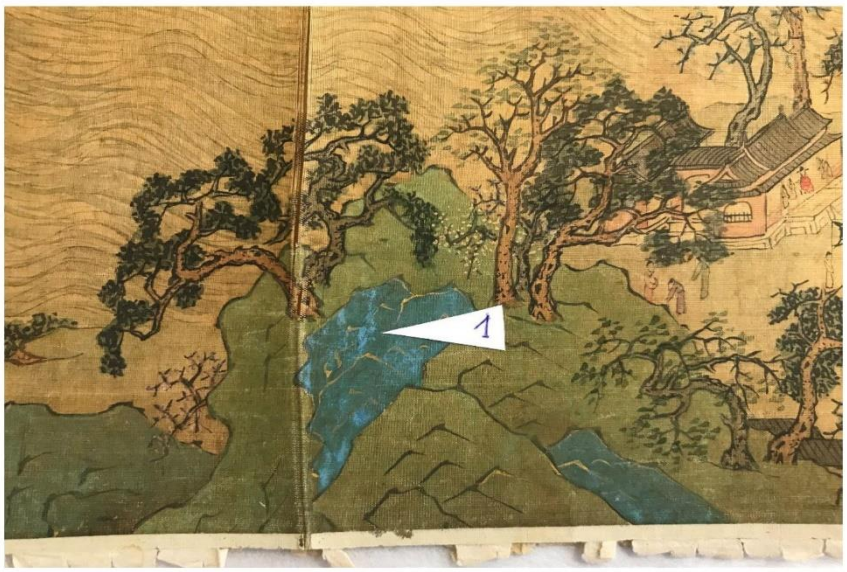
V rámci materiálové analýzy byl proveden průzkum na odebraných mikrovzorcích.

vzorek č. 1 – modrá
vzorek č. 2 – zeleno-modrá
vzorek č. 3 – tmavě zelená

1. Použité metody a specifikace přístrojů

- vzorky – zrníčka malby byly při odběru umístěny na uhlíkovou pásku na hliněném nosiči a byly fotograficky zdokumentovány USB mikroskopem AM4113ZT-FV2W, zvětšení 50×, 200×, polarizované viditelné světlo (VIS), 1,3 Megapixel (1280 x 1024 pix), zpracováno programem Dino-Capture 2.0, Zoner Photo Studio ZPS 18 PRO
- strukturní analýza byla provedena metodou Ramanovy mikrospektroskopie, přístroj DXR Raman Microscopy Thermo Scientific, excitační lasery 780 nm, spektra byla zpracována v programu Omnic 9 a interpretována na základě porovnání s knihovnou spekter
- prvková analýza byla provedena na elektronovém mikroskopu s mikroanalyzátorem JEOL JSM 6460 LA (příloha: protokol SEM/EDS)

2. Zákres odběrových míst (podklad L. Khaindrava)



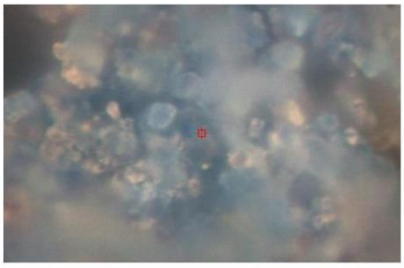

2


3

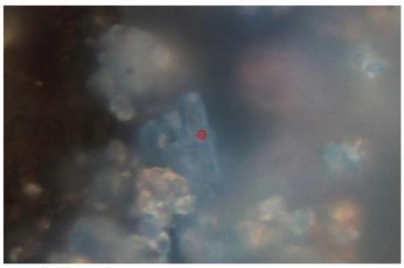
3. Ramanova mikrospektroskopie

Vzorek č. 1 – modrá

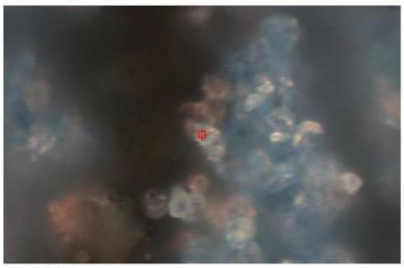
měřená místa – modrá bod 1



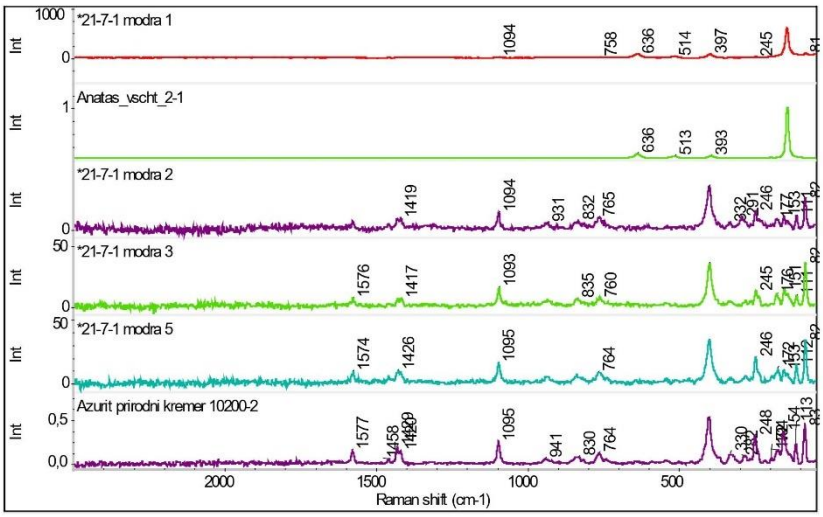
modrá bod 2



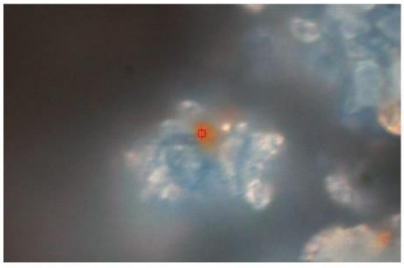
modrá bod 3



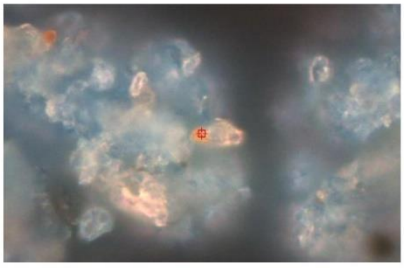
modrá bod 5



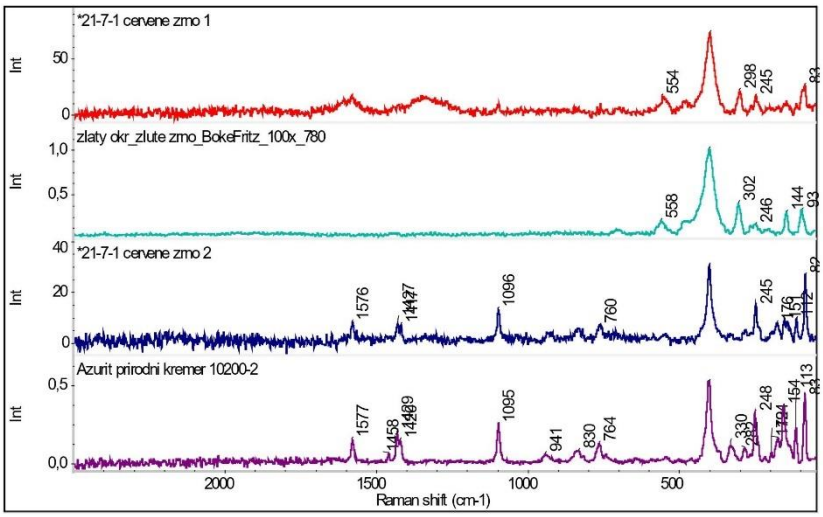
Spektra z modrých částic a srovnávací spektra standardů. Ve vzorku byl identifikován azurit (2 $CuCO_3 \cdot Cu(OH)_2$) a anatas (TiO_2).



měřená místa – červená bod 1

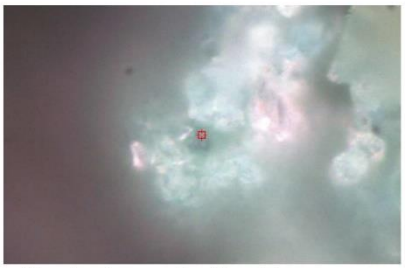


červená bod 2

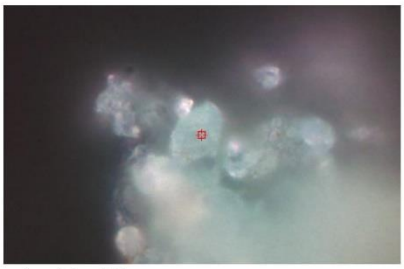


Spektra z červených částic a srovnávací spektra standardů. Ve vzorku byl identifikován žlutý okr (FeOOH) a azurit ($CuCO_3 \cdot Cu(OH)_2$).

Vzorek č. 2 – zeleno-modrá

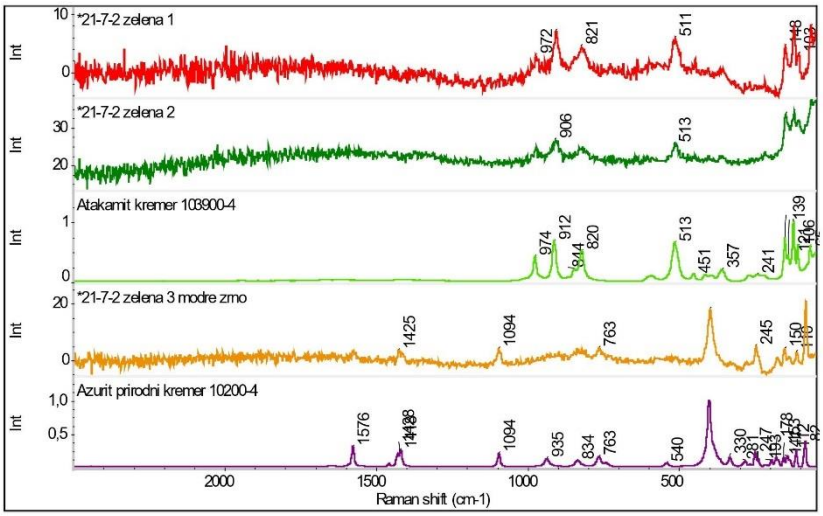


měřená místa – zelená bod 1



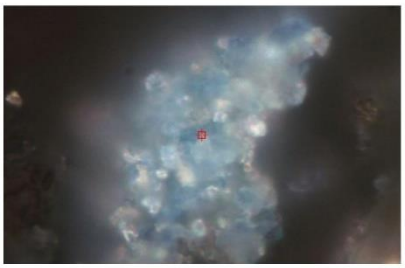
zelená bod 2

zelená bod 3

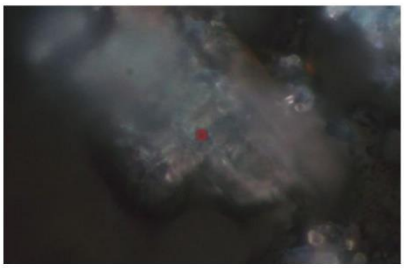


Spektra zelených a modré částice a srovnávací spektra standardů. Ve vzorku byl identifikován atakamit ($Cu_2Cl(OH)_3$) a azurit ($CuCO_3 \cdot Cu(OH)_2$).

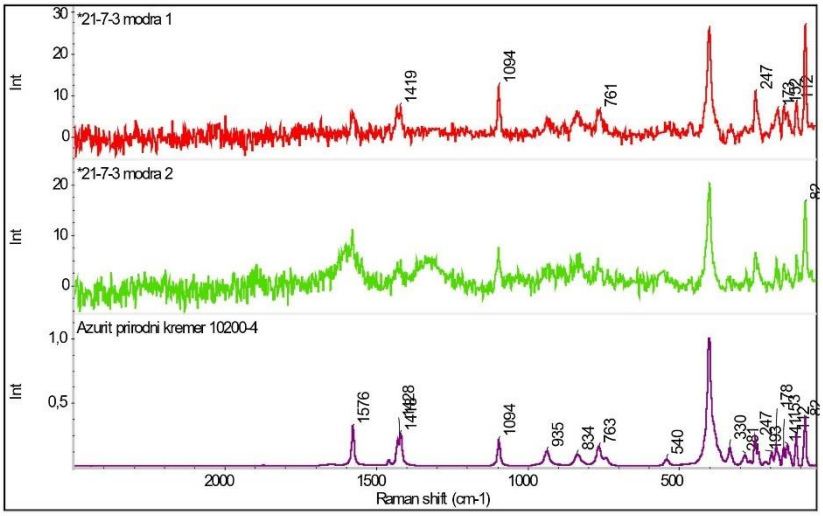
Vzorek č. 3 – tmavě zelená



měřená místa – modrá bod 1



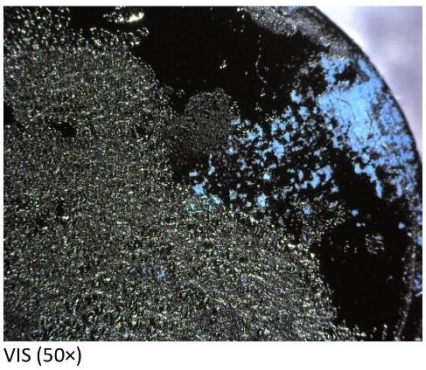
modrá bod 2



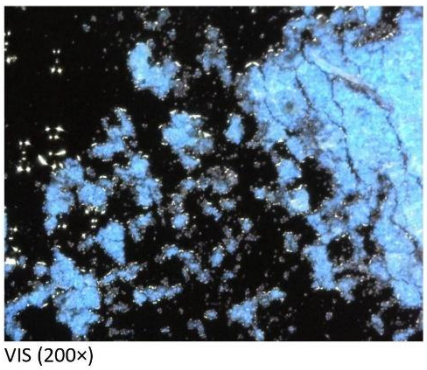
Spektra z modrých částic a srovnávací spektra standardů. Ve vzorku byl identifikován azurit ($CuCO_3 \cdot Cu(OH)_2$).

4. Interpretace výsledků analýz na mikro-vzorcích

Vzorek č. 1 – modrá



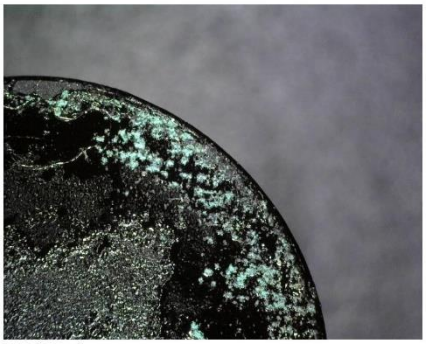
VIS (50×)



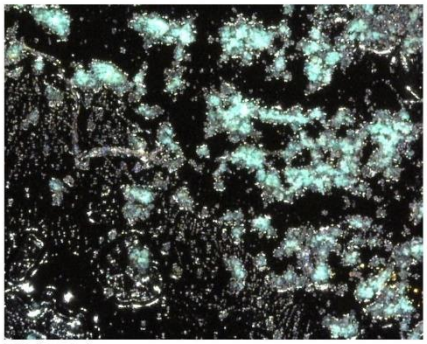
VIS (200×)

Ramanovou spektroskopií byl ve vzorku prokázán azurit, okry a anatas, který může být součástí přírodních okrů, které se v přírodním azuritu vyskytují jako příměs. Tomuto faktu nasvědčuje i analýza EDS, kterou byly identifikovány, vedle dominantně zastoupené mědi (Cu), rovněž charakteristické prvky pro přírodní okry (hlinky), zejména železo (Fe) hliník (Al), křemík (Si), hořčík (Mg), draslík (K).

Vzorek č. 2 – zeleno-modrá



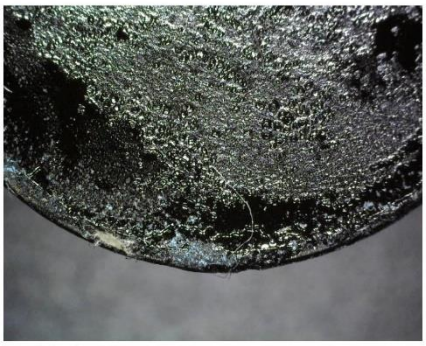
VIS (50×)



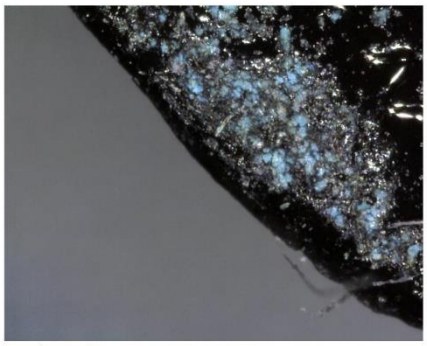
VIS (200×)

Ramanovou spektroskopií byl ve vzorku prokázán atakamit s příměsí azuritu. Identifikace metodou EDS prvkového složení odpovídá identifikaci Ramanovou spektroskopií. Pouze v jednom bodě analýza ukázala přítomnost arsenu a olova. Mohlo by jít i o druhotnou kontaminaci, neboť jinou analýzou (např. XRF) tyto prvky nebyly potvrzeny.

Vzorek č. 3 – tmavě zelená



VIS (50×)



VIS (200×)

Dle odběrového místa by mělo jít o tmavě zelenou malbu. Při dokumentaci vzorku byly rozpoznatelné pouze modré a zlaté částice. Ramanovou spektroskopií byl ve vzorku prokázán azurit a na základě prvkové analýzy EDS lze předpokládat i příměs okrů. EDS analýza prokázala, že zlatavě zabarvené částice jsou částice zlata.

Ing. Radka Šefců Digitálně podepsal Ing. Radka Šefců Datum: 2021.03.15 18:57:07 +01'00'

V Praze 15. března 2021

ing. Radka Šefců
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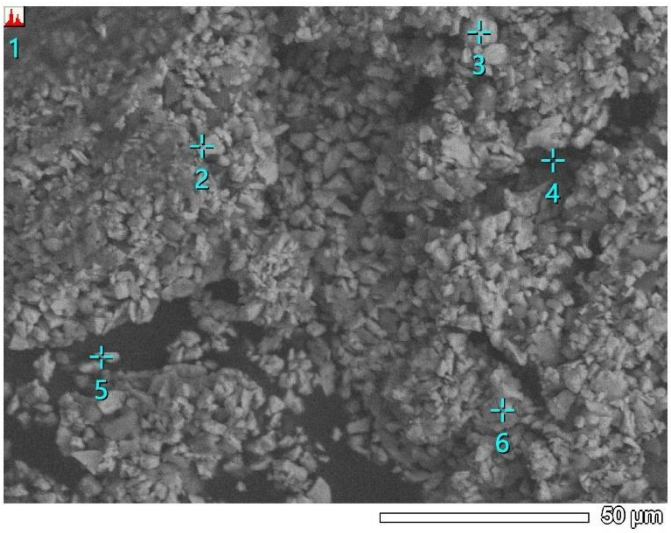
Rozsah dodatku č. 1: 9 stran
Přílohy: 5 strany protokol SEM/EDS
Celkem stran protokolu: **14 stran**

21-7-1 detail 1

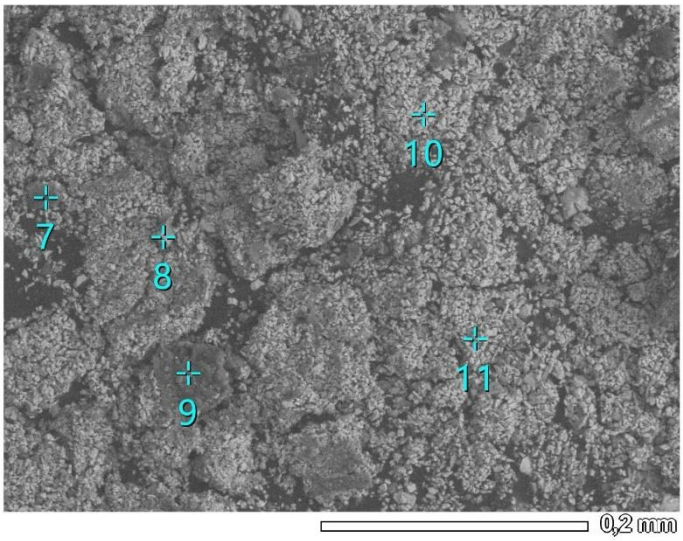


Title	: IMG1
Instrument	: 6060(LA)
Volt	: 20,00 kV
Mag.	: x 800
Date	: 2021/03/11
Pixel	: 1024 x 768

Mass%

	Mg	Al	Si	P	S	Cl	K	Ca	Fe	Cu	Total
1	0.91	8.04	11.66		1.27		0.94	1.72	0.77	74.69	100.00
2		7.32	7.20	0.75	0.66		0.65	1.09	0.39	81.93	100.00
3		3.97	3.79			0.90	0.35	0.39	0.32	90.27	100.00
4		6.22	3.80		0.33		0.33	0.97	0.56	87.78	100.00
5	0.64	5.61	5.00		0.54		0.53	0.79	0.69	86.20	100.00
6	1.51	9.98	17.54		0.45		2.74	0.69	1.02	66.07	100.00

21-7-1 detail 2



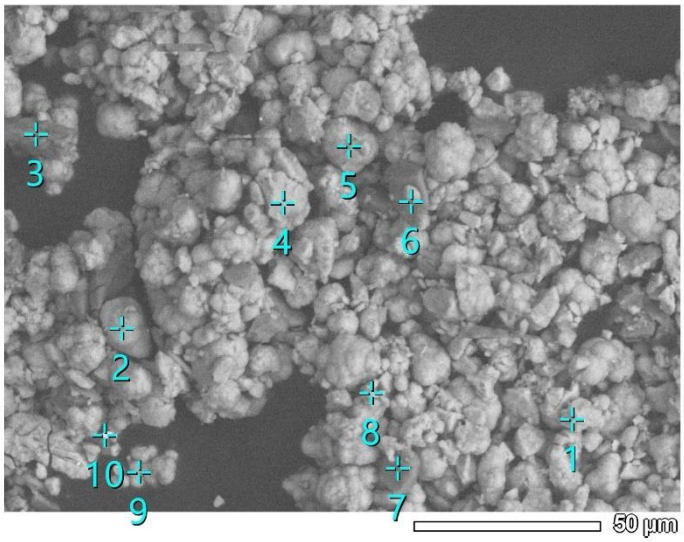
Title	: IMG1
Instrument	: 6060(LA)
Volt	: 20,00 kV
Mag.	: x 250
Date	: 2021/03/11
Pixel	: 1024 x 768

Mass%

	Mg	Al	Si	P	S	Cl	K	Ca	Fe	Cu	Total
7	1.63	10.83	12.12		14.56	1.74	2.01	18.28		38.83	100.00
8		5.70	3.53			60.60		0.87		29.30	100.00
9	1.17	9.77	4.35	0.86	15.71	1.94	1.36	33.92		30.91	100.00
10		9.93	3.10				0.32	0.60		86.05	100.00
11		9.35	7.59		0.56		0.57	1.05	0.53	80.35	100.00

21-7-2

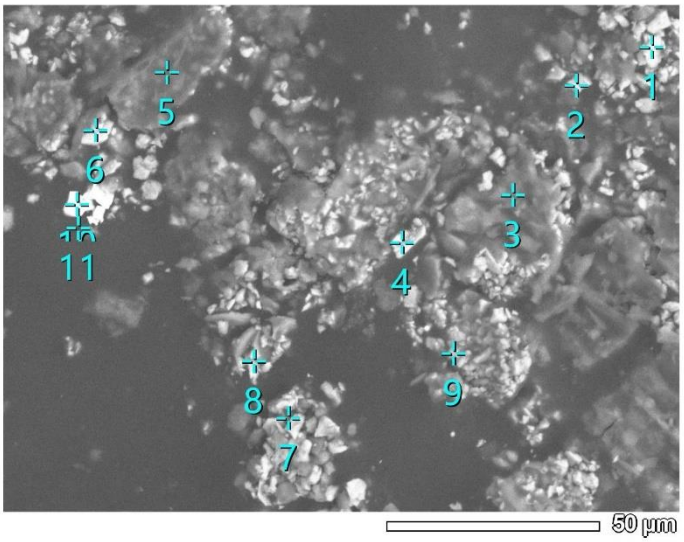
Title	: IMG1
Instrument	: 6060(LA)
Volt	: 20,00 kV
Mag.	: x 700
Date	: 2021/03/11
Pixel	: 1024 x 768



Mass%

	Mg	Al	Si	S	Cl	Ca	Cu	As	Pb	Total
1	1.09	1.24		0.77	22.01	1.08	73.80			100.00
2	0.73	1.27		0.68	7.97	55.79	33.55			100.00
3		1.30		0.53	4.05	69.42	24.69			100.00
4	0.63	0.99		0.54	18.21	1.40	78.22			100.00
5		0.81		1.03	21.31	0.90	75.96			100.00
6	0.69	1.08	0.31	0.88	15.44	10.59	71.00			100.00
7		1.19		0.52	3.97	69.23	25.10			100.00
8		1.27	0.29	1.14	18.65	1.48	77.18			100.00
9		1.17		0.79	20.62	0.78	76.64			100.00
10		0.71		1.75	4.51	2.54	17.12	24.10	49.26	100.00

21-7-3 detail 1



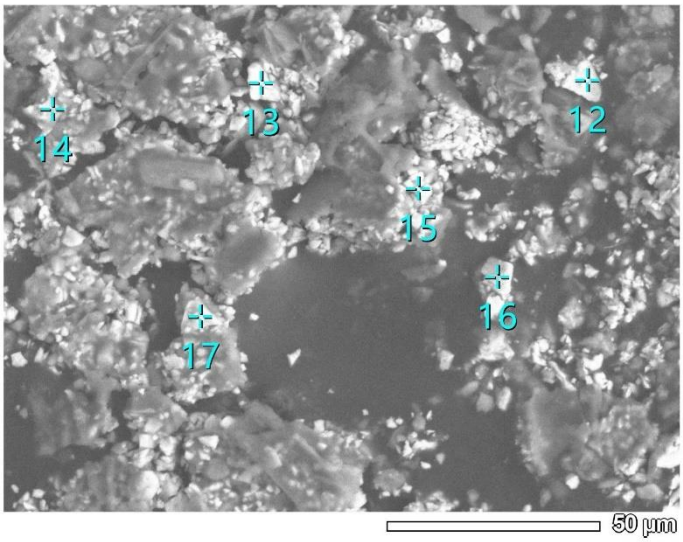
Title	: IMG1
Instrument	: 6060(LA)
Volt	: 20,00 kV
Mag.	: x 800
Date	: 2021/03/11
Pixel	: 1024 x 768

Mass%

	Mg	Al	Si	S	Cl	K	Ca	Fe	Cu	Au	Total
1		12.51	4.03	0.92		0.42	0.93		81.20		100.00
2		15.37	6.36	2.05		0.75	2.07		73.39		100.00
3	7.51	24.28	18.90	3.55	0.64	1.00	4.10	22.06	17.96		100.00
4		12.11	3.39	1.14		0.40	0.90		82.05		100.00
5		20.73	7.08	6.59	1.89	1.77	7.53	0.85	53.55		100.00
6		14.67	26.25	1.73	0.67	0.70	2.22	0.99	52.76		100.00
7	1.06	12.62	9.77	0.99		1.80	1.21	1.02	71.53		100.00
8		13.39	5.92	1.08		0.62	0.77	0.54	77.69		100.00
9	1.55	14.34	13.12	1.38		1.31	1.70	0.93	65.67		100.00
10		2.67		2.57			0.63		3.84	90.30	100.00
11		43.12	10.00	13.33		1.06	3.79		28.70		100.00

21-7-3 detail 2

Title	: IMG1
Instrument	: 6060(LA)
Volt	: 20,00 kV
Mag.	: x 800
Date	: 2021/03/11
Pixel	: 1024 x 768



Mass%

	Al	Si	S	Cl	K	Ca	Fe	Cu	Total
12	14.68	3.24	1.01		0.44	0.91		79.72	100.00
13	14.00	4.19	1.23		0.58	1.02		78.97	100.00
14	15.30	3.52	1.28	0.40	0.48	1.62		77.40	100.00
15	15.53	4.01	0.87			1.86	0.59	77.14	100.00
16	14.30	2.69	0.71			0.67		81.63	100.00
17	12.72	3.95	0.63		0.40	0.60	0.39	81.30	100.00

EAST ASIAN PAINTINGS ON SILK SUPPORT:

Approaches to Conservation, Materials and Methods

1 INTRODUCTION

The principal forms of Chinese painting are found on hanging scrolls, horizontal handscrolls, fans and in albums of paintings. In Japan, the principal forms are hanging scrolls and handscrolls, sliding doors and folding screens. Silk and paper are the main painting support for the East Asian tradition.

In addition to paintings on silk lined with paper arranged as handscrolls or hanging scrolls, European collections also contain unlined paintings, which are often intended as export pieces and relate to the popularity of oriental works, *chinoiseries* and *japoneseries*. Unlined paintings often form a part of various folding screens and panels, however their assembly in frames under glass is also very common.

The theoretical section of this thesis provides a summary and a detailed description of the characteristics of individual materials associated with handscrolls and paintings produced on a silk support, and a closer look at the problem of deterioration, preventive care, handling and storage of Asian handscrolls.

2 MATERIALS

2.1 Silk

2.1.1 History of silk

Silk was known in China already during the late Neolithic period in the 3rd millennium B.C.E. Many legends tell of the emergence of silk in relation to the wife of the legendary Yellow Emperor, Empress Leizu, also known as Lady Xilingshi. She was attributed with the discovery of silk and invention of the silk loom. According to legend, the Empress was drinking tea in a mulberry garden, when suddenly, the cocoon of a silkworm fell into her cup of tea. The Empress noticed that the filament became loose in the hot water and attempted to remove it from the cup. As she wrapped the thread around her finger, she realized that the cocoon was an endless thread.[11] This discovery was highly esteemed in China, and silk became one of the most valuable goods in other countries. Patterned silk weaves were exchanged for even more than their weight in gold in India, Persia, Greece and Rome.[12] The Chinese people were very grateful to the empress who made this valuable discovery, and they named her the "Goddess of Silkworms".[13]

The legendary Yellow Emperor was a patron of agriculture. During the time of his alleged reign the legendary establishment of the first agriculture and sericulture festivals is also mentioned in the Chinese lore. Later, during the historical periods, Chinese royal families made offerings to the ancient Empress Xilingshi as part of these festivals. Among other ceremonies, the emperor ploughed a furrow, while the empress offered cocoons and mulberry leaves at the altar of their deified predecessor.

Silk production was a major support to the economics in China. The Chinese did not want the technology of silk production to spread abroad, and hence they carefully

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[11] KOPSOVÁ, Barbora. *Restaurátorská dokumentace: Čínský závěsný svitek s portrétem zemřelé aristokratky 2. polovina 19. století.* Diplomová práce. Litomyšl-Toruń: 2011. Fakulta restaurování, Univerzita Pardubice, p. 188.

[12] HOOPER, Luther. *Silk: Its production and manufacture.* London. Sir Isaak Pitman and Sons, Ltd., p. 19

[13] BROWN, Harriet G. *The story of silk*. Instructor Literature Series – No. 93. Dansville, New York. F. A. Owen Publishing Company, 1907, p. 15.

and strictly guarded this secret. They informed curious foreigners that silk originated from the fleece of sheep. It is known that the technology was successfully kept secret until about 300 CE. [14] Despite this, the breeding of silkworms eventually spread to other countries. In about the fourth century CE, silk production technology reached Japan through Korea, where it was introduced by Chinese migrants.[15] It is believed that the silkworm appeared in Europe around the sixth century with the aid of two Persian monks. The monks had learned the entire mysterious process of sericulture while living in China. Later, they arrived in Constantinople and shared their knowledge with the Emperor Justinian, who was profoundly interested in the process of silk weaving and the art itself. The monks managed to bring the eggs of the silkworm moth by concealing them in a hollow cane. Those precious materials brought trade and prosperity to the Western world. Slowly, the technology spread all over the Near and Far East, and later it was introduced in Italy, France and Spain.[16]

Silk has always symbolized elegance and luxury. The material was only ever intended for the imperial family. Even those who produced it were not permitted to keep itor wear it themselves. Silk has always been a valuable commodity characterized by exceptional properties.

Silk is used for both painting and mounting hanging scrolls or handscrolls in the Asian tradition. It accomplishes a functional and decorative purpose. The silk pattern can be processed in a variety of ways, for example, weaving, dyeing and embroidery.[17]

2.1.2 Silk threads

Silk is a natural protein fibre obtained from the cocoons of the silkworm (*Bombyx mori L.*). The life cycle of a domestic silkworm consists of several stages. Caterpillars hatch from the small eggs which silk moths lay at a temperature of around 20–25 °C. They are initially very small but with regular nutrition, they can grow up to 8 cm in length within 25–38 days.[18] In the summer, when first laid by the moth, the eggs are

[14] HOOPER, 1924, pp. 19, 20.
[15] KOPSOVÁ, 2011, p. 188.
[16] HOOPER, 1924, p. 22.
[17] KOPSOVÁ, 2011, p. 188.
[18] ONDRÁK, František. *Malá technologie hedvábí I.díl: Smotávání hedvábí*. Svazek 36, publ. č.68. Praha: Textilní ústav československý. 1942, p. 5.

cream-coloured, however they soon change their colour to grey and remain that way until spring, when it is time for them to hatch. After the caterpillar hatches, it looks for a source of nutrition, which is usually mulberry leaves, which allows it to grow very quickly.[19] Silk breeders put caterpillars on light, movable shelves. When it is necessary to clean the shelf space, breeders place a netting with fresh mulberry leaves above the caterpillars. Once the silkworms crawl up to eat the leaves, the shelves can be cleaned without disturbing the animals. In a few days, they grow too large for their skins, which become tight and yellowish. At this point, the caterpillars cease feeding, and their skins are ready to shed. This process is called moulting. As the caterpillar grows larger, it becomes paler. Silkworms grow rapidly and change their skins four times. After the final moulting, the animal is about three inches long and becomes a fully grown caterpillar. It has two long glands called spinners which are used to spin the silk for the cocoon. The glands extend along each side of the caterpillar and end at a single opening in the head, where the silk thread emerges in one piece. When the thread is inside the caterpillar's body it is quite soft, but once it is outside and is exposed to air, it becomes hard.[20] The caterpillar pupates in a light-coloured cocoon which it creates on a mulberry branch. In China, straw is used for the pupae. The silkworm spends about two weeks in this transformational stage. Eventually, an adult moth emerges from the cocoon. Although it has wings, it cannot fly. The moth has a short life, about a week, and its only goal is to mate and lay eggs for the next cycle. The female moth lays around 300–500 eggs.[21]

If the moth emerges from the cocoon by itself, it will create a hole and disrupt the silk thread, which consequently cannot be used by silk breeders. The cocoons are therefore thrown into boiling water with the moth inside. The threads are separated from the gum which binds them together and can then be used after this process.[22] The total length of the fibre can reach several kilometres, although the highest quality fibre is obtained from the middle layer and is only 600–1200 metres long.[23]

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[19] HOOPER, 1924, p. 8.
[20] BROWN, 1907, p. 11.
[21] HEROLDOVÁ, Helena. *Čína - země hedvábí: od starověku po současnost*. Dějiny odívání. Praha: Nakladatelství Lidové noviny, 2010, pp. 12-13.
[22] BROWN, 1907, p. 11.
[23] HLADÍK, Vladimír. *Textilní vlákna*. Praha: Státní nakladatelství technické literatury, 1970, pp.16-17.

2.1.3 Structure and properties of silk

Silk is widely used in textiles because of its outstanding mechanical strength, comfort for wearing and elegant appearance; hence it has been called the queen of fibres.[24] Natural silk fibre has two components, fibroin and sericin, in a proportion of 2:1.

Fibroin forms the core of a fibre. It is not soluble in water, even when it is boiled, and only swells in aqueous solutions. The chemical composition of fibroin differs from sericin. Sericin consists of more residues with polar side chains than non-polar side chains. Of the polar chains, 60 % are hydroxyl groups, which are soluble in hot water.[25] The process of boiling separates the sericin from fibroin and helps the fibre remove the silk gum. During this process, silk loses 20–26 % of its weight, although its remarkable strength, softness, flexibility and shiny brilliance in appearance remain. These properties make silk one of the most luxurious and expensive materials.[26] Sericin makes fibres more resistant to mechanical stress, but causes a rougher texture, reduces gloss and impairs its dyeability.[27] Due to its composition, fibroin is the simplest of the structural proteins. Most of the constituent amino acids are glycine, alanine and serine in a proportion of 3:2:1. These amino acids make up approximately 60 % of the crystalline regions of fibroin (stabilized by hydrogen bonds), which give the fibre high tensile and tearing strength. Silk has slow elastic recovery or creep after extension and does not regain its original length because the protein chains are already fully extended.

Silk is flexible because it contains pleated sheets which slip along each other easily because of the weak secondary forces which bind the sheets together. Light reflected by these pleated sheets produces the glossy appearance of the silk's fibres.

The highly crystalline components of the silk fibres produce a high mechanical strength and resistance to chemical agents. The amorphous parts of the silk fibres are

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[24] YANG Jinqiu, LU Shenzhou, XING Tieling, CHEN Guoqiang. *Preparation, Structure, and Properties of Silk Fabric Grafted with 2-Hydroxypropyl Methacrylate Using the HRP Biocatalyzed ATRP Method.* National Engineering Laboratory for Modern Silk. China: Suzhou, Soochow University, 2018, p. 1.

[25] TÍMÁR-BALÁZSY, Agnes. *Chemical principles of textile conservation.* 1st ed. Oxford: Butterworth-Heinemann. Oxford: 1998. p.444

[26] HLADÍK, 1970, p. 16-17.

[27] HOOPER, 1924, p. 2-3

easily penetrated by water and chemical agents. The isoelectric region of silk fibre is between pH 3 and 7.

Cultivated silk loses up to 25 % of its weight during the degumming process. The main purpose of weighting treatments is to increase its weight by 30–300%, hence, to replace the lost weight. Many types of weighting agent have been used since the Middle Ages, including gum Arabic, materials containing tannin, sugar, logwood and iron sulphate. From the beginning of the nineteenth century, mineral salts such as iron, lead, tin and zinc compounds were used to weight silk. Sodium silicate, salts of bismuth and tungsten were also common weighting agents. The agents used to weight silk often behave as catalysts for many chemical reactions which deteriorate the fibres.[28]

2.1.4 Degradation of silk: internal and external effects

Several factors can lead to the deterioration of silk. Fibroin, which is one of the main components of silk fibres, can be degraded by water, oxygen, sunlight, heat and microorganisms. These agents cause a visible colour change in silk fibres. They become yellowish and fragile. The major cause for yellowing is photodegradation due to sunlight exposure. An increase in relative humidity can degrade the strength of the fibres.[29]

Relative humidity and temperature

Fibroin is greatly hygroscopic and can absorb around 30 % of water without feeling damp to the touch. Silk can maintain its flexibility even at 40 % RH through its strong ability to bond with water. When silk fibres are exposed to some solutions with inorganic salts (e.g., calcium salts), they start to swell and experience a corresponding reduction in length. As a result, washing silk in hard water on may lead to visible dimensional changes than washing in soft water.

Silk fibres may dry out if kept in an inappropriate environment with a relative humidity of less than 40 % or hot temperatures. Dehydrated silk is stiff, brittle and has reduced softness and elasticity.[30]

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[28] TÍMÁR-BALÁZSY, 1998, p.445.

[29] HIRABAYASHI, Kiyoshi; YANAGI, Yoshikuni and KAWAKAMI, Shotaro. *Degradation of silk fibroin. The journal* of *sericultural science* of *Japan*. 1986, **56** (1), 18-22, p. 18.

[30] TÍMÁR-BALÁZSY, 1998, pp. 445-446.

The most common effect of heat on silk is dehydration and free radical thermal oxidation. The mechanical properties of silk suffer significant changes above 140 °C.[31] A temperature over 150 °C results in fibroin degradation and yellowing of the silk. Temperatures of 170–180 °C lead to the decomposition of fibres.[32] Silk may become dry due to a lack of humidity, which can later cause brittleness and vulnerability.

Light

Silk is very sensitive to electromagnetic radiation. Radiation with wavelengths of 220–370 nm causes yellowing and photodegradation of silk. Exposure to visible light results in fading.

Silk is susceptible to photodeterioration due to the presence of tryptophan, tyrosine and phenylalanine amino acid residues in its amorphous constituents. Tyrosine and tryptophan residues readily experience photo-oxidation when exposed to UV light. Upon oxidation, these side groups transform into various chromophoric groups which cause colour changes in the material. It may change to yellow brown, grey or a light pink colour. The effect of photo-oxidation on silk fibres is discolouration, rigidness and weakening. [33]

[31] TÍMÁR-BALÁZSY, 1998, pp. 445-446.
[32] MILITKÝ, J. *Textilní vlákna: klasická a speciální.* 1.vyd. Liberec: Technická univerzita, 2002, p. 136
[33] TÍMÁR-BALÁZSY, 1998, pp. 445-446

Effect of acids on silk

The hydrolysis of silk with dilute acids causes one constituent of the material to dissolve relatively rapidly. The remainder takes a longer time or higher temperatures to dissolve. This occurs because the amorphous parts are generally more vulnerable to attack (peptide bonds, salt linkages and hydrogen bonds are more susceptible to acids, which break these bonds). The result of this process is a weakened and fragile silk thread.[34]

Effect of alkalis on silk

Both alkalis and acids rupture the peptide bonds in silk fibre structures. However, alkaline degradation is not as significant as acidic degradation. Reduced alkaline solutions attack only the ends of chains, depolymerizing the fibroin, while acid hydrolysis of fibroin acts randomly. The process of depolymerization does not result in a considerable transformation of the mechanical properties of silk fibres, yet it can affect silk and reduce its resistance to further deterioration. An alkaline environment can cause the appearance of cross linking in fibroin. Cross-links decrease the flexibility and water absorption properties of the silk.

Biological factors

Because it has a densely packed supramolecular structure, degummed silk has superior resistance to micro-organisms than sericin, which is more vulnerable. Insects such as book lice may directly attack silk, although insects generally eat through silk only to reach another material which is more attractive to them.

[34] TÍMÁR-BALÁZSY, 1998, p.447.

Figure 58. The silk moth, Bombyx mori [online].[35]

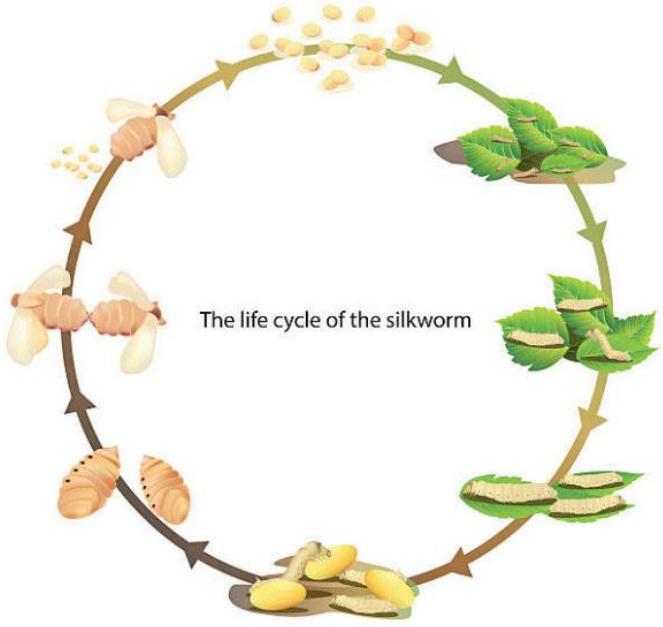

Figure 59. The life cycle of the silkworm. In: Lalouette [online].

[35] Lalouette. *How Is Silk Made? From Silkworm to Silk Fabric: The Secrets of Silk Production*. [online][last access 17.08.2021]. Available at: https://lalouettesilk.com/blog/how-is-silk-made/

Figure 60. The cocoon of the silkworm. In: SmartSilk [online].[36]

Figure 61. Collecting cocoons of the silkworms. In: SmartSilk [online].

[36] SmartSilk. *The History of Silk* [online] [last access 17.08.2021]. Available at: https://smartsilk.com/blog/history-of-silk/

Figure 62. The process of boiling cocoons. In: Lalouette [online].

Figure 63 Twisting of the silk threads. In: Lalouette [online].

2.2 Painting on silk

Chinese painting and calligraphy have a unique and long history. Their tradition and roots go back to the first millennium B.C. The aspects of Chinese paintings are complex and differ from Western art in many ways.

After many generations of intense study and development, Chinese paintings gained various characteristics. The main tools are known as the "Four Treasures of Study", consisting of the brush, ink, an ink stone, and paper or silk.[37] The brush is generally used according to two different techniques: *gongbi* (meticulous strokes), which is the application of fine outline strokes and rich colours while drawing details,[38] and *xieyi* (the "writing" of ideas), which applies only a variety of soft shades and ink mixed with either large or small amounts of water. Painting motifs are expressed only with brush strokes.[39]

The main difference between Western and Asian paintings is that Asian paintings are created mainly with lines, which is why it is often referred to as the "art of the line". This relates to the culture of calligraphy, which is one of the most important disciplines in China. The theory of Chinese painting is intricately associated with calligraphy.[40]

The interaction of light and shadow and gradation of lighter and darker areas are the main instruments applied in Western fine art tradition to express the volume of three-dimensional objects. Chinese painting has no need to use gradations of colour tones between light and dark areas of the painting. The correct effect can be achieved through lines.[41] Simply, two types of line are applied: iron lines and leaf lines. Iron lines are straight, simple sharp lines with no change in intensity or width. Leaf lines are created with different strengths and graduate from light and thin lines to stronger lines.[42]

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[37] Inkston shop. *China's Four Treasures of the Study* [online][last access 17.03.2021]. Available at: https://www.inkston.com/stories/guides/chinas-four-treasures-of-the-study/

[38] AU, Ho-Nien. *The Characteristics and Spirit of Chinese Paintings.* Lecture Presented at the University of Indianapolis on August 25, 2004, 1-2, p. 1

[39] WANG, 1995, p. 73.

[40] Ibidem, p. 77.

[41] Ibidem, p. 41.

[42] AU, 2004, p. 1.

2.2.1 Chinese silk painting techniques

The *gongbi* painting technique is characterized by a rich colour palette and careful brush strokes. Before painting on a silk support, a line drawing (in Chinese, *huagao*) is made on paper using a thin brush and ink. Traditionally, Chinese ink was made in solid form and was therefore ground and mixed with water before use. Today, it can be simply poured onto an ink stone from the bottle and be diluted with water to the required density.

After preparation of the drawing outline, a piece of raw silk is selected for its weave and texture and then treated with a sizing agent. A solution of glue and alum is used for this process and provides good adhesion of the ink and pigments to the silk support. However, the proportions of glue and alum should be carefully observed and stabilized, or certain complications may arise while painting. A large quantity of alum makes the surface of the silk difficult to paint, whereas if applied in a quantity too small, it will be insufficient for the pigments to adhere properly.

The silk is treated with a sizing solution using a flat brush and then stretched over a board using starch paste. After the silk has completely dried, it can be used as a painting support. The silk is placed over the drawing, and the lines are carefully drawn with ink. The thickness of the line depends on the pressure applied to the brush by the artist's hand.

Silk is a thin material, and therefore the application of colour requires a certain support. A smooth layer of paint is applied to the back side of the line drawing. White pigment is usually applied for light areas, while a darker pigment is used for dark areas. In Chinese, this process is called *tuose*. However, in the painting *"Sunset on the Sea"*, it appears that this step was not executed because neither the back side of the silk nor the paper lining show any sign of pigment support.

The front side of the painting is ready for painting once the pigment on the back has dried. The first applied layer of colour acts as a base. To achieve the correct tone, artists apply several layers of light wash over painted areas. Two types of brush are used to create colour washes. This process is time consuming and requires great concentration by the artist. After the main coloured areas of the painting are ready, subtle details can be added.

The final step involves tracing outlines in ink on the painting to add accents and create a more concrete appearance.[43]

Figure 64. Outlining the drawing with ink. In: Victoria and Albert Museum [online].

Figure 65. A layer of white colour used as a support for other pigments. In : Victoria and Albert Museum [online].

[43] Victoria and Albert Museum. *How was it made? Silk Painting.* [Video][last access 27.07.2021]. Available at: https://youtu.be/C_Dn2OkwlQg

Figure 66. Pigments used for painting. In : Victoria and Albert Museum [online].

Figure 67. The process of painting. In : Victoria and Albert Museum [online].

2.3 Paper

2.3.1 The history of paper

Papermaking is believed to have its roots in China around the beginning of the Common Era, when, according to legend, Cai Lun, an official of Chinese Imperial court, produced a sheet of paper composed of mulberry and bast fibres along with fishnets, old rags and hemp waste. In the subsequent centuries, the technology of papermaking continued its expansion to Japan through Korea and to Central Asia, reaching Samarkand in 751, where paper was made of linen rags;[44] and in 793 the first paper was made in Baghdad during the golden age of Islamic culture and finally it reached Europe in the twelfth century.[45]

2.3.2 Chinese paper

Chinese papers are characterized by their fineness and high quality. They are made using sustainable local ingredients, especially different types of mulberry.

Xuan paper is a handmade paper used for painting, calligraphy and book printing. It is fine, high quality paper made using traditional technologies from the bast fibres of the blue sandalwood tree (*Pteroceltis tatarinowii*), also called tara wingceltis or qing tan, in combination with rice straw. *Xuan* paper has very positive characteristics: it has a fine, strong surface, it can be folded (several times) without its fibres breaking, and it has excellent absorption ability.[46] Xuancheng in Anhui Province is believed to be the place of origin of *xuan* paper during the Tang dynasty. According to Chinese legend, a man once noticed a branch of blue sandalwood floating in a river. The branch was soaked so that the black parts of the tree were falling off, leaving the white parts of the tree exposed. He then decided to use this tree to make paper from its fibres.[47]

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[44] ĎUROVIČ, Michal. *Restaurování a konzervování archiválií a knih*. Praha: Paseka, 2002

[45] Britannica. *Papermaking.* [online] [15.04.2021]. Available at: https://www.britannica.com/technology/papermaking/Fibre-sources

[46] UNESCO. *Traditional handicrafts of making Xuan paper.* [online] [last access 08.02.2021]. Available at: https://ich.unesco.org/en/RL/traditional-handicrafts-of-making-xuan-paper-00201

[47] MULLOCK, Hilary. *Xuan paper*. The Paper Conservator. 1995, **19** (1), 23-30, p. 23

Several types of *xuan* paper are produced:

Raw / "untreated" *xuan* Paper is a type of unsized *xuan* paper. This type has a very high absorption ability and is used in Chinese ink painting. Its extreme absorption rate allows the paper to reveal each layer of the brush stroke, which makes it impossible to hide any painting mistake or inaccuracy. Raw *xuan* paper is also known as "honest" paper since it "cannot lie" and changes cannot be hidden. The paper therefore requires precise painting techniques.

"Treated" *xuan* paper: is sized paper. Unlike raw *xuan* paper, cooked *xuan* paper is sized to lower its absorption ability and used for different art techniques. It is widely applied in *gongbi* painting because it allows detailed brush strokes.

"Half- treated" *xuan* paper: is a mixture of unsized and sized *xuan* paper. It has higher water absorption ability than sized treated *xuan* paper but lower than untreated *xuan* paper.[48]

This method of Chinese hand papermaking is comparable to the Japanese method, with the exception of sheet-forming techniques. However, unlike Japanese *washi* paper, Chinese *xuan* paper has shorter fibres, therefore its tear strength is not as good as Japanese papers.[49] The fibre orientation of Chinese paper is also not as strong as in Japanese paper. This relates to the papermaking technology and direction of the screen motion applied during the papermaking procedure. The material used as a fibre dispersion agent in paper pulp bath in East Asia is a plant which belongs to *Malvaceae* family: *Hibiscus manihot* (or *Abelmoschus manihot, Medicus*). The plant is called *huang shu kui* (nebo pouze *huang kui*) in China, *dakpul* in Korea and *tororo-aoi* in Japan.[50] Chinese paper was first used as a decorative material for interior, and only later it became a material for art and mounting.

2.3.3 Japanese paper

Japanese paper – *washi* is handmade paper of exceptional quality produced with traditional technologies in Japan. It can be made from the bast of various domestic

[48] Inkston shop. *Art papers*. *Inkston.* [online] [last access 17.03.2021]. Available in: https://www.inkston.com/shops/paper/

[49] MULLOCK, 1995, p. 24

[50] YUM, Hyejung. *Traditional Korean papermaking: history, techniques and materials.* Doctoral thesis, Newcastle: 2008. Northumbria University, p. 68

plants, such as shrubs and trees (including bamboo). However, the most established materials used to produce washi are *kozo*, *mitsumata* and *gampi*. Of these materials, *kozo* is the most common. The Japanese learned the papermaking technique from the Korean Buddhist monk *Damjing* in 610 CE.[51]

Kozo (Mulberry) bark – is a high-quality long fibre paper used primarily for painting, calligraphy and mounted scrolls. Its long fibres make *Kozo* papers strong and durable, therefore they are commonly used in conservation and restoration.[52]

Gampi (*Wikstroemia*) – is made from the bast of the *Gampi* bush, which is found in warm, mountainous areas of Japan. It is a shrub 1–1.5 meters high and has long thin fibres. Gampi is the most expensive washi since it cannot be cultivated. *Gampi* provides a strong, clear crunchy sheet of paper with a smooth, glossy surface. *Gampi* is used in restoration and for various art techniques.

Mitsumata (*Daphne*) – a shrub two metres high. Compared to *kozo* and *gampi*, *mitsumata* has short fibres, which makes the paper weak and glossy. This material was used to produce banknotes. Its fragility makes it unsuitable for mounted scrolls and paintings.

The traditional technology of Japanese papermaking involves steaming branches of *kozo*. The bark and the green and brown parts must be removed thoroughly. Only the white parts (the bast) are used for the highest quality paper since the green parts are prone to insect infestation. The white bast is placed into a mild alkaline solution such as wood ash or soda ash to remove lignin and other impurities.[53] After that, the bast mass is struck using a special stick until it is smooth enough to be placed into water with *"neri"*, a dispersion agent made of plant *tororo-aoi* (hibiscus root soaked in water), which helps to disperse the fibres during the sheet making process. After the *tororo-aoi* is dispersed into water, the master papermaker dips the flexible papermaking bamboo screen into the paper pulp to form the sheets of paper.

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[51] SONG, Minah and MUNN, Jesse. Permanence, Durability, and Unique Properties of Hanji. *The Book and Paper Group Annual*. 2004, **23**, 127 – 136, p. 127

[52] Hiromi Paper. *Japanese Gampi paper* [online] [last access 15.04.2021]. Available at: https://store.hiromipaper.com/collections/100-japanese-gampi

[53] IFLA. *Paper conservation by using Japanese paper, washi* [online] [last access 15.04.2021]. Available at: https://www.ifla.org/paper-conservation-by-using-japanese-paper-washi/

2.3.4 Korean paper

Korean paper, *hanji*, is a handmade paper made from mulberry *dak*, or *daknamu*, which is the Korean version of Japanese *kozo*. As in the case of Japanese *washi* and Chinese *xuan* paper, *hanji* became broadly used not only for painting and calligraphy but also as a material for house interiors, decorations, crafts and many other applications.[54]

No written information about the origin of papermaking in Korea is available, but it is believed that knowledge of papermaking reached Korea from China sometime between the second and fifth centuries.[55] Based on a sheet of paper discovered in an ancient tomb in *Chehyupchong* dated between 108 BCE–313 CE, we can be more concrete and presume that papermaking in Korea might have begun at the beginning of the third century.[56]

The process of papermaking in Korea appears to be comparable to the Japanese and Chinese methods. Based on researches, scholars assume that the Korean papermaking technique was similar to the Chinese methods until the seventh century. From the eighth century, Koreans developed their own methods, using mulberry as the main material used for traditional papermaking.[57]

2.3.5 Degradation of paper: internal and external effects

Several factors result in the deterioration of paper. These factors fall under two categories: internal effects (acidity, metal ions, lignin appearing in the paper composition, etc.) and external effects (heat, humidity, air pollutants).[58]

Temperature and relative humidity

Temperature and relative humidity are interrelated factors which affect paper. Due to its hygroscopicity, paper is very sensitive to over-drying. Changes in temperature and relative humidity accelerate the deterioration of paper and related materials.

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[54] SONG, MUNN 2004, p. 127.

[55] YUM, Hyejung. A Brief Account of Traditional Korean Papermaking. *Paper History: Journal of the International Association of Paper Historians.* 2010, **14** (2), 3-27, p. 8.

[56] SONG, MUNN, 2004, p. 127.

[57] YUM, 2010, p. 8.

[58] AREA, María Cristina; CHERADAME, Herve. *Paper aging and degradation: Recent findings and research methods*. *BioResources.* 2011, **6**(4), 5307-5337.

Excessively high relative humidity may also lead to the formation of mould on paper and adhesives. Changes in temperature and relative humidity frequently stress papers and other materials and lead to embrittlement.

Light

Poorly controlled lighting may also cause the deterioration of paper. UV radiation present in sunlight and fluorescent light causes the process of oxidation, rapidly deteriorating the paper and fading the paper's colour. If lignin is present in the paper's composition, it may react with other compounds and turn the paper yellowish or brownish. Even after eliminating the source of deterioration due to light, the reactions initiated by it may continue.

Biological factors

Biological growth such as mould or fungus often appears in places with excess moisture or condensation and uncontrolled temperatures. Mould attacks and digests paper and other organic materials, resulting in stains and a reduction of the material's strength.

Although poorly controlled temperature and RH can cause the biological degradation of paper, negligence may also have a major role. Poor ventilation, a dirty environment, or entry of insect-infested items into the workshop may also contribute to biological deterioration.

Rodents and insects are other risk factors for paper. Starch pastes, sizing agents and other materials containing proteins and carbohydrates and other organic materials are attractive to insects. It is therefore very common for paper objects to be attacked by creatures such as silverfish, booklice and other insects.

Atmospheric pollutants

Sulphurous and sulphuric acids arising from the combustion of fuels and other industrial processes is one of the greatest risks to paper objects. Contamination by sulphuric acid causes acidity in the paper, with a resultant loss in the paper's strength

and an increase in fragility. Dust and dirt particles occurring in the air also have a detrimental effect on paper.[59]

Figure 68. The process of separation of the green and brown parts of the bark from the white parts of the bast.

Figure 69. Japanese method of pounding the bast.

[59] Cultural heritage. *Causes of deterioration of Paper*. [online] [last access 15.06.2021]. Available at: https://cool.culturalheritage.org/byauth/maravilla/deterioration-causes.html

Figure 70. Chinese method of pouding the bast.[60]

Figure 71. Unlike the Japanese method of preparing the bast for the paper pulp, the Chinese method includes cutting the bast after pounding.[61]

[60] Zhihu. [online][15.06.2021]. Available at: https://www.zhihu.com/question/64927852

[61] Ecns. *Villagers innovate method of traditional Chinese papermaking.* [online] [15.08.2021]. Available at: http://www.ecns.cn/m/visual/hd/2018/01-22/152211.shtml#nextpage

Figure 72. Process of forming sheets of paper using paper pulp, Japanese method.

Figure 73. Process of forming sheets of paper using paper pulp, Chinese method.[62]

[62] Yuwanqing. Bamboo paper. [online] [last access 26.08.2021]. Available at: http://www.yuwanqing.net/1070.html

Figure 74. Process of drying paper, Japanese method.

Figure 75. Process of drying paper, Chinese method.[63]

[63] People's Daily Online. *Cave workshop of traditional papermaking persisted in SW China.* [online] [last access 26.08.2021]. Available in: http://en.people.cn/90782/780465.html

2.4 Adhesives

Three classes of adhesives are used in Asian painting and scroll mounting:

- Animal glues (used as a painting medium and sizing agent)
- Starch pastes (used mainly in mounting and restoration)
- Minor adhesives, such as seaweed mucilage (used mostly for facing of the paint layer).[64]

2.4.1 Animal glues

San qiang ben jiao (Chinese) or *nikawa* (Japanese) are the generic names for animal glue, which is one of the earliest types of adhesive. Animal glue is almost transparent and is used as painting medium, a sizing agent for paper support, and an adhesive. In *nihonga* (Japanese-style painting), animal glue is used to adhere pigment to the support. The main component of animal glue is collagen, but it also contains proteins of high quality.[65] It has good characteristics, being strong, elastic and resistant to the growth of microorganisms, although it becomes less flexible with age.

To prepare animal glue, the skins, bones, and tendons of either cows, pigs or rabbits are left to swell and then boiled. This achieves a jelly-like adhesive substance. After the substance cools, it regains its solid state. Animal glue (*ben jiao*) does not dissolve in cold water but can be dissolved when heated. [66]

The animal collagen in the substance is then subjected to hydrolytic decomposition. The quality of the glue depends on the raw materials used in its production. The product derived from bones has greater fragility and is harder, while the product made from skin is soft and elastic. Rabbit glue (*usagi nikawa)* is the most flexible of all the animal glues.[67]

Dosa is the liquid produced by mixing *nikawa* (animal glue) and *myōban* (alum). A feature of the handmade Japanese paper washi is its ability to easily absorb water.

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[64] WINTER, John. Natural Adhesives in East Asian Paintings. *Studies in Conservation*. **29**, 1984, p. 117

[65] HIRAYAMA, Ikuo and Tōkyō Geijutsu Daigaku. *Nihonga: An illustrated dictionary of Japanese-style painting terminology.* Japanese Painting (Conservation), Graduate School of Fine Arts, Tokyo University of the Arts. Tōkyō : Tōkyō Bijutsu, 2010, p. 58.

[66] JAANUS. *Nikawa* [online][last access 17.03.2021]. Available at: www.aisf.or.jp

[67] KOPSOVÁ, Barbora. *Restaurátorská dokumentace: Čínský závěsný svitek s portrétem zemřelé aristokratky*, p. 110.

Silk and Japanese paper are therefore treated with a sizing liquid before painting to prevent blurring.[68] Alum increases the hardening effect on animal glue. The density of the solution depends on the type of paper and season.[69] Dosa is made by dissolving animal glue in hot water, adding alum, boiling, and then adding cold water and cooling. Alum (potassium alum, $KAl(SO_4)_2$) crosslinks collagen, which makes it insoluble in water. However, after some time, the sulphate contained in alum is released and it reacts with moisture in the air. The product of this reaction is sulphuric acid, which can lead to visible changes in both the paint layer and paper. This acid environment can cause colour changes and rapid degradation in the paper. Therefore, this type of suspension is not used for conservation, but it is applied in traditional Japanese painting *nihonga*.[70]

2.4.2 Starch pastes

Starch is believed to be one of the oldest types of adhesive and was used in early Egypt, China, Japan and other regions.[71] With heating, a starch and water solution transforms into a paste which is still widely used in the conservation field. In East Asian pictorial art, wheat starch paste is mainly used for mounting and remounting painted scrolls (on silk or paper support) to attach the layers of paper lining.[72] This technique is known for its good properties as the material ages and its reversibility, which allows the paper backing to be removed from even severely deteriorated silk or the paper support by moistening the starch adhesive. However, this type of adhesive has disadvantages, such as a high possibility of mould growth and poor flexibility.[73] It is therefore important to select the right storage conditions for the painting to reduce the likelihood of these factors appearing. Also, the starch paste used to line the painting must have the right consistency for flexibility. Unlike European paper, Japanese, Chinese and Korean paper have strong adhesion, even if less concentrated starch paste is used. An overdiluted mixture though may lead to insufficient adhesion, and later, separation of the paper lining from the painting support.

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[68] JAANUS. *Dousa* [online][last access 17.03.2021]. Available at: www.aisf.or.jp
[69] HIRAYAMA, 2010, p. 58.
[70] KOPSOVÁ, 2011, p. 110.
[71] VAN STEENE, G and MASSCHELEIN-KLEINER, L. Modified Starch for Conservation Purposes. *Studies in Conservation.* 1980, **25** (2), 64-70, p. 64
[72] WINTER, 1984, p. 118.
[73] VAN STEENE, MASSCHELEIN-KLEINER, 1980, p. 64.

Starches are naturally occurring polymers of glucose consisting of two molecules: the linear chained molecule amylose (25 %) and branched molecule amylopectin (75 %). The distinct characteristics of these molecules give starch a more complicated and complex structure than cellulose.

Starch grains are insoluble in water, but they absorb and swell. Wheat starch in its wet state or dry starch is mixed with water, stirred rapidly over a source of heat, and the finished paste is poured into a storage jar. Heating the milky solution of water and starch causes the bonds in the macromolecule to cleave, and as a result, the molecules of amylopectin and amylose separate. As the volume of the starch grains increases, the substance becomes transparent and gel-like.[74] At this point, as the paste stiffens, the heat must be reduced by at least half. The paste remains in this state for five to six minutes and must be stirred very quickly. This process greatly contributes to the viscosity of the starch paste. After approximately 20 minutes, the stiffness of the paste declines and its colour becomes slightly white. After cooling down, the starch paste is strained through a horse-hair sieve and thoroughly kneaded in a wooden bowl with a brush. After kneading, the paste is prepared for further use. It can be diluted, mixed with aged paste and other adhesives. The substance of the paste can be modified according to the purpose, and the type of bond and materials required.[75]

In Chinese tradition, a lining paste made from gluten flour and a small amount of alum is often used. Alum increases the hardness of the glue and has a natural antiseptic effect. Chinese paste tends to adhere better at lower concentrations than Japanese paste, but due to the alum content, it is not as elastic as traditional Japanese starch paste.[76]

2.4.3 Minor adhesives

Hailuo (in Chinese) / *funori* (in Japanese)[77] is a polysaccharide extracted from the *red algae Gloiopeltis furcate*, mostly found in Japan.[78] This seaweed was first used

[74] KOPSOVÁ, 2011, p. 234.

[75] WILLS, P. The manufacture and use of Japanese wheat starch adhesives in the treatment of Far Eastern pictorial art. *Studies in Conservation.* 1984, **29** (1), 123 - 126, p. 124.

[76] CATCHER, Susan; CHANG, Ge and ZHU, Qinggui. The problem of Chinese paper reinforcement strip repairs on a set of four hanging calligraphic scrolls. *Journal of the Institute of Conservation.* 2017, **40** (1), 49-63, p. 61.

[77] WINTER, 2008, p. 89.

[78] GEIGER, Thomas and MICHEL, Françoise. Studies on the Polysaccharide Jun Funori Used to Consolidate Matt Paint, *Studies in Conservation*. 2005, **50** (3), 193-204

300 years ago, is common, and has been used for conservation purposes ever since. *Funori* was first mentioned in Japanese records in 1673 as a sizing agent for textiles and papers and as a building material. It is still produced today and can compete with many other traditional and synthetic consolidants since it is non-toxic and easy to use. *Funori* is extracted from three species of red seaweed: *Gloiopeltis tenax* (*ma-funori*), *Gloiopeltis complanate* (*hana-funori*), and *Gloiopeltis furcata* (*fukuro-funori*).[79] Sheets of *funori* are made by bleaching and drying the red agar obtained from the three seaweeds. To prepare *funori* for conservation purposes, it is first washed to remove salts. It is then soaked in water and allowed to swell. Later, the solution is heated and filtered through a cloth to remove any contamination and insoluble seaweed.

The chemical properties of *fukuro-funori* and *hanafunori* have been described and both are known to contain a polysaccharide called *funoran*, which consists of carrageenan and agaroid chains.[80] Three groups of red seaweeds are found in the *Rhodophyta* family: *agar*s, *carrageenans*, and *porphyrans* (this group is not used for conservation). *Funori* is an agar, but its chemical and structural qualities are close to carrageenans. This weed has the ability to form a low viscosity solution and is difficult to gelatinize, which allows it to be easily reversible. *Hailuo / funori* has good penetrating ability, can be diluted with water, and is non-toxic. In addition, it removes dirt easily and has a matte texture.[81] The polysaccharide molecule of Gloiopeltis can create a large number of hydrogen bridges, which are responsible for *funori*'s ability to absorb and bond a large quantity of water. These factors allow the occurrence of tidelines around the treated area to be avoided. Furthermore, *funorans* do not change the appearance of the consolidated surface and are characterized as stable and transparent.[82]

The excellent properties of *hailuo / funori* allow many uses in conservation, such as a sizing agent for paper and textiles, a thickener for the production of more viscous but less sticky adhesives, an adhesive used for facing East Asian paintings and scrolls,

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[79] SWIDER, Joseph and SMITH, Martha. Funori: Overview of a 300-Year-Old Consolidant. *Journal of the American Institute for Conservation.* 2005, **44** (2), 117-126, p. 117.

[80] HAYAKAWA, N. Characterisation of funori as a conservation material: Influence of seaweed species and extraction temperature. *Studies in Conservation.* 2014, **59** (S1), 230-S231.

[81] SWIDER, SMITH, 2005, p. 117.

[82] HARROLD, Jillian and WYSZOMIRSKA-NOGA, Zofia. Funori: The use of a traditional Japanese adhesive in the preservation and conservation treatment of Western objects. In: *Adapt & Evolve 2015: East Asian Materials and Techniques in Western Conservation. Proceedings from the International Conference of the Icon Book & Paper Group, London 8-10 April 2015*. London: The Institute of Conservation, 2017, 69-79, p. 70.

and to repair silver and gold leaf and mica. In combination with animal glue, *funori* may also be used to line paintings.[83] *Mafunori* is especially suitable for conservation. Unlike *funori*, *mafunori* dissolves at room temperature, which makes it more reversible. It can be removed from the object at room temperature without being heated (Figure 77).

Bletia gum is derived from the *Bletia hyacinthina* orchid commonly found in northern and central regions of China. A mucilaginous polysaccharide adhesive is produced from this flowering plant, and originating from China, the substance known as *bo ji* or *bai ji* (in Chinese) was probably used as a mounting adhesive. This type of adhesive is stronger than starch paste and allows good adhesion in joining scroll linings or mounts, but it is hard to remove. Its poor reversibility means this type of adhesive is not commonly applied in the conservation field.[84]

Konjak gum is produced from the bulbs of *Amorphophallus rivieri*, herbaceous plant which yields konjac flour (in Japanese *konnyaku*). The gum produced from this plant forms an adhesive for sizing paper or textiles. It is generally used in the production and sizing of decorative paper.[85]

[83] SWIDER, SMITH, 2005, p. 117 – 122.
[84] WINTER, 2008, p. 90.
[85] Ibidem.

Figure 76. Animal glue *ben jiao* (Chinese) / *nikawa* (Japanese) in a solid state in the form of sticks.

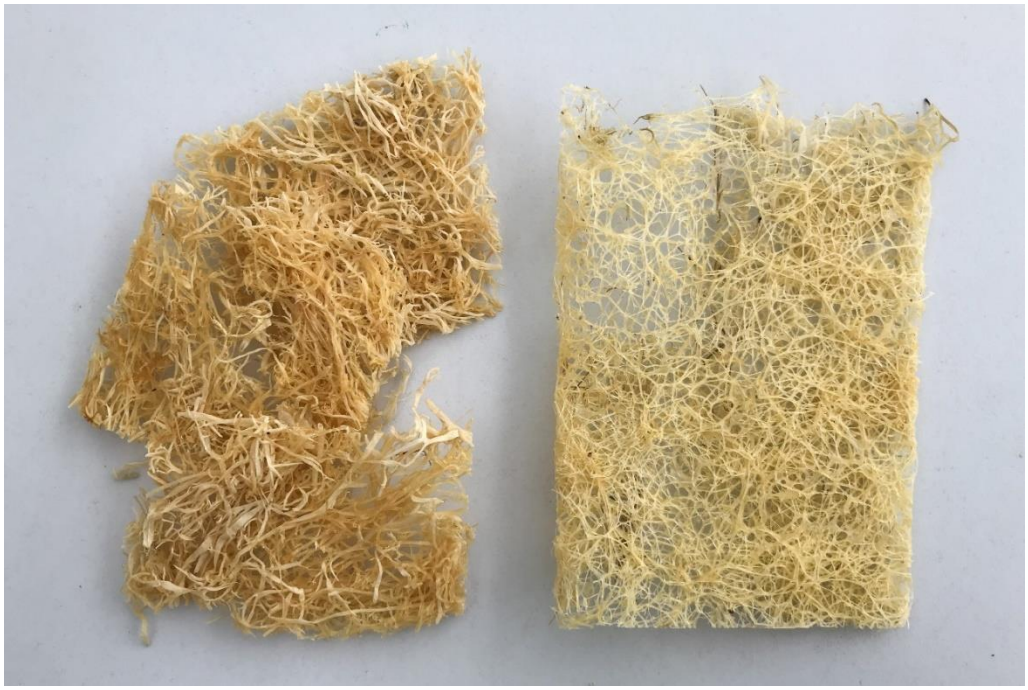

Figure 77. *Funori* (left), *mafunori* (right). Unlike *funori*, *mafunori* dissolves at room temperature, which makes it more reversible. It can be removed from the object at room temperature without being heated.

Figure 78. Dry Japanese wheat starch.[86]

Figure 79. Thin Japanese starch paste prepared for lining.

[86] Talas. *Japanese wheat starch Jin Shofu.* [online] [last access 26.08.2021]. Available at: https://www.talasonline.com/Zen-Shofu-Japanese-Wheat-Paste

3 DETERIORATION OF EAST ASIAN SCROLL PAINTINGS

East Asian paintings experience three main types of damage:

a) Physical damage caused by improper handling, neglect, or insufficient care,
b) Chemical deterioration caused by internal degradation processes,
c) Biological deterioration due to poor storage and unsuitable climatic conditions.[87]

These types of deterioration manifest as creases, cracks, tears, flaking and delamination. The types are related: creases result in cracks, which lead to tears, and in combination, all can cause flaking of the paint layer.[88]

Inappropriate conservation interventions may also cause visible damage to the scroll. It is therefore important to understand the composition and philosophy of Asian art, as it differs from Western art in many aspects.

3.1 Creases, cracks and tears

Creases and cracks caused by rolling are the most common form of deterioration in East Asian scrolls.[89] According to Kenzō Toishi, two types of deformation occur in the scroll: first-stage deformation and second-stage deformation. First-stage deformation can occur if the scroll is stored for a long period, resulting in the rolled shape becoming the scroll's natural shape and consequently leading to stress when the scroll is unrolled. During the process of unrolling, the front side and its painted layer experience tension, causing the inner side of the painting to expand, while the back side of the scroll experiences compressive force, causing the outer side to shrink. This type of deformation is, however, reversible since the scroll can obtain its natural shape once it is rolled again (Figure 80).

[87] PAISLEY, Leslie and MALKIN, Amanda. Preservation strategies for East Asian painting. *Art Conservator Journal.* 2009, 19-22, p. 20.
[88] SMITH, Sarah Jean. *A comprehensive guide to the prevenative care and museum storage of Chinese, Japanese and Korean hanging scrolls*. Thesis work. Florida: 2011. University of Florida, p. 40.
[89] NISHIO, Yoshiyuki. Maintenance of East Asian Paintings (Examination). *The Book and Paper Group Annual.* 1993,**12**, 32-35, p. 33.

Second stage deformation occurs with hanging scrolls when the scroll is left hanging for a long period. The weight caused by the lower roller results in rippled vertical deformation of the scroll, which unlike first-stage deformation, is irreversible. The above-mentioned types of deformation lead to the occurrence of creases and cracks when a scroll is rolled or unrolled. The greatest number of creases and cracks usually appears in the area of greater curvature near the roller.

The typical size of a handscroll differs from a hanging scroll. Handscrolls are much longer than hanging scrolls but smaller in width. To decrease the dimensions and increase the general flexibility of rolled scrolls, mounters use thin paper as a lining. This method does not prevent lateral vertical creases in the painting. Vertical creases and cracks appear mainly at the ends near the roller, where the curvature is much narrower. In many cases, handscrolls are not fully unrolled to the very end, and therefore the material in those areas has no chance to be fully straightened.

To view the painting or calligraphy on a handscroll, it should be unrolled from the right side first. Because the scroll is long, the portion unrolled on the right side should be rolled up again. While the left side of the rolled scroll is supported by the roller, the right side is susceptible to mechanical pressure caused by gripping too hard while unrolling, which results in longitudinal creases and cracks.

The pressure caused by tying the braid used to tie the rolled scroll too hard may also lead to vertical cracks in the area of the knot.[90] Unlike Japanese paper, Chinese paper has shorter fibres, and when vulnerable areas start creasing, all the forces are concentrated on these areas. This result in more severe creases and fibre breakage which progresses into serious cracks.[91]

Another factor which results in creases and cracks is ageing of the materials used to produce the scroll. This process leads to a scroll's further deterioration. The molecules of polysaccharides present in paper and silk fabrics lose their ability to cohere over time. Paper or silk fibres lose their flexibility and become stiff and brittle. The scroll thus becomes vulnerable to many factors, such as stretching, tearing and other

[90] KENZŌ, Toishi. The Scroll Painting. *Ars Orientalis*. Freer Gallery of Art, The Smithsonian Institution and Department of the History of Art, University of Michigan, 1979, **11**, 15-25, p. 20- 24.
[91] NISHIO, 1993, p. 33.

types of mechanical damage, and it loses its important function of being rolled and unrolled.[92]

3.2 Mechanical deterioration

Unlike hanging scrolls, the rod of a handscroll does not have sufficiently protruding end knobs to reduce the vulnerability of the scroll's edges to mechanical damage. As a result, the process of storage, handling and any other manipulation with the scroll may lead to ragged edges and shrinkage on the paper or silk support.

Creases and cracks and any ripples in the paper or silk support can also lead to scratches on the painted areas and the abrasion of pigments (*3.4 Flaking and paint loss*).

3.3 De-lamination

The structure of a scroll consists of several thin paper layers joined together with highly diluted starch paste, which gives the scroll flexibility and allows it to be rolled. If the layers are too thick, it may cause certain forces as a result of the curvature during rolling and encourage creasing and further delamination of the lining layer. Starch also loses its adhesive function over time. Excess humidity contributes to the separation and delamination of the paper support by swelling and loosening the stiffened paste and weakening its ability to adhere.[93]

3.4 Flaking and paint loss

Animal glue used as a binding agent for pigments in East Asian paintings degrades with time, consequently causing pigments to become stiff and less flexible, and as a result, the paint layer becomes chalky and brittle. Hence, when a scroll is rolled, the areas with pigment layers and silk or paper support experience different tension while bending. The support layer tends to curve more smoothly than the paint layer, resulting in flaking and paint loss.[94]

Pigments used in scroll paintings have a porous structure. The adhesive media does not fully cover and impregnate the pigment grains, making it susceptible to flaking and paint loss. Storage in a rolled position has both advantages and disadvantages. While

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[92] HUA, Hai -Yen. Important Factors in the Deterioration of Classical Chinese Scroll Paintings. *The Paper Museum Magazine.* Spring Issue.1996, 1-3, p. 1-3

[93] NISHIO, 1993, p. 33

[94] NISHIO, 1993, p. 34.

the scroll is rolled, pigments are protected because the pigment layer remains very close to the back side of the painting. However, rubbing against the layers of paper leads to abrasion of the pigments (Figure 89, 90). This happens mainly on sections which are raised above the remainder of the painting surface, such as areas with cracks and creases or the joints in the scroll lining paper.[95]

3.5 Distortion

The narrow side borders of scrolls tend to show greater shrinkage. This occurs because of the larger quantity of paste applied to these areas, which then shrink to a greater degree than the remainder of the scroll. This may lead to an overall distortion of the scroll. The upper and lower wooden rods have a tendency to warp if the wooden material has not been adequately aged. The structure of the wood should also be straight and even to avoid causing any problems in the future.[96]

3.6 Stains and discolouration

Stains and discolouration can affect both the painting and mounting structure. The materials used to create the scroll are prone to discolouration as they age and deteriorate.[97]

Exposure and storage in an inappropriate environment may affect the structure of the materials and result in colour changes and rippling in the scroll.[98]

Interaction with malachite and azurite pigments, which are commonly used in East Asian paintings, can affect the backing paper and primary support and lead to discolouration caused by the migration of cupric ions and corrosion. This occurs mainly when the paper or silk support is acidic.

Decorative paper applied to the back side of handscrolls often causes discolouration of the front side. For example, if the silver leaf used for decorative backing deteriorates, oxidation may affect the front side of the scroll and cause discolouration.[99]

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[95] KENZŌ, 1979, pp. 20-24.
[96] NISHIO, 1993, p. 34
[97] SMITH, 2011, p. 55.
[98] HUA, 1996, pp. 1-3.
[99] NISHIO, 1993, p. 35.

East Asian artworks tend to store better in a neutral to slightly acidic state. Therefore, the amount of alum (*myoban*) used in a sizing solution plays an important role in ageing the support materials. This also applies to the pigments used for painting, as they tend to discolour more quickly in an alkaline environment.[100]

3.7 Secondary interventions

Inappropriate secondary interventions are a type of damage which constitute amateur repairs using unsuitable adhesive types, polyvinyl acetate adhesives, and other materials.

Even professional restorers can adversely affect the art piece by using materials which do not suit the structure and character of the painting. This generally occurs because of poor knowledge of Asian art philosophy and its traditional conservation techniques and is the main reason for inappropriate repairs and handling. It is therefore important to regard East Asian paintings as complex objects and understand their purpose and functions.

3.8 Biological degradation

Due to their organic composition, East Asian paintings in certain scrolls are susceptible to biological deterioration, especially when stored or displayed in unsuitable environmental conditions. Insects such as book lice attack the materials of the scroll and cause damage with an irregular shape. These insects generally attack silk only to reach another material which is more attractive to them. As a result, all layers of the scroll are damaged, causing its overall deterioration.

Another major factor which may cause the deterioration of a scroll is mould or fungus. These biological agents appear rapidly in environments with poorly controlled temperatures and humidity and degrade the binders and organic materials and may also cause colour changes.

[100] GRANTHAM, Sandra. Some painting techniques and materials used in Japan and the Far East. *The Paper Conservator*. 2010, **30** (1), 11-24, [online], p. 14.

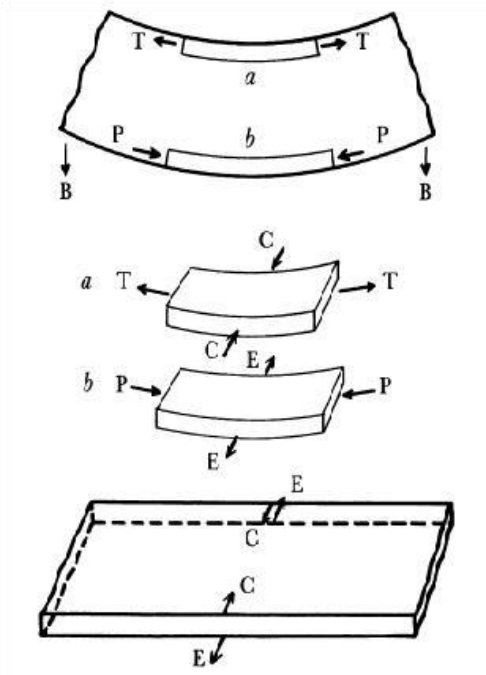

Figure 80. First stage deformation of the scroll. In: KENZŌ, 1979.

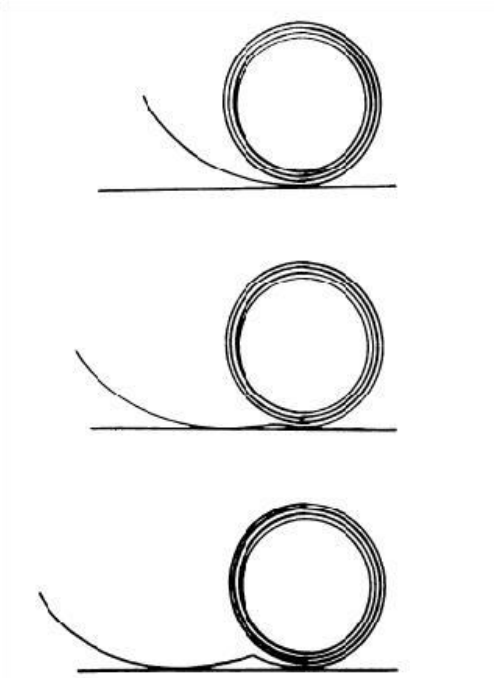

Figure 81. Possible occurance of cracking during unrolling as a result of long storage in a rolled position. In: KENZŌ, 1979.

Figure 82. Example of deterioration of a Chinese handscroll as a result of overly long storage in a rolled position and inapropriate handling,deformation,wavy undulatins, stains. Collection of Asian Art National Gallery Prague.

Figure 83. Example of deterioration of a Chinese handscroll as a result of overly long storage in a rolled position,deformation, ripples, creases and cracks. Collection of Asian Art National Gallery Prague.

Figure 84. Example of deterioration of a handscroll as a result of overly long storage in a rolled position, deformation, creases and cracks. Collection of Asian Art National Gallery Prague.

Figure 85. Example of deterioration, wavy undulations and creases. Collection of Asian Art National Gallery Prague.

Figure 86. Example of deterioration of a handscroll as a result of embrittlement of the materials used for mounting and the painting technique, losses of silk support. Collection of Asian Art National Gallery Prague.

Figure 87. Example of deterioration, vertical creases and cracks ocurring at the end section of a handscroll, in the area of curvature around the rod. Collection of Asian Art National Gallery Prague.

Figure 88. Example of deterioration, vertical creases, cracks and losses of silk support as a result of embrittlement of the materials. Collection of Asian Art National Gallery Prague.

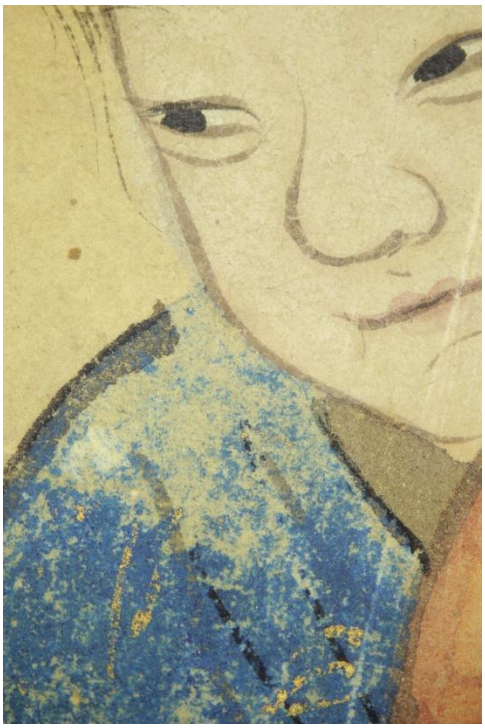

Figure 89. Example of deterioration, flaking and losses of the paint layer.

Figure 90. Example of deterioration, flaking and losses of the paint layer.

4 DISPLAY, STORAGE AND HANDLING

4.1 Environmental considerations

One of the differences between works of art from East Asia and elsewhere is that East Asian paintings were intended for temporary display. Over time, exposure may have undesirable effects on the paintings. Inappropriate environments and careless handling may damage the artworks. Optimized lighting, temperature and humidity in combination with clean air can therefore prolong the life of the painting.

4.1.1 Temperature and relative humidity

Elevated temperatures and dryness are common problems which East Asian paintings experience when displayed outside their traditional environments. High temperatures dry the materials and cause brittleness and future deterioration in the form of creasing, cracking, tearing and flaking. Excess moisture leads to waving and distortion caused by delamination of the lining layers. Organic materials such as silk, paper, starch paste and animal glue used in the creation of East Asian scrolls make them very susceptible to airborne pollutants, mould and pests.[101] Excess humidity in combination with high temperatures therefore encourages microbiological degradation of these paintings. The ideal conditions for East Asian works of art are a controlled temperature of 18 °C ± 1–2 °C and 50–55 % relative humidity. It is also important to prevent any fluctuations of these values.[102]

4.1.2 Light

Because East Asian paintings are very sensitive, light is another major factor which can cause their deterioration. Overexposure to light leads to fading and colour changes in the pigments and dyes used for the painting and mounting. Long-term display can result in silk and paper becoming stiff, fragile and losing flexibility. Intense white light is also damaging. The International Centre for the Study of the Preservation and Restoration of Cultural Property (ICCROM) standards recommend displaying Asian

[101] SHELLEY, Marjorie. East Asian Paintings on Silk and Paper: hanging scrolls, Handscrolls, Folding Screens, Storage Boxes, Albums, and Fans. In: *The Care and Handling of Art Objects:* Practices in The Metropolitan Museum of Art. New York: The Metropolitan Museum of Art, 2019, 112-122, p. 112

[102] HARE, 2006, p. 74.

paintings with a maximum illumination intensity of 50 lux and exposure time of 250 lux/hour per year.

4.2 Storage

As already mentioned, Japanese, Chinese and Korean scrolls are intended only for short-term display. It is more natural for them to remain in a rolled-up state than unrolled, an important consideration when dealing with East Asian scrolls. Wooden boxes with tight-fitting lids are traditionally used to store scrolls: low-resin paulownia wood is popular in Japan; hardwood boxes of various types or textile wrappers are common in China. Modern Chinese boxes are usually made of cloth-covered paperboard and are lined inside.[103]

One of the best and proper storage materials for scrolls are cases made of paulownia wood. The unique characteristics of paulownia wood make it a suitable material for protective cases and boxes for scrolls: it is very light, warp-resistant, fine-grained and contains a low percentage of resin. Its specific structure permits air circulation, and it also maintains a constant climate inside the case.

A box made of acid free cardboard is a more affordable alternative to a paulownia case. This option is used in museums and galleries and often for private collections. Acid-free materials protect the scrolls from destruction over time, thereby prolonging their life.

Once every year, the scroll should be removed from its storage case, unrolled and laid flat on a clean surface. Over a several days, some of the deformations caused by the period of being rolled up will reduce. According to Asian traditions, the most suitable time for this step is in spring or autumn since those periods have the most favourable climatic conditions.

To reduce the possibility of creases and cracks appearing, it is sometimes preferable to make a roller. The lower rod/larger rod is placed into a recess cut into the roller and the scroll is then wrapped around the roller. The roller enlarges the diameter of the rolled scroll, allowing safer storage of the scroll.[104]

[103] SHELLEY, 2019, p. 118.
[104] KOPSOVÁ, 2011, p. 39.

Figure 91. Wooden box made of paulownia wood for storage of Asian scrolls.

Figure 92. *Futomaki* roller made to reduce the possibility of creases and cracks appearing.

Figure 93. Storage box made of acid free cardboard.

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4.3 Displaying scrolls for exhibition

Long-term display may lead to deformation of the scroll. One month of display followed by eleven months of storage is also acceptable. At the Freer and Sackler Gallery, scrolls are kept on display for six months and then stored in a rolled-up state for one and a half years. This rotation cycle may also be altered to alternative of three months of display and several months in storage.[105] Regular rewinding of the displayed sections of the painting allows longer periods of display.

In case of private collections, scrolls should not be displayed for more than two weeks, twice a year. One month of display followed by eleven months of storage is also acceptable. The selection of the correct placement of the scrolls is also important. Paintings should not be placed near fire sources or air vents, on external walls or in direct sunlight. Kitchen and bathroom areas or areas of high traffic are not suitable for the display of Asian scrolls and may accelerate their deterioration.

Handscrolls are intended for viewing in brief, continuous moments while being held with both hands on a table. Today, however, the purpose and conditions for displaying for handscrolls have changed. In some museums and galleries, scrolls are usually unrolled over several meters to fit the length of a display case and left unrolled and exposed for several months. The safest way to display an unrolled hand scroll is on a flat surface. To make it easier to view the scrolls, they are often displayed at an angle of less than 35° to prevent it from slipping or falling. Folded Melinex strips or film are commonly used to fix the scroll to an angled board and support it without causing any conspicuous changes. Melinex strips are applied to the scroll approximately every 30 cm along its edges. Both rolled ends should be supported with linen tape tie-downs and end supports at the bottom. To prevent the scroll from rolling up, weights can be placed near the rolled ends. Another way to secure the scroll is transparent strips of plexiglass placed over the scroll and fixed to the supporting board with screws. Magnets are also a very popular alternative method of securing the displayed scroll. However, it is important to consider that any contact with the painting can cause damage, and it is therefore important not to place weights on any painted surface area.[106]

[105] HARE, 2006, p. 76.
[106] Ibidem.

4.4 Handling handscrolls

A clean environment and clean hands are sufficient for handling handscrolls or any other artwork. Hands should be thoroughly washed before they touch the scroll to ensure no stains or impurities remain on it. Another important factor is a suitable flat, clean area which has enough space to fully support the scroll. To prevent the scroll from falling off the edge of the table, placing weights to form a barrier at each end is recommended.

To remove a handscroll from its storage box, the box should be carefully tipped, and the scroll allowed to roll into the palm of the hand or the table. The scroll can then be unwrapped if any protective paper has been used. The scroll is now ready to be unrolled and viewed. The first section of the scroll is unrolled from right to left. Small textile bag weights are placed on the edges to hold it in place. It is important to remember that the weight should not be placed on the decorative parts of the scroll.

The chords and clasps should be secured with tissue paper before rolling the end section of the scroll to prevent any scratches or other damage.

To view each section, the right side of the scroll should be gradually rolled to meet the left. The scroll should then be moved to the right side of the table. It is important to lift the scroll, not drag it, to prevent any mechanical damage. The scroll should continue to be unrolled in this manner until the end is reached.

When the viewing is finished, the scroll should be returned to its original state and position using this same procedure.[107]

[107] Guide to Handling East Asian Handscrolls. Princeton University Library Preservation Office. Images courtesy of the Freer and Sacker Gallery. Available at: https://www.youtube.com/watch?v=enCWYmbj8Ew

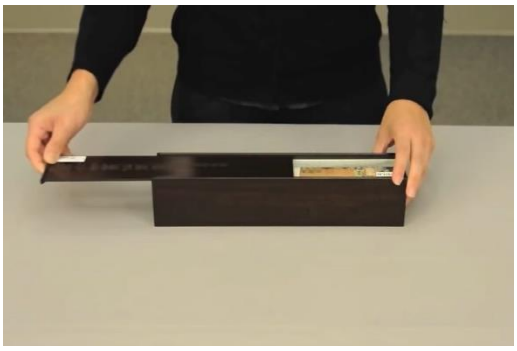

Figure 94. Removing a handscroll from its storage box

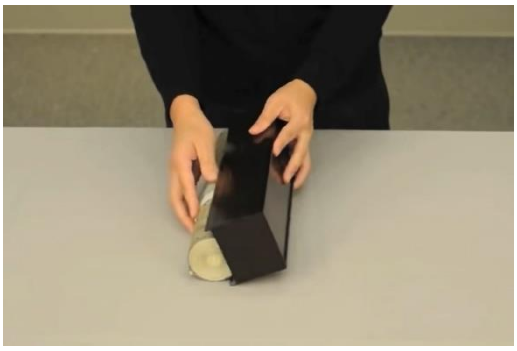

Figure 95. Removing a handscroll from its storage box

Figure 96. Unrolling the first section of the scroll.

Figure 97. Securing the chords and clasps with tissue paper.

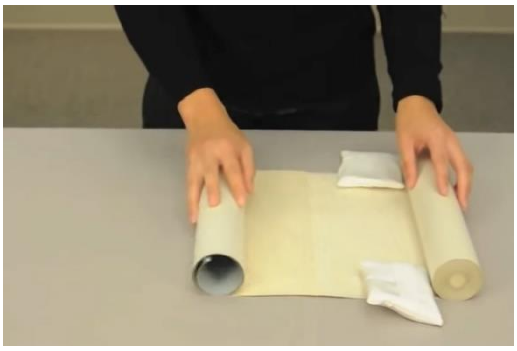

Figure 98. Viewing each section of the scroll.

Figure 99. Viewing each section of the scroll.

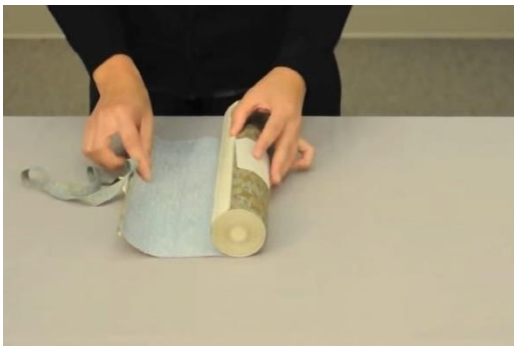

Figure 100. Returning the scroll to its original position after viewing using the same procedure.

Figure 101. Returning the scroll to its original position after viewing using the same procedure.

Images courtesy of the Freer and Sacker Gallery. Available at: https://www.youtube.com/watch?v=enCWYmbj8Ew

5 CONSERVATION TREATMENT METHODS

5.1 Cleaning

When in contact with air, paper and silk are naturally exposed to small amounts of static electricity, which attracts dust deposits and other types of pollution that adhere to the surface of the materials.[108] There are two options to remove dirt which has accumulated on the material over a long time: dry cleaning and wet cleaning. The decision whether to undertake the cleaning process in general must be carefully considered according to the condition of the material and various tests.

Dry cleaning

Dry cleaning is a mechanical surface cleaning technique used to reduce superficial soil, dust and other surface deposits. This type of cleaning may be used as an independent technique if the art piece cannot be subjected to any treatment with the addition of water or as the first step of a more comprehensive cleaning after which wet cleaning techniques may follow. The purpose of dry cleaning is to reduce the potential of degradation to the paper and silk materials by removing the source of the problem, i.e., acidic, hygroscopic, or degradative products of soiling.

Another reason for removing the dirt from the surface of an art object is aesthetic purposes, for example, when the dirt accumulated on the painting interferes with the visible display of the art piece and renders it unclear or unreadable.[109]

Various brushes, rubber erasers, sponges and eraser powders can be used in the process of dry surface cleaning. The first step of dry cleaning involves the careful removal of solidified deposits, such as lumps of dust or insect excrement, with a scalpel. The surface can then be cleaned with soft brushes to remove layers of dust and other dirt. Smoke sponges are frequently used for the removal of soot or other pollution products, but their structure is not as soft as PU sponges. Soft PU sponges are especially effective for cleaning subtle and fine materials such as silk and paper. Due to their softness, PU sponges allow the surface of a silk or paper support to be cleaned without

[108] AIC Wiki. *BPG Surface Cleaning* [online] [last access 15.04.2021]. Available at: https://www.conservation-wiki.com/wiki/BPG_Surface_Cleaning

[109] Ibidem.

the destruction of their fibre structure and are friendly to the paint layer. Another option suitable for cleaning some Asian paintings and scrolls is the application of eraser powder on the dirty surface of a painting. Dust and dirt deposits can be removed by scattering finely milled eraser powder and spreading it gently with a brush. After the powder absorbs the dirt, it can be removed using a brush, or if the material allows, a vacuum device with reduced suction power.[110] In some cases, a rubber eraser can be used to provide more intense cleaning, but it should be used very carefully not to overclean the surface or leave a "halo" effect. The tools for dry cleaning Japanese paper should be selected very thoughtfully to avoid the release of long paper fibres.

Wet cleaning

If the painting medium is sufficiently stable to allow contact with water, a wet cleaning process can be performed. The traditional Japanese method of wet cleaning, which is used for sensitive cleaning of paintings on paper and silk, is the most sparing and controllable.

During this process, the painting is placed onto several layers of thin, dry blotting paper and gradually sprayed with deionized water from the front side. Spraying should be repeated several times.[111] This allows the attached dirt to dissolve into the water and be absorbed into the blotting paper. This process should be undertaken very carefully, as too much water applied to the surface of the painting may damage the texture of the materials. Blotting papers can be also placed on top of the front side of the painting (only if the condition of the art piece allows and if the paint layer is stable) to let the dirt be absorbed from the front. This step should be controlled thoroughly.

Before wet cleaning, the painting can be placed under a sandwich composed of hydrophile membrane with wet blotting paper on top, covered with polyester foil to maintain the humidity inside the arrangement. This process allows gradual humidification of the painting and aids in avoiding the stress caused by vigorous spraying.

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[110] HUA-STRÖFER, Hai-Yen. *Buddha's Brush, Buddha's Paste. Rebirth of a Taima-Mandala.* Hai Yen Institute for Conservation of Works of Art; 1st edition, Mannheim, Germany, October 31, 2011, p. 35.

[111] SUGIYAMA, Keisuke; CLARK, Tim, AMBERS; Janet and VERRI, Giovanni. The study and conservation of the silk painting Death of the Buddha. *The British Museum Technical Research Bulletin*. 2014, **8**, 39-57, p. 45.

Figure 102. Materials used for dry cleaning: a), b) brushes with soft hair; c) antistatic brush; d) cleaning sponge Cleanmaster; e) soft PU sponges.

Figure 103. Dry cleaning of a painting on paper support using soft PU sponges.

Figure 104. Dry cleaning of a painting on silk support using soft PU sponges.

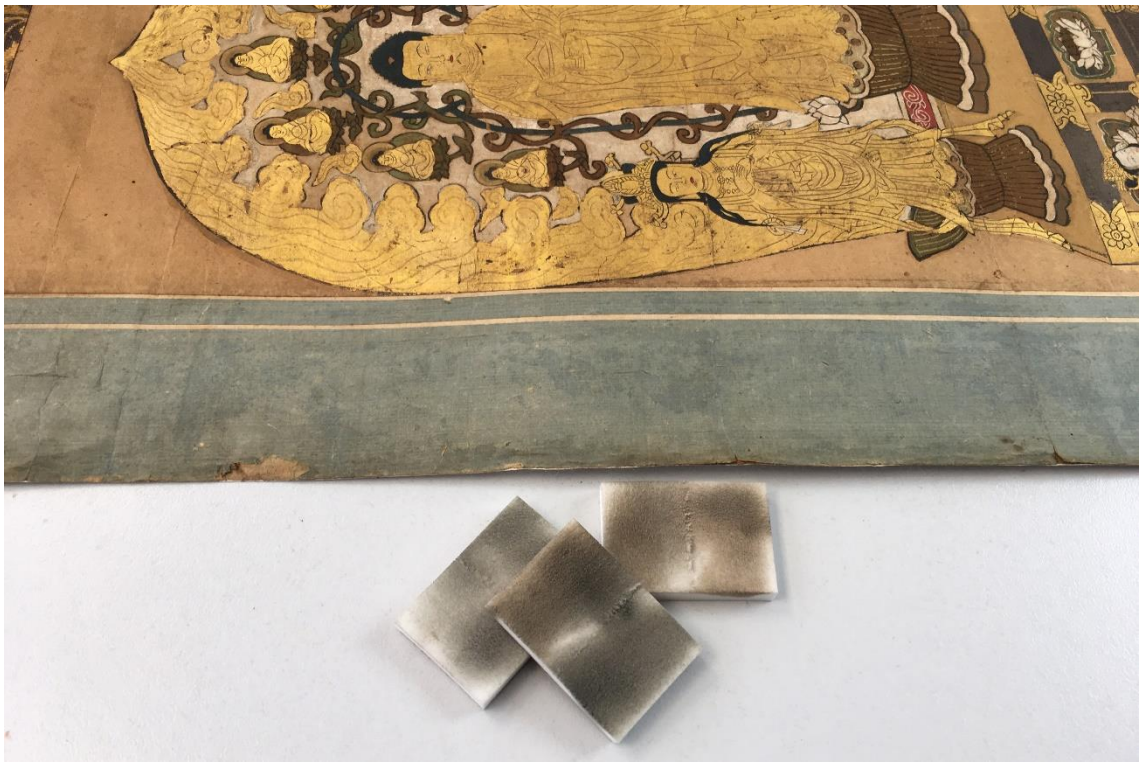

Figure 105. Dry cleaning of a Japanese scroll using soft PU sponges.

Figure 106. Wet cleaning of the Japanese scroll using wet blotting papers.

Figure 107. Blotting papers after wet cleaning, with dirt absorbed from the scroll.

5.2 Consolidation and reinforcement of the structure

Pigment binders tend to lose their adhesive strength over time. They lose elasticity and become dry, causing the pigments to flake. To ensure adhesion of the pigments to the silk or paper support during conservation treatment, the paint layer should first be consolidated.

Animal glue *nikawa* is traditionally used not only as a binder for pigments applied in Japanese painting techniques but also as a consolidation agent in the conservation of Asian paintings on textile or paper supports. Unlike *funori*, *nikawa* has greater adhesive strength. An aqueous animal glue solution is applied locally with a small brush to vulnerable areas of pigments on the surface of the painting. To allow better penetration of the *nikawa* solution, the areas with pigments can first be treated with ethanol. The process of consolidation may be repeated several times, depending on the concentration of the solution and the desired result. In the case of severe flaking, consolidation of the paint layer using a nikawa aqueous solution can be applied in combination with heat from a heating spatula.

Funori is applicable to most consolidation treatments which require a low-strength material.[112] It was traditionally used in Japan as a sizing agent for textiles and papers and is still produced today. *Funori* can compete with many other traditional and synthetic consolidants since it is non-toxic and easy to use.[113] An aqueous solution of *funori* can be applied to the painting surface with a soft brush. Another method of application is the use of a steam generator, which applies the fixing solution in a vaporous state to reinforce the fragile silk fibres gently and gradually.

[112] SWIDER, SMITH, 2005, p. 122.
[113] Ibidem, p. 117.

Figure 108. Consolidation of the paint layer using *nikawa* aquous solution.

Figure 109. Consolidation of the paint layer using nikawa and heated with heating spatula.

Figure 110. Gradual fixation of fragile silk fibres using *funori* aqueous solution in a vaporous state.

Figure 111. Gradual fixation of fragile fibres of silk borders using *funori* aqueous solution in a vaporous state.

5.3 Facing

Facing has two general purposes: to protect and to consolidate.[114] To remove an old lining or apply a new one, the painting support must first be stable and ensure no further damage with additional conservation treatment. Simply attempting to remove the lining may result in damage to a brittle silk support. It is therefore important to fix the front side of the painting with a temporary facing.

As a first step, the painting should be placed on Hostaphan foil and then humidified by spraying with water. The rayon paper is brushed to the surface of the painting using a *funori* solution. Various versions of rayon paper which differ in thickness are available: 12 g/m², 18 g/m², 20 g/m², 60 g/m², 70 g/m². The application of a facing with rayon paper is very individual and depends on each particular case, therefore the number of rayon paper layers can vary from 2 to 5, depending on the painting's condition. Each layer can be brushed onto the painting, or the first layer can be applied directly with the remainder being pre-adhered to each other on a mounting table before application.[115] The first layer consists of small rectangles of rayon paper, while the others may be applied in a single piece which covers the entire length of the scroll. This will depend on the type of painting, its composition and condition. However, it is important to place the layers in different directions to provide greater stability for the painting during wet conservation treatments.

If the scroll consists of two different materials, for example, a painting on paper with silk borders, the components may react differently to moisture applied during the process of facing. Paper becomes saturated with moisture more quickly than silk, which can lead to the formation of ripples. However, this can be prevented by applying a rayon paper facing to the paper and silk components separately. The two pieces of rayon paper should be prepared, the first cut according to the exact format of the painting for the paper support, and the other according to the size of the entire scroll and silk boards, with 3 cm of overlap on each side. The smaller piece of rayon paper is applied first to the surface of the painting using *funori*. The bigger piece is then applied over the top of the first layer of facing. The rayon paper layers are applied so that their fibres run perpendicularly.

[115] SUGIYAMA, CLARK, AMBERS; VERRI, 2014, p. 47.

and aqueous solutions of *funori* are currently the most popular materials used for temporary facing. Other materials such as Japanese paper, Chinese paper or oil paper are also used for this purpose. An example of the use of alternative materials for facing is restoration of the Japanese painting "*Taima-Mandala of Buddha Amitabha's Pure Land*" conducted by Hai-Yen Hua-Ströfer, who applied warm, liquid silk glue and sheets of oil paper as a facing.

Powdered silk glue is made from a liquid sericin solution produced by cooking silkworm cocoons in alkaline conditions. Crystalized silk glue is made from a dried sericin solution. When dissolved in water, sericin powder creates a homogeneous liquid known as silk glue. Its characteristic is chemical affinity with silk fibres, making the silk glue very suitable for silk conservation treatments. The application of silk glue as a sizing agent can help reinforce the fabric's structure. The process of application of the silk glue is highly reversible since the silk glue is water-soluble. In addition, it does not leave any traces on the silk surface. This type of glue is prone to degradation and a decrease in its adhesive strength by UV radiation.[116] It is also very expensive and therefore prohibitive for general conservation use.

According to Hai-Yen Hua-Ströfer, special handmade oil paper is the only suitable material for the facing of old and brittle paintings on silk supports. It is made of sheets of thin, handmade Japanese paper with long fibres. The paper is coated with a wood oil produced from the seeds of the tung tree and then left to dry in air away from direct sunlight.

The oil paper should be thin, have a high adhesive ability and be easy to detach. It should be able to release moisture but must never bleed onto the painting. The two papers are easily separated with minimal humidification, which allows it to be reused several times.[117]

[116] HUA-STRÖFER, 2011, p. 47
[117] Ibidem, p. 49

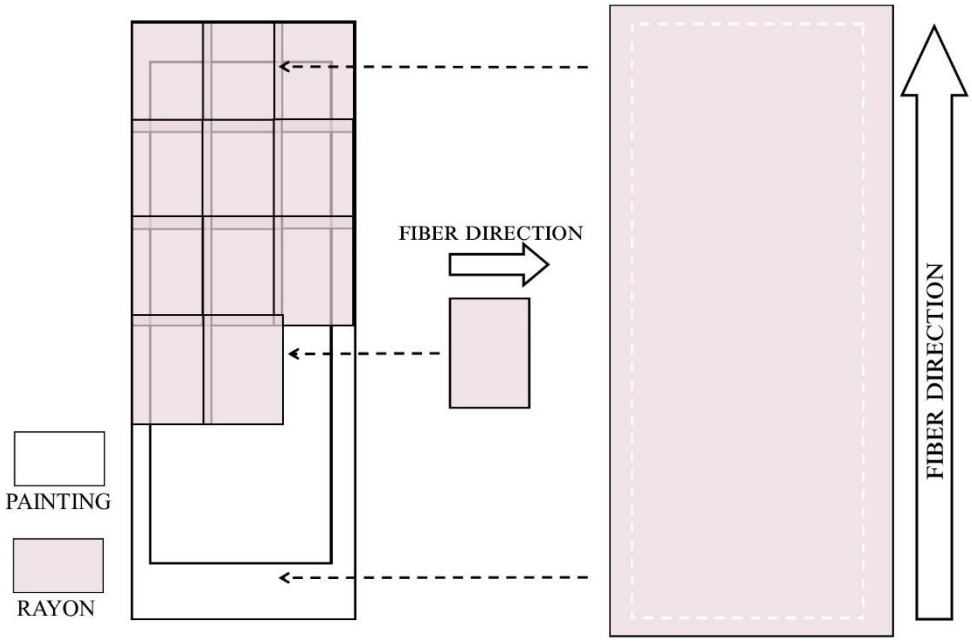

Figure 112. Facing using rayon paper, several layers of rayon paper.

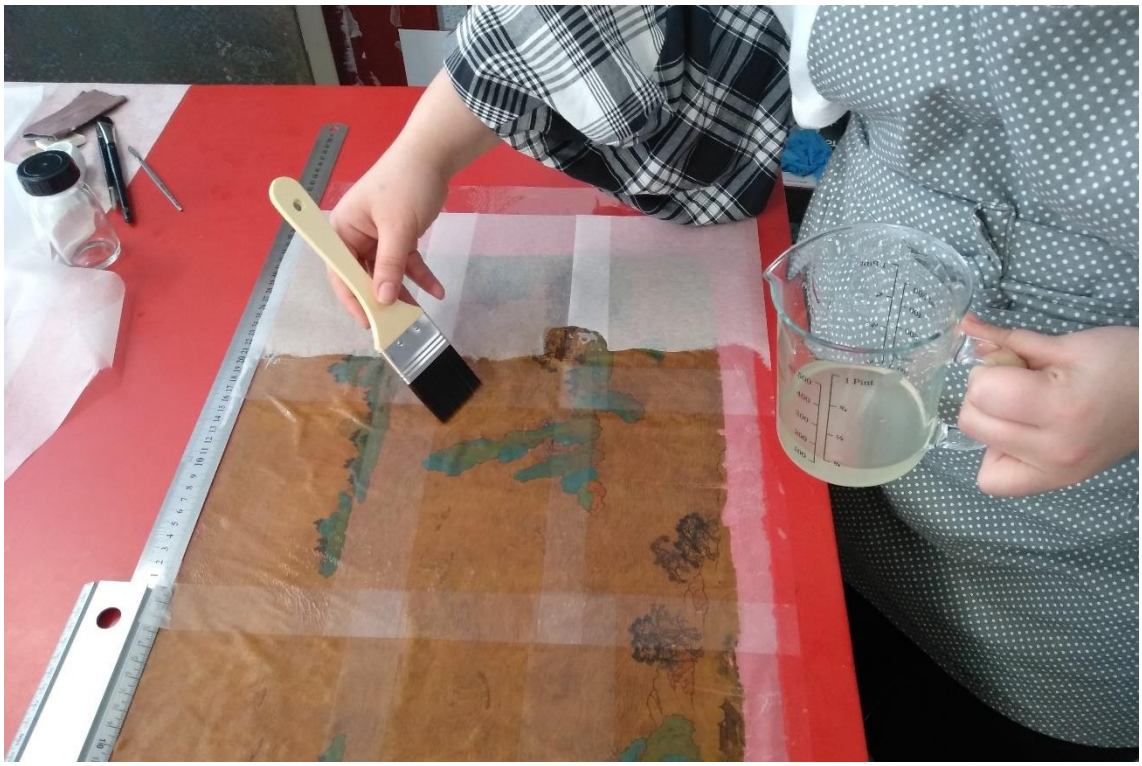

Figure 113. Facing using rayon paper, application of the first facing layer.

Figure 114. Facing using rayon paper, application of the second facing layer.

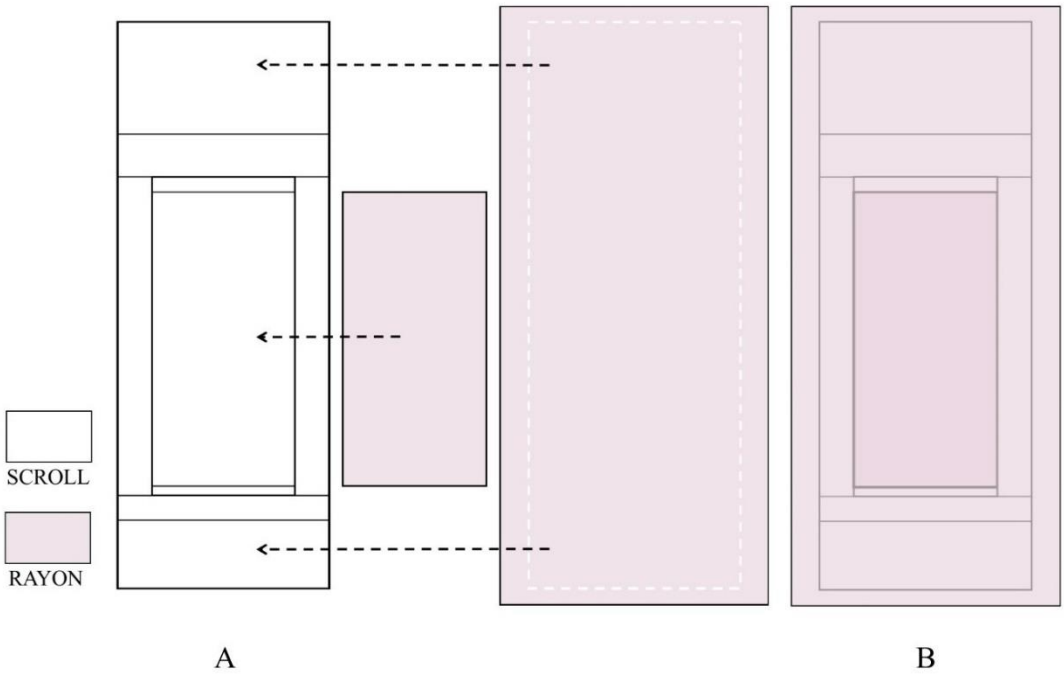

Figure 115. Facing using rayon paper, application of two layers on different parts of the scroll.

Figure 116. Facing using rayon paper, application of the first rayon paper layer on the painted part of the scroll.

Figure 117. Facing using rayon paper, application of the second rayon paper layer to the entire scroll.

5.4 Reinforcement strips

Creases are a very common type of deterioration mainly encountered on older scrolls. Older creases may result in cracks, especially when the scroll is rolled. To prevent this type of deterioration, narrow paper reinforcement strips (*tiaozi* in Chinese, *oribuse* in Japanese) are traditionally used. The reinforcement strips are applied to vulnerable areas of the scroll using a very thin layer of wheat starch paste.[118]

Creases and other defects should first be marked with a faint pencil over a light table. All the creases and cracks should be raced and marked precisely so that reinforcement strips are placed exactly over the centres of the damaged areas. Defects should be marked a second time under raking light. Raking light may reveal some damage which is not visible in daylight or transmitted light. *Tiaozi* strips are cut into 3– 5 mm wide strips from a sheet of *xuan* paper, while *oribuse* strips are usually narrower and cut into 1.8–3 mm strips from *kozo* paper. The width of the strips depends on the type of crease. The direction of the fibres should be parallel to the direction of fibres in the lining paper to prevent any tension caused by the strips. In most cases, *tiaozi* strips are adhered to the first lining (in some cases, they can be applied to the burnished verso area of the scroll as a repair), while *oribuse* strips are usually applied to the second lining.[119]

A good result from the application of reinforcement strips depends on the correct choice of materials and method of execution. The weight of the paper used as reinforcement strips and the concentration of the wheat starch are also factors in this process.[120] If the paper and wheat starch paste are too thick, it will cause the appearance of a new creases and later cracks on the painting. If the paste and paper are too thin, they cannot provide sufficient fixation and protection for the scroll support and may begin to peel from the lining. The right choice of these materials requires suitable experience in scroll mounting and conservation.

[118] SUGIYAMA, CLARK, AMBERS; VERRI, 2014, p. 47
[119] CATCHER, CHANG, ZHU, 2017, pp. 54, 62.
[120] Ibidem, p. 61.

Figure 118. Preparation of reinforcement strips *tiaozi*, cutting process.

Figure 119. Application of reinforcement strips on the back side of the scroll.

5.5 Filling in losses in the silk support

As a result of ageing, the materials and silk support become less flexible and more fragile. The appearance of losses in the silk is therefore a very common type of deterioration. These holes should be filled in with a repair silk of similar quality and appearance so that the repaired areas do not obviously stand out after the conservation treatment. Finding the appropriate type of silk in a European environment might be a very challenging task, hence some conservation studios which deal with Asian art use Japanese or Chinese paper to fill losses in silk. The paper should have the same thickness as the silk support, or several layers can be applied to achieve the same plane. The paper then can be toned to the required colour corresponding to the silk.

To commence the repair process, a plain weave silk with a weave similar to that of the original silk should be selected. Because a silk selected for repairs will undoubtedly have different characteristics from the original, older silk, it should be aged before application to the original support. It is important to match the infill material to the original more closely according to mechanical properties.

The Chinese method of artificial ageing involves soaking silk fabric in a 0.1 M solution of potassium permanganate for a controlled period according to the level of desired deterioration and the type of silk.[121] The Japanese method uses electron beam irradiation to deteriorate silks. The dose of radiation can be precisely regulated, enabling control of the extent of deterioration to the modern silk used for infilling.

This step not only contributes to the visual appearance of the treated object, it also makes the artificially aged silk closely resemble the original in strength, therefore avoiding further damage from physical stress.[122]

The infill silk can be dyed with alder cone dye (*yasha*) containing potassium carbonate as a mordant to match the original silk and thereby require less inpainting. The prepared silk is then temporary lined with *kozo* paper using *funori* and left to dry and straighten on a drying board.[123] The patches should be carefully cut to shape the loss to prevent any overlap in the two materials. The silk infills are then set into the losses

[121] DANIELS, HACKE, QIU; MARABINI, 2013, p. 41-51.
[122] HANDA, Masaki. Methods of controlled deterioration for preparation of silks used to conserve East Asian silk painting and writing. *Studies in Conservation*. 2014, **59** (:1), S225–S226.
[123] SUGIYAMA, CLARK, AMBERS; VERRI, 2014, p. 46.

and pasted to the lining paper with wheat starch from the front side of the painting. The temporary paper facing is removed from the silk infills once they are completely dry. The missing sections of original silk can instead be filled from the back side if the painting has a front facing.[124] It is important not let any materials overlap, as this can lead to a further deterioration of the scroll during rolling.

[124] Museum Volkenkunde. *BLOG POST 008: RESTORATION UPDATE APRIL 2020 – Part 1 of 2.* [online] [last access 09.05.2021]. Available at: https://www.metmuseum.org/toah/hd/clpg/hd_clpg.htm

Figure 120. Losses in the silk support, transmitted light photography.

Figure 121. Filling in the losses in the silk support, cutting out the silk infillings.

Figure 122. Filling in the losses in the silk support, silk support before application of silk infills.

Figure 123. Filling in the losses in the silk support, silk support after application of silk infills.

5.6 Flattening

Drying boards are used in Asian mounting workshops and conservation studios as tools for stretching and drying scrolls and paintings on paper or silk supports. This method of flattening under tension is also popular in Western paper conservation studios.[125] The tension produced while drying allows the scroll to be straightened without developing any wrinkles. [126]

Drying boards or walls are generally constructed from a wooden lattice frame covered with several layers of paper. These boards are common tools in Chinese, Japanese and Korean studios, however some differences in construction and materials exist (see *6.9 Drying panels*). Japanese *karibari* boards have a special coating of *kakishibu* juice from unripe fermented kaki fruit to facilitate removal of the object from the board. The coating used on Chinese panels is an aqueous animal glue solution. The structure of a *karibari* board allows air flow from both sides of the board, providing gradual drying of an object from both sides.[127]

An original *karibari* board is not always available in Western conditions, therefore some Western conservation studios use alternative drying panels with similar effect: for example, a painting canvas fixed to wooden stretchers and covered with several layers of paper or a wooden board. Another option is hexagonal core cardboard panels or Gatorboard™ with a final coating of weak PVA solution as an alternative to *kakishibu* or animal glue.[128] However, these alternatives cannot fully replace the unique properties of a *karibari* board, only partially provide the necessary function.

The paper used as auxiliary borders must always be lighter in weight and strength than the original painting. In this case, the auxiliary borders will tear instead of the original painting if shrinkage during the drying process is too intense.

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[125] WEBBER, Pauline. The use of Asian paper conservation techniques in Western collections. *Adapt & Evolve 2015: East Asian Materials and Techniques in Western Conservation. Proceedings from the International Conference of the Icon Book & Paper Group, London 8–10 April 2015*, p. 18.

[126] BARTYZALOVÁ, Barbora. *Karibari technique of flattening East Asian scrolls. Conservators and Historians. Confernce,* Jihlava 2019, conference talk.

[127] WATKINS, Stefanie. Practical Considerations for Humidifying and Flattening Paper. *The Book and Paper Group Annual.* 2002, **21**.,61 - 76, p. 70.

[128] WEBBER, 2015, p. 19.

Important factors

The paper direction of the auxiliary borders must match the direction of production of the original paper.

The original work should not be too wet or dry, especially if a wooden board is used to straighten it. If any uncertainties arise, it is better to allow the work to dry freely or under a light weight and let the materials adhere together before moistening it again (in a chamber, using a sprayer or a vapour-permeable membrane) and only then attaching it to the board.

If the work dries too quickly, for example because of low humidity, it is possible to slow down the process by covering it with Hollytex or thin Melinex. It is important that the entire process be well controlled.

The board used for the *karibari* technique should be sufficiently porous to allow good adherence of the edges to the board's surface with a starch paste. Smooth or laminated surfaces do not work.

The edges should be glued firmly. Any peeling at any point will deform this area of the painting. The glued edges must be dry before the painting dries and shrinks; it is therefore very important to apply the starch paste evenly and in its optimal consistency.

The tension while attaching the painting to the board should be even, therefore the edges should be smoothed in a crosswise direction, always at opposite points. During the process of smoothing and attaching the painting to the board, only the edges with auxiliary borders should be touched with the brush, never the original painting or borders.

A narrow strip of paper should be inserted under the right side in the lower corner. At this point, some air should be blown below the work to prevent it from adhering fully to the board. The strip will allow easy peeling of the dried and straightened painting from the board with a bamboo spatula.

The painting should be left on the board for a sufficiently long period (from three weeks for small objects to several months for more complicated works). The longer the painting is left to straighten on the board, the less deformations or ripples caused by temperature and humidity changes will occur in the future. It is important to allow climatic fluctuations of relative humidity and temperature during the process of

flattening. If the artwork is flattened only under stable conditions in an air-conditioned studio without any climatic changes, the appropriate flattening effect from the *karibari* method cannot be accomplished.[129]

If the painting requires a lining, its overlapping edges can later be used to attach it to the drying board. The thickness of the paper is of no concern, as it is naturally maintained with this method of flattening. Once the entire surface of the painting is humidified, an even layer of starch paste is applied to the edges of the lining paper, and the painting is smoothed on the drying board and left to dry.

If the painting requires no lining but needs to be straightened on a drying board, additional strips of paper of suitable weight and structure can be applied to the back side of the painting around its perimeter using wheat starch paste. The edges of the strips should be water cut to produce long strands which are later stretched even more using starch paste and then applied to the back side of the painting.

If the art piece is in a very brittle state, the additional strips can first be creased before application to the original. The excess material provides a reserve of material for dimensional changes. All joints treated with starch paste must be perfectly dry before the entire surface is moistened and attached to the board. This method is suitable for all artworks, including large formats.

[129] KATO, Masato and KIMISHIMA, Takayuki. Karibari: The Japanese drying technique. *Adapt & Evolve 2015: East Asian Materials and Techniques in Western Conservation. Proceedings from the International Conference of the Icon Book & Paper Group, London 8–10 April, 2015*.London: The Institute of Conservation, 2017, 91-98, p. 95.

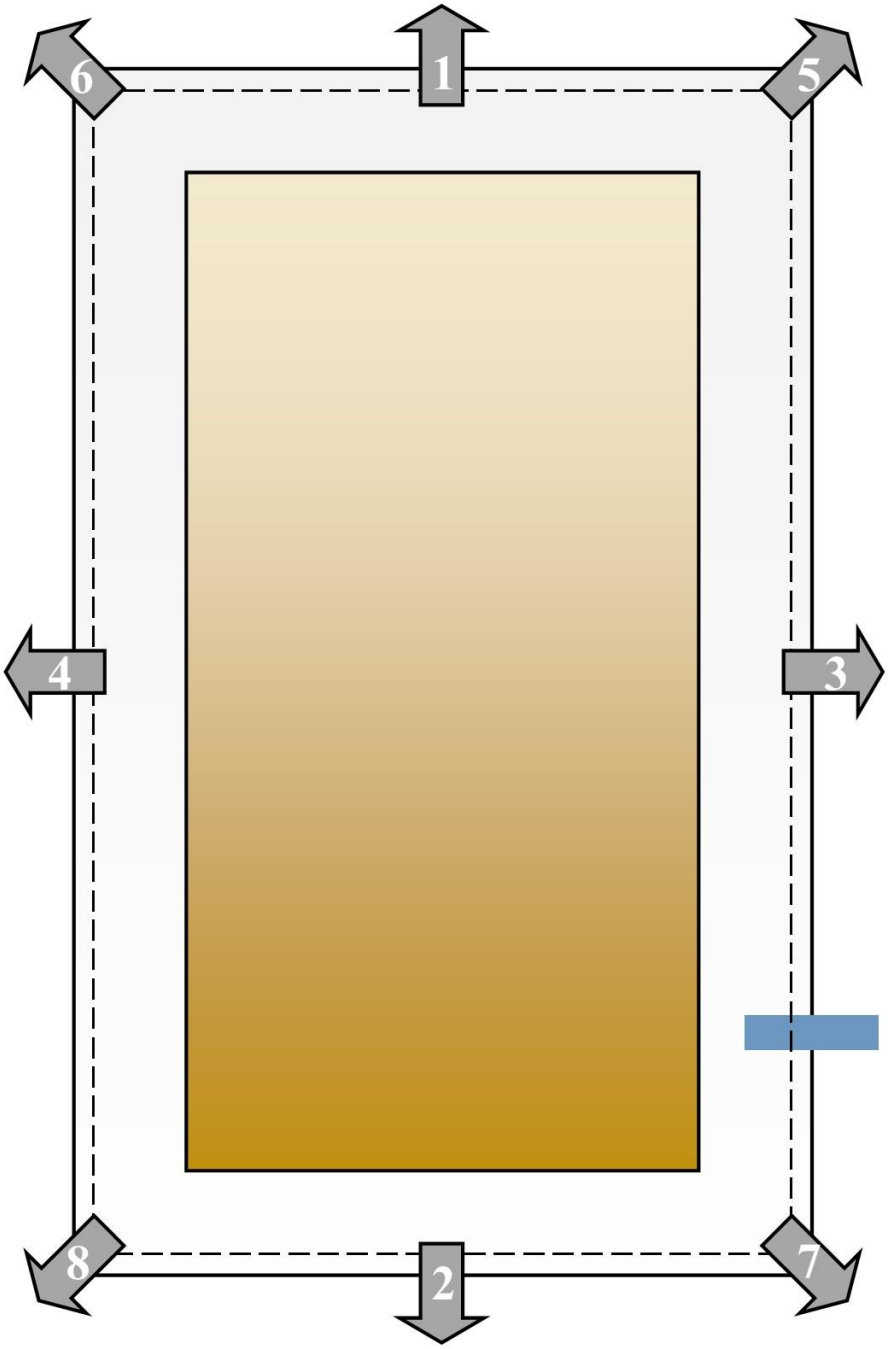

Figure 124. Scheme of smoothing the glued edges towards the board with the brush in crosswise directions, always at opposite points.

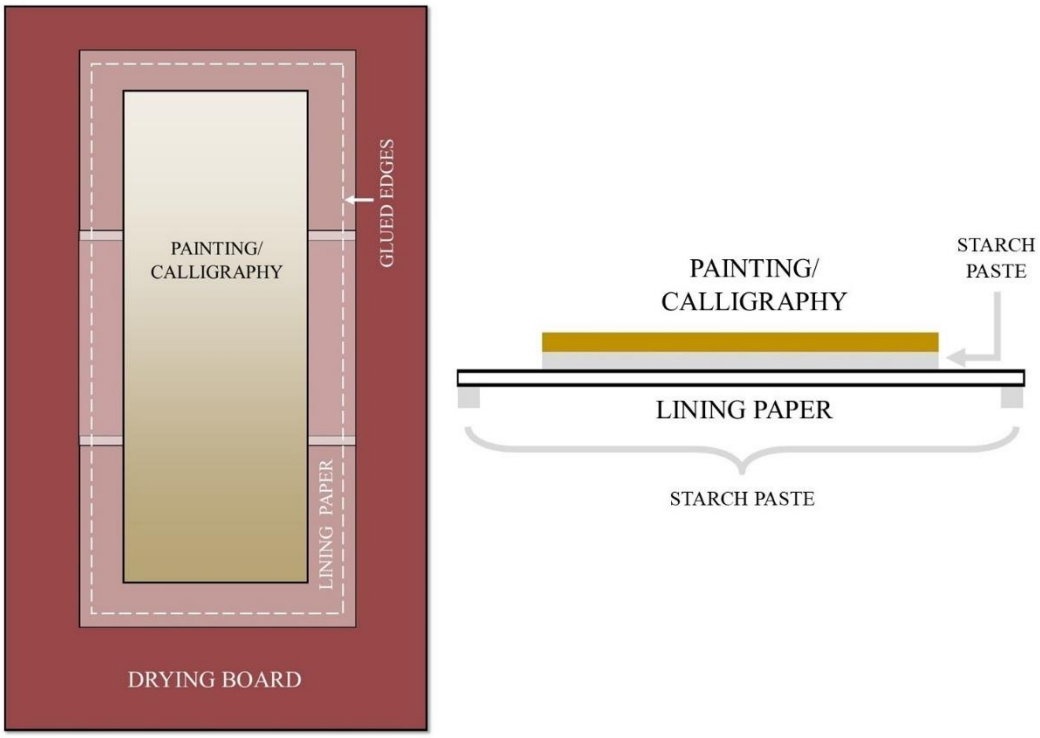

Figure 125. Scheme of application of an object to the drying board using the edges of the lining paper.

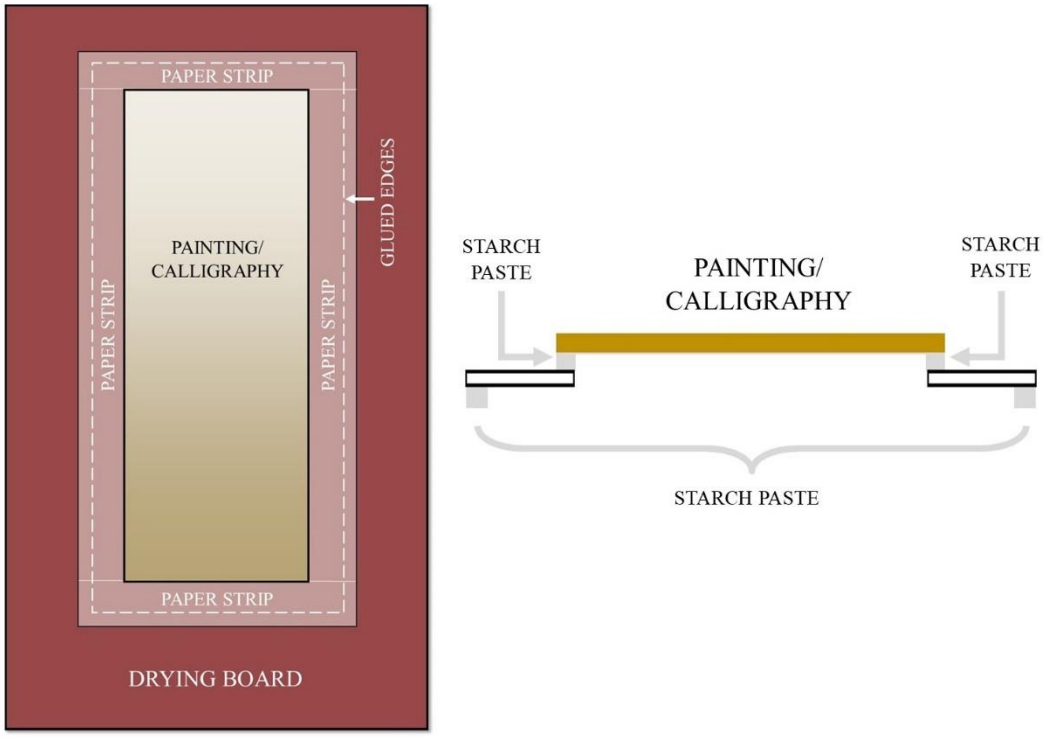

Figure 126. Scheme of application of an object to the drying board using paper strips.

Figure 127. The painting prepared for flattening using creased additional strips.

5.7 Toning paper

The tradition of toning paper comes from seventh century China. During the Tang dynasty, hemp was the main ingredient used to produce paper. Two types of paper were produced, one white and the other yellow. Yellow paper was dyed with *huang bo* juice extracted from the bark of the Amur cork tree (*Phellodendron amurense*). This dye is believed to have insecticidal properties which protect paper. It was therefore used for important documents and precious paintings. Today, the extract from Amur cork trees can be used to tone Chinese paper and confer it with a slightly aged appearance.[130]

5.7.1 Traditional East Asian colourants

Natural dyes have two types: additive and substantive. Substantive dyes can bond to fibres without any chemical intervention, while additive dyes are fugitive and require metallic salts (mordant) to improve their fastness.[131] The shade of a natural dyes is often dependent on the pH of the environment. Natural dyes are still popular in Asian mounting and conservation studios and are often used to dye lining papers and silk supports. Japanese methods of production and dye technologies are based on Chinese tradition and practice.

Yellow and brown colours

Yellow ochre. *Tu huang* (Chinese*) / Odo* (Japanese) - hydrated ferric oxide HFeO, (mineral goethite) mixed with clay. All ochres are very stable colours; they present a variety of yellows from light to dark ochre depending on the local ingredients.

Orpiment (yellow) and realgar (orange*). Ci huang* or *shi huang* (Chinese) */ shio* or *sekio* (Japanese) – orpiment As_2S_3*. Xiong huang* (Chinese) */ you* (Japanese) – *realgar* As_2S_4. Orpiment and realgar were known in China by at least the second century B.C.E. and as early as fourth century B.C.E. in Japan.[132]

[130] MULLOCK, 1995, p. 24.
[131] SOLEYMANI, Somayeh. *The Effects of Plant Dyes, Watercolours and Acrylic Paints on the Physical, Chemical and Biological Stability of Japanese Tissue Paper Used in Paper Conservation.* Final thesis, University of Canberra, Australian Capital Territory, Australia, February 2015, p. 15.
[132] WINTER, 2008, p.23.

To-o or *Shio* (*gambogi*), also knowns as 'female yellow'"female yellow" in Japan, is a yellow resin from the Garcinia tree. Its place of origin is Cambodia. It provides a clear, bright yellow colour.[133]

Huangbo or *Huangbai* (Chinese) / *Kihada* (Japanese) is a yellow dye extracted from the bark of *Phellodendron amurense* (Amur cork tree) It has been used in Japan to dye paper since the eighth century. The bark contains the alkaloid berberine. The bright yellow colour of *huangbo / kihada* tends to darken when exposed to light and in combination with wood-ash lye. With the addition of indigo, *huangbo / kihada* may also produce green colours.

Shiche fuzi (Chinese) / *yasha* (Japanese) is a yellow-brown dye extracted from the cones of the Japanese alder tree (*Alnus japonica*). It is one of the most popular colouring agents used for toning paper. It has been used since the eighth century in Japan to dye linen clothing. For general dying, the cones, wood and bark are dried, but for toning paper, only the cones are used. *Shiche fuzi / yasha* provides a light-stable colour which can be washed to alter the tone. To slightly increase the darkness of the colour, wood-ash can be added. The cones from the European common alder (*Alnus glutinosa*) have also been used to produce dyes, but the tone they create is much deeper and browner than the dyes produced with *shiche fuzi / yasha*.

Blacks

Ink. *Mo* (Chinese***) / Sumi*** (Japanese) is a carbon ink stick made from soot or lamp black. Sumi has been produced since around 500 CE. *Mo / Sumi* provides two different colours: a blue-black ink made from the soot collected from burning pinewood, and a brown-black ink from seed-oil soot, which can be produced from camellia seed, grapeseed, linseed, paulownia seed, rapeseed and soya bean. These two varieties of ink also have different structures: a blue-black ink has a matt appearance, while brown- black ink gives slightly glossy structure due to its higher percentage of oil in the remaining carbon.

The particles produced from seed-oil soot are more suitable for calligraphy since they are three or four times smaller than pine-wood soot and tend to adhere to paper

[133] GRANTHAM, Sandra and WEBBER, Pauline. Mellow yellow: Toning papers with traditional Far Eastern colourants. *The Paper Conservator*. 2002, **26** (1), 49 – 51. p. 50.

more densely. The small and even size of pigment particles used in high quality ink sticks provide a very even application effect. [134]

- **Green and blue colours**

Malachite. *Shi lu* (Chinese) / *iwa -rokusho*, ofen *rokusho* (Japanese) – basic copper carbonate mineral ($CuCO_3.Cu(OH)_2$. The mostly used coloured pigment in East Asian paintings, as well as azurite. It is found in upper, oxidized areas of copper ore deposits. Basic copper compounds, such as found in malachite also occur on the paintings in other forms, such as atacamite (the pigment detected on the painting "*Sunset on the Sea")*. [135]

Azurite. *Kong qing* (Chinese) / *iwa-gunjo* (Japanese) ($Cu(OH)_2.2CuCO_3$). A commonly used mineral pigment usually associated with malachite, but is less abundant. Azurite is found mainly in China, but also in Japan and Korea.

Indigo. *Dianhua* or *huaqing* (Chinese) */ai* (Japanese) ($C_{16}H_{10}N_2O_2$) is produced from the leaves of the *Polygonum tinctorium* plant. The transparent substance obtained from the leaves (indican) turns blue upon contact with oxygen (indigotin).

Ai bo enogu is a stick made of oxidized indigo in combination with animal glue. It consists of fine small particles which enable an even wash of colour. The hue of this wash is light-stable and can be used as an addition to yellows to provide a greenish colour.[136]

5.7.2 Toning with paper extract

Paper extract *susu* (Japanese) can be used as an alternative to watercolours. It is reversible colourant which matches the brownish colour of aged papers. According to tests, paper extract has a neutral pH and it is therefore safe to apply to artworks. The main ingredient of the extract is discoloured paper obtained mainly from the backings of old paintings and scrolls, etc. Old papers are soaked in water and left overnight. The next day, the wash water is evaporated by boiling. This process produces a neutral pH in the suspension. Once the suspension achieves sufficient concentration,

[134] GRANTHAM, WEBBER, 2002, p. 51.
[135] WINTER, 2008, p 26.
[136] GRANTHAM, WEBBER, 2002, p. 51.

it is poured into small containers to dry. Paper extract is generally applied locally to discoloured areas of paper or silk.[137]

5.7.3 *Shiche fuzi / Yasha*

Japanese version of *shiche fuzi*, *yasha* has been selected as the best alternative of all the options available at the National Gallery Prague for toning paper. Its stability and durability proved by centuries of practical application in combination with suitable colours convinced me to apply this dying technique to tone the first layer of Chinese backing paper on the handscroll. Unlike many plant dyes, which are light sensitive, *yasha* is light-stable and affords it an advantage over other dyes.

Preparation of the dye from *shiche fuzi / yasha* cones

First, a layer of yasha cones covered with water was filled into a pot. The ingredients were simmered for approximately two hours until the intensity of the colour increased. After sufficient boiling, the dye was left to cool and acquire a deeper colour. The solution was then strained through an unwoven textile fabric to remove any impurities which could cause problems during application of the dye to paper.

Application of the dye

Unlike Western paper, East Asian paper allows even application of a dye with a brush. I applied the following method to tone the paper. First, sheets of Chinese paper were cut to the same size. The Chinese paper was lightly humidified and smoothed with a soft dry brush. The dye solution was then applied to the smooth side of the paper with a large brush using light brush strokes and respecting the direction of grain in the paper. The next sheet was placed on top of the previous sheet, offset by 5 mm to create a darker line, and the process of toning was repeated.[138] The Using this procedure, the paper dyed first becomes the darkest, while the final sheet is the lightest. This occurs because

[137] TOWNSHEND, Piers. Toning paper with „paper extract". *The Paper Conservator*. 2002, **26** (1), pp. 21-26.

[138] CATCHER, Susan. Just coloured paper: Toning paper using natural dyes. In: *Adapt & Evolve 2015: East Asian Materials and Techniques in Western Conservation. Proceedings from the International Conference of the Icon Book & Paper Group, London 8–10 April 2015*.London: The Institute of Conservation, 2017, 128–36, p. 130.

the dye penetrates through the entire stack of papers and becomes concentrated at the bottom.

Once all the paper sheets had been toned, the stack of papers was left to dry slightly. As the moisture evaporated, the sheets became less brittle and could be removed from the table and left to dry in a hanging position.[139]

Fixation of the dye

The dried sheets were rinsed in cold water to remove any dye residues which were still fugitive. A solution of water and potash mordant (potassium carbonate) with pH 9 was then prepared. Each sheet of paper was rinsed in this solution to fix the dye onto the paper's surface. After drying, the Chinese papers were again rinsed in clean cold water to remove any residues of mordant. After the final rinse, the paper was left to dry and was ready for use.

This toning technique has advantages since the dye penetrates the paper's structure to colour the fibres fully. As a result, the paper is evenly dyed, and the brush strokes are not visible.[140]

5.7.4 Direct (substantive) dye

A direct dye or substantive dye is a Western alternative to natural Asian dyes. The dyes are water-soluble with an affinity for fibre and are taken up directly. Their light stability and ability to dye fibres even with a low solution concentration is attractive to paper and textile restorers. Direct dyes are generally inexpensive and easily applied, and they can yield bright colours. Direct dyes are applied to the fabric in a hot aqueous dye solution. Heating the solution improves penetration of the dye molecules by increasing the wettability of natural fibres and the solubility of the dye.[141] The group of direct light-stable dyes includes Saturn® dyes, which are used to dye paper pulp and paper for restoration purposes. Saturn® dyes have a high affinity for cellulose fibres, but they are not suitable for dyeing papers which contain wood pulp. The encrusting

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[139] Chester Beatty Conservation. *Yasha: A Traditional Japanese Paper Dyeing Technique*. [online] [last access 06.07.2021]. Available at: https://chesterbeattyconservation.wordpress.com/2017/08/08/yasha-a-traditional-japanese-paper-dyeing-technique/

[140] Ibidem.

[141] Britannica. *Dyeing techniques: Direct dyeing*. [online] [06.08.2021]. Available at: https://www.britannica.com/technology/dye/Dyeing-techniques

substances contained in wood produce coloured clouds around fibres. Saturn® dyes are light-stabile and averagely wash resistant, but they perform better on bleached cellulose. Non-cellulosic fractions accruing on unbleached cellulose decrease light fastness and may change the shade of the dye. Saturn® dyes are generally used to dye a mass, although some of them are also suitable for surface dyeing. They dissolve easily in water and dye the fibres in a neutral solution at room temperature. They are suitable for dyeing cotton, flax, hemp, ramie, paper, etc. Usually natural shades similar to aged paper are used for conservation, and it is not necessary to consider the addition of any fixing agent. After application of the dye, the paper or paper pulp is washed in clean water to remove any dye residues and is ready for use.

The use of these dyes for conservation purposes has several advantages. A low concentration (0.1 %) is sufficient for dyeing the paper; therefore no significant amount of foreign substance is added to the paper structure. The dyes have a defined composition, and the dyeing ability is homogeneous. They are also easily obtained and inexpensive. According to research provided by the National Archive, after dyeing with these types of dyes, no significant changes occur in the mechanical properties of the paper, and they do not deteriorate during accelerated ageing.[142]

[142] KOPSOVÁ, Barbora. *Restaurátorská dokumentace: Technologie barvení dolévací papíroviny*. *Bakalářská* práce. Litomyšl: 2009. Univerzita Pardubice. Fakulta restaurování, p. 11.

Figure 128. Preparation of the dye for toning paper from *yasha* cones, cooling the solution after boiling.

Figure 129. Preparation of the dye for toning paper from *yasha* cones, straining the solution through an unwoven textile fabric.

Figure 130. Preparation of the dye for toning paper from *yasha* cones, application of the dye using brush.

Figure 131. Preparation of the dye for toning paper from *yasha* cones, application of the dye using brush.

Figure 132. Preparation of the dye for toning paper from *yasha* cones, washing avay residues of potash.

Figure 133. Preparation of the dye for toning paper from *yasha* cones, drying toned papers.

6 HANDSCROLL MOUNTINGS

Another factor which differentiates Chinese pictorial art from European paintings is the method of mounting. The common method of mounting classic European paintings is to place them in a wooden frame or a wooden frame with glass protection (according to the painting technique). Wooden frames may be carved or decorated with gilding. Unlike European framing, more modest Asian mounting is composed of several layers of paper, silk and sometimes brocade. The subtle beauty of mounting is an essential component of Asian and Chinese art, and therefore it is important it receives special attention.[143]

The main materials used to mount Asian scrolls are silk and paper. These have been favourite painting supports of Chinese and Japanese painters and calligraphers for around a thousand years, ever since the decline in popularity of mural paintings.[144] Because the inks and colour pigments used in Chinese paintings tend to fade if left exposed for a long time and the materials have sensitive characteristics, the paintings are not usually displayed permanently. Instead they are mounted as handscrolls, kept in a rolled position in a box and exposed for a special occasion or a suitable period. Unlike the Western tradition of viewing from a distance, East Asian paintings are "read" at a close distance.

To view the handscroll, it should be unrolled from right to left, exposing one scene/section at a time. The previous section is rolled up gradually as each new section is unrolled.[145]

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[143] CHAU, Cheuk Ying. *Enchanting Borders: The Art & Psychology of Chinese Hanging Scroll Mounting.* A Final Thesis. The Chinese University of Hong Kong: August 2010, p. 1.

[144] VAN GULIK, R. H. *Chinese Pictorial Art: As Viewed by the Connoisseur*. Taipei, Taiwan: SMC Publishing, reprinted, 1993, p. 57.

[145] Khan Academy. *Mountings: hanging scrolls, handscrolls, fans and the album leaf.* © Trustees of the British Museum [online] [last access 09.05.2021]. Available at: https://www.khanacademy.org/humanities/art-asia/imperial-china/song-dynasty/a/mountings-hanging-scrolls-handscrolls-fans-and-the-album-leaf

6.1 Drying panels

The mounting boards or panels have an important role during the mounting process. The mounted scroll is left to dry and straighten on these boards. The tension produced by drying allows the scroll to be straightened without the development of any wrinkles.

The Japanese version of a drying board is known as *karibari*. The use of the *karibari* technique has several advantages. If the technique is executed properly, it does not change the structure of the paper. It is not only suitable for Asian papers and scrolls, but with minor modifications, it can be also used for certain works of European origin (pastels, coloured layers, large-format works). *Karibari* stabilizes the paper for a long time and reduces rippling in adverse climatic conditions.

The roots of *karibari* technique go back to China. In Chinese mounting workshops there are, long drying walls *hengban* which are used for straightening and drying scrolls. The construction of Chinese drying walls varies by region. They are made as wooden prismatic constructions covered with several layers of paper, or the walls can simply be made of wood. This option is usually found in regions with higher humidity. In some workshops, paper or scrolls are placed directly against the wall. Due to the structure and method of construction, the properties of Chinese paper walls are very similar the properties of wooden walls and light Japanese *karibari* panels. This may be because Japanese dwellings, unlike Chinese architecture, have very few walls but contain many light sliding doors and panels which are quite similar to the structure of *karibari* panels. The panel is constructed from wooden slats of hinoki cypress wood, which is a very light wood with a low resin content.

Laths are intertwined to minimize torsion of the wooden structure and provide high stability. Several layers of paper cover the wood on both sides. The final layer is coated with *kakishibu* juice from fermented unripe kaki fruit. The number of layers of paper depends on the region, but it is usually from 5 to 9. Paper impregnated with *kakishibu* acquires properties similar to hydropile membrane: it is resistant to water but allows water vapour to pass in both directions. Such a surface is smooth with a typical brown-red colour. Although this kind of treatment seals the surface of the drying panel, it is still possible to glue the edges of the paper lining to the board with wheat starch.

The glued edges can be then easily mechanically removed using a flexible bamboo spatula.[146]

6.2 Composition and terminology of Chinese handscrolls

The composition of the scroll may differ slightly by particular case. In China, a painting mounted as a handscroll is called *hua juan*, calligraphy mounted in this manner is known as *zi juan* (or *shu juan*). Combination of painting and calligraphic writing mounted together as a single handscroll is *shu hua juan, shu -huashuang bi.*

The schematic drawing below depicts the parts of the handscroll (Fig. 134). Actual handscrolls dimensions are much longer than we can represent in the scheme. Some parts of the depicted scroll are intentionally shortened and shown schematically.

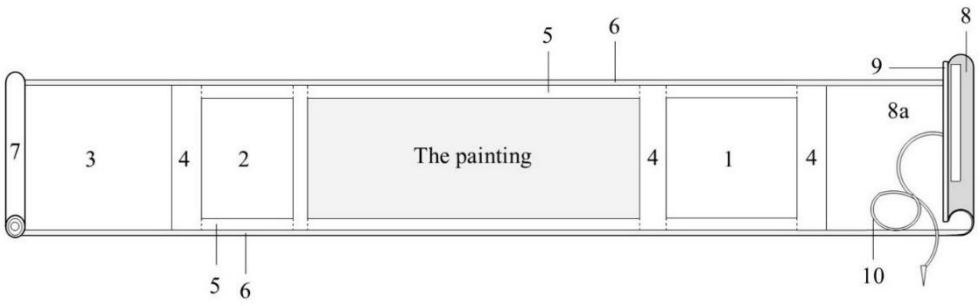

Figure 134. Schematic drawing of a Chinese handscroll.

1. *Ti* (Chinese)

The space of silk or decorated paper reserved for the legend or inscription. The legend usually consists of the title of the scroll written with large characters or other citation.

2. *Bo* or *bowen* (Chinese)

A paper or silk portion of the scroll placed after the painting. This part is used for writing comments referring to the painting and colophons.

[146] BARTYZALOVÁ, Barbora. *Karibari technique of flattening East Asian scrolls.* Conservators and Historians Confernce, Jihlava 2019, conference talk.

3. *Tuozhi* or *tuoweizhi* (Chinese)

Long sheet of paper without any decorations. The strip of paper is not unrolled while viewing the handscroll to prevent the painting itself from any damage caused by excessively tight rolling. The Japanese version of this strip is much shorter than the Chinese version, as the Japanese do not usually place colophons at the end of a scroll.

4. *Jieling, gejie* or *geshuijie* (Chinese)

Vertical strips made of silk or paper which are used to separate different parts of the handscroll.

5 & 6. *Tiandi* or *xiangbian* (Chinese)

The upper and lower borders. They are usually made of the same colour as the vertical strips (4) The outer edges of the borders are reinforced with a subtle seam of silk or tough brown paper *xiangbian* "folded border" (6) running the entire length of the scroll, unlike silk borders which finish where the *tuozhi* (3) begins. In contrast with wide Chinese upper and lower borders, Japanese handscrolls have a very narrow folded border.

7. *Zhou* or *Zhouxin* (in Chinese)

The wooden roller. Today, Chinese scrolls usually have no protruding end knobs as they once had in the old Chinese style. The end knobs are often covered with subtle round medals made of jade or ivory. Unlike Chinese handscrolls, Japanese handscrolls have protruding end knobs.

8. *Baoshou* (Chinese)

The protecting flap. The area situated on the inside of the scroll is called *li* (Chinese) / *mi-kaeshi* or futokaro (Japanese), and the outer area is called *piao* (Chinese) / *omote* (Japanese). In both the Chinese and Japanese traditions, the inner part is often made of decorated ornamental paper or thin, coloured silk, while the outer part is made of embroidered silk or coloured brocade. [147]

9. *Tiangan* or *tiezhu* (in Chinese)

A thin wooden stave, flat on the one side and half-moon shaped on the other. This stave is attached to the flap.

[147] VAN GULIK, 1993, p. 62.

10. *Dai* (Chinese)

A strip situated on the thin stave and used to fix the scroll into a rolled position. The Chinese version of this band or strip has a flat fastening pin on its end. This pin is usually made of ivory or jade, sometimes carved. However, Japanese bands usually have no such a pin; instead, it is tied in a bow.

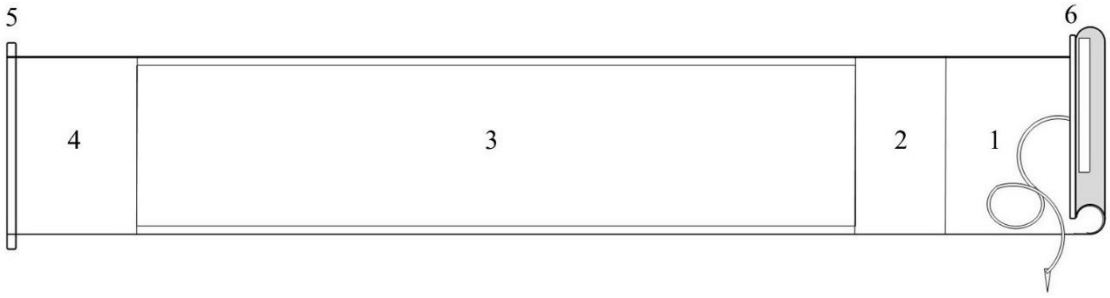

Figure 135. Schematic drawing of a handscroll, old Chinese model of handscroll.

The Chinese modern model of the handscroll (Fig. 134) differs slightly from the model described above (Fig. 135). This version is still used by Japanese mounters; Japanese makimono have only “folded seams”.

No strips of upper and lower borders on the mounting are applied in this type of Chinese handscroll, only narrow “folded seams”. Later versions were updated with strips of upper and lower borders approximately 4 or 5 cm wide.[148]

1. The protecting flap. Its outer part is made of brocade; the inner part is made of thinner silk.[149]

2. A strip of blank paper used for writing notes or comments or applying seals.

3. The painting or calligraphy. Another option is a series of paintings and calligraphy.

4. A blank paper strip used for writing colophons.

5. The end roller with protruding decorated or carved knobs.

6. A thin stave with a silk or brocade band.[150]

[148] VAN GULIK, 1993, pp. 155 - 156.
[149] Ibidem.
[150] Ibidem.

6.3 Application of the backing

The process of applying the backing paper to a painting or calligraphy is called *bei* (Chinese) / *ura-uchi* (Japanese). A thin, but tough paper is used as the first backing layer.

To apply the backing paper, the painting is first placed on a mounting table with its front side downwards and moistened. When all wrinkles and ripples disappear, a sheet of lining paper which has been prepared and cut to the required size and treated with a layer of a starch paste (with overlapping edges) is placed over the painting. The lining is then smoothed and tapped with a stiff-haired brush until the painting and the backing paper stick together.

In the case of larger painting formats, because the application of a backing from only one large sheet of paper may be too complicated, mounters use several smaller sized papers for this process. Each sheet of paper is applied to the back side of the scroll, overlapping the previous sheet by a few millimetres to form a subtle joint. The direction of each layer of lining should be different. If the direction of fibres in the first layer of backing paper runs parallel to the painting's direction of fibres, then the second layer should follow a different direction. This step is sufficient to ensure a firmer backing.

Joints of this type of backing should be adjusted in a manner that they do not interrupt any important sections of the painting and end in an area different from the joints of the previous lining.

After the process of lining is finished, the painting is left to dry on the table fully. If one layer of backing is not enough, the mounter may apply more layers. The second backing is applied in the same manner as the first using the same materials.

6.4 Application of the front mounting

Preparation of the mounting begins with measuring and cutting silk strips. After the strips are cut, they are lined with paper. If the silk is thin, only one layer of paper is sufficient. However, in the case of heavy brocade, a second layer of paper may be added.

After all the lined components for the front mounting have dried, they can be joined to the lined painting. The cut edges of the strips are placed at the edge of the table and treated with the paste brush.[151]

Special brushes for pasting the starch paste to the narrow margins are called *hu- shua* (Chinese) / *nori bake* (Japanese). These types of brush are broad and thin with short hairs.[152] The join is pressed by fingers, and the painting assembled with the mounting can be left to dry on the table, covered with heavy rulers.[153] The margins of the silk borders are then folded and pasted with a starch paste.

6.5 The final backing

After the scroll is completely dry, it can be removed from the drying panel. Weather has an important role in this process: the scroll should be taken down on a dry day, otherwise it will warp. The scroll is placed face down on the table, and the final backing can be added. In China, the same materials used for the painting's first backing are used for the final backing. In Japan, a special type of thick paper (*uda-gami*) is used.[154]

Before applying the final backing, the scroll is placed face down on the table and moistened and smoothed with a brush. Envelopes for the upper and lower borders are then applied to the back side of the moistened scroll, brushed with a water brush and then smoothed with a smoothing brush. The envelopes for the upper and lower rods are usually made of the same paper used for the first backing. The length of the envelopes is the same as the width of the backing paper. The height of the envelope should be approximately two-thirds circuit of the lower rod, with space for edges. The height of the upper envelope is equal to the height of the flat side of the upper rod, with space for

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[151] KOYANO, Masako. *Japanese scroll paintings: a handbook of mounting techniques*. Washington: Foundation of the American Institute for Conservation, 1979, p. 60.
[152] VAN GULIK, 1993, p. 76.
[153] KOYANO, 1979, p. 60
[154] VAN GULIK, 1993, p. 78.

the edges.[155] Once the final lining process is finished, the scroll should again be placed on the drying board. When it is dry, it can be removed from the board for the last time and be burnished to add some flexibility to the linings pasted with starch. The burnishing process is used in both Chinese and Japanese mounting tradition. Chinese mounters use a river stone for this process, while Japanese scrolls are burnished with a long chain with beads made of glass. Before burnishing is commenced, carnauba wax is applied to the back side of the scroll.[156] Finally, all the supplementary items, the stave, roller and suspension loop, can be added to the scroll.

[155] KOYANO, 1979, pp. 66-67.
[156] CATCHER, CHANG, ZHU, 2017, p. 60.

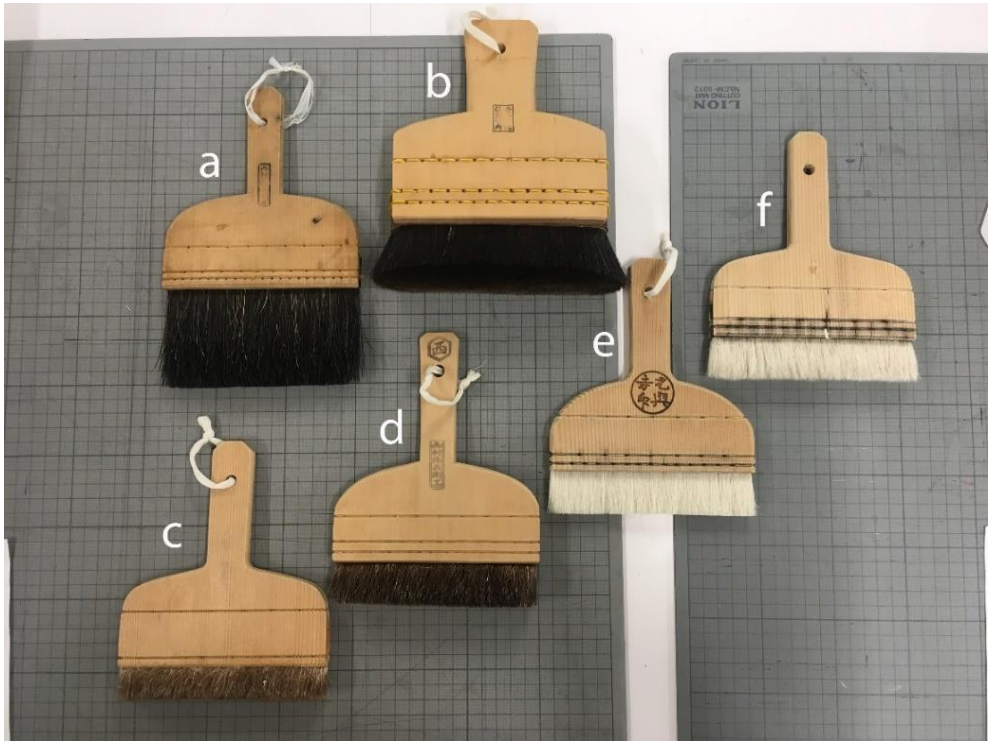

Figure 136. Japanese brushes with their Chinese equivalents: a) *nadebake* (Japanese) – smoothing brush, b) *uchibake* (Japanese) / *tsung bi shua* (Chinese) – tapping brush, c) d) *mitsubake* (Japanese) / *shui shua* (Chinese) – brush for water processes, e) *noribake* (*tsukemawashi-bake*) (Japanese) – brush for the application of glue, f) *noribake* (Japanese).

Figure 137. Application of the paper lining.

Figure 138. Application of the front mounting, applying a thin layer of a starch paste on the edges of the mounting strip.

Figure 139. Application of the front mounting, pasting the mounting strip treated with starch paste to the painting.

Figure 140. Application of the front mounting, pushing the strip towards the painting for better adjustment.

Figure 141. Process of burnishing with a long chain with beads (Japanese method).

EXPERIMENTAL

1 INTRODUCTION

European conservators use different materials to repair tears. Water based adhesives are avoided because the pigments used in silk paintings of Western origin are often water soluble. By contrast, the materials used for Asian painting on silk can easily tolerate contact with water because of their composition and painting technology.

European textile conservators typically use stitching to repair losses in silk fabrics used for historical costumes or other purposes. However, sizing applied to an Asian painting silk does not permit this type of operation, as the needle used during the stitching process can destroy the subtle structure of the fabric and is quite visible. Because the silk fabric used for Asian painting has a transparent character, an overall backing with paper (Japanese or Chinese paper) or subtle textile support (such as crepeline) is usually applied. The main goal of this experiment was to find a compromise solution between Eastern and Western traditions for the stabilization of localized damage.

Sized silk specimens to be used as surrogates for a typical Asian painting support were prepared for exposure to experimental treatments in three steps: mechanical damaging, local tear mending methods (paper patching, textile patching, “bridging” with textile threads) and tensile tests (the samples were placed on a board, and experienced tension while drying and flattening).

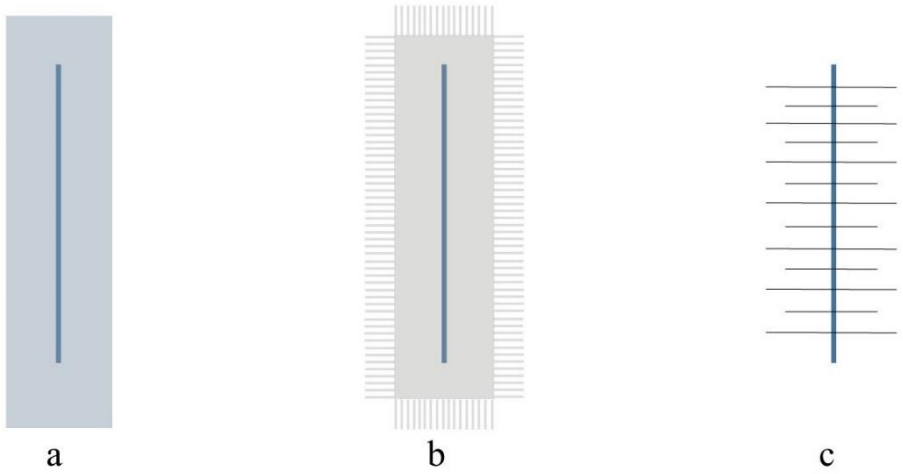

Figure 142. Surrogates with a tear mended with: a) paper patch; b) textile patch; c) “bridging”.

1.1 Materials

Sized painting silk fabric was selected as the support for investigation in this experimental section of the thesis research. To determine a suitable material for mending tears, five specimens of paper, four different types of textile fabrics and eight types of adhesives were tested. The results are presented in Appendix C (in printed version). Each specimen was applied to a sized silk support with each of the adhesives. The aim was to determine the best possible combination of material and adhesive based on its appearance and the ability to adhere to the silk support.

1.2 Mechanical damage

Two types of tear were created on the surface of a silk support, one in the warp direction and another in the weft direction. Breaking cracks are very typical in paintings on silk due to sizing, which reduces the flexibility of the fabric. Mechanical damage was then intentionally created with a dull scalpel by pressing through the fabric to create the effect of a crack.

1.3 Stabilization of damage

After several attempts to stabilize the damaged surface of the fabric without detectable stains from an adhesive, the best solution was found. The silk support was first slightly humidified. This allowed a more satisfactory application of the adhesive without visible traces of glue remaining on the silk surface. Any attempt to apply glue to the dry surface of silk was not successful, causing severe stains, and in some cases, resulted in tension in the fabric.

Application of a paper patch

Japanese paper *Mino Tengujo* and an adhesive of 5 % isinglass aqueous solution was determined as the most suitable of the materials for mending tears by applying paper patches. Isinglass created a very thin layer of glue between the silk support and paper patch and provided good adhesion ability. After application of the paper patch treated with isinglass, light weights were placed on the silk support to allow the adhesive to set properly.

Application of a textile patch

French silk crepeline and an adhesive of starch paste mixed with *funori* was determined as the most suitable of the materials for mending tears by applying textile patches. Isinglass was the best option for adhesive, but it was challenging to work with on a small piece of crepeline. Starch paste with *funori* provided an effective alternative to the first option.

A rectangular patch of French crepeline with frayed edges (to allow gradual tension after application) was applied to the back side of the silk support using starch paste with *funori*. Light weights were then placed on the silk support to allow the adhesive to set properly.

Application of "bridging"

Mending tears by "bridging" was executed using thin threads of French silk crepeline penetrated with isinglass. Penetrated threads were then cut into approximately 1.5–2 cm lengths and placed alternatively, a longer thread placed after a shorter one. The application process was undertaken using a heat spatula to adhere the thread to the treated area of the tear (Hostaphan foil was placed on top of the thread during the ironing process). Light weights were then placed on the silk support to allow the adhesive to set properly.

1.4 Flattening

The silk support with stabilized and mended damage was placed on the drying board. To allow the flattening process, the silk was slightly humidified with water and then attached to a board using starch paste on the edges of the textile support. This method was also selected for the tensile testing process since it allows the natural tension typical for this type of painting, which are usually mounted in the same manner. We could therefore observe whether the applied patches and "bridging" were strong enough to tolerate the tension and preserve the actual appearance.

The samples were left to flatten on a board for a period of one month. The tear in the weft direction mended by "bridging" widened slightly at the beginning of the flattening process while the silk was still wet, but the threads did not tear off. No other significant changes were noticed during the one-month period.

1.5 Discussion

Unlined paintings on silk support are one of the common forms of Asian painting. The results of this study may be applied when dealing with Asian paintings with similar damage as presented above, and because the selected support corresponds to the supports traditionally used in Asian silk painting techniques.

The characteristics and transparency of silk fabric pose a challenging task in selecting the right materials and method of application for mending tears and stabilizing the support. Assembly on a cardboard background and subsequent mounting into a frame with glass is very common for this type of an artwork. The cardboard background can be a light or dark colour, although the existence of a darker background complicates any kind of local tear mending without any visible factors. Any interventions, such as patches of any type, even slight traces of adhesive, remain visible on a darker background. A lighter background is much easier to work with in this aspect since the materials used during conservation treatment tend to scatter.

During material testing, various types of paper, textile and adhesive were examined by applying them to the sized silk support. Isinglass and Klucel demonstrated the best results, however other adhesives also provided a good result.

The textile specimens also produced a nice result in combination with isinglass. However, it was very difficult to work with during the tear mending process. This occurred probably because of the smaller pieces of crepeline selected for this process. The pieces were not as stable as the larger sample used during material testing and became easily deformed during application with a rather thin isinglass solution. For this reason, Klucel G in ethanol solution was selected as an alternative option for this purpose. Because the glue had a thicker composition than isinglass, the crepeline maintained its shape during the patching process. Additionally, less stains remained after application of this adhesive. Each specimen reacted positively with these adhesives, although some of them did not have an advantageous appearance: the origami fabric specimen created moiré effect; the raw silk specimen made was too thick compared to other specimens. The glues which proved the best adhesive ability on the textile support were starch paste, starch paste with *funori*, Klucel G and isinglass. Starch pastes have a very strong adhesive ability, but during use, it is important to choose the right consistency, otherwise the glue may cause tension on the silk support,

or if the paste is too thin, the patches will not adhere well to the silk. Methylcellulose also produced good results, but it took a longer time to adhere a textile specimen to a silk support using this adhesive. Adhesive combinations with *funori* (gelatin + *funori*, isinglass + *funori*) did not produce results as positive the remainder of adhesives, as they tended to peel from the surface of a silk after drying. Owing to the quite open structures of the textile fabrics, the adhesives permeated through to the front side of the silk support more than with the paper specimens. Slightly humidifying the surface of the silk support prevented the appearance of any seriously visible stains. In the case of smaller patches applied during the tear mending process, the adhesive is slightly visible, although only on darker backgrounds.

Tear mending by “bridging” was the most time consuming and required a great patience. In this case, it was necessary to activate the adhesive by slightly heating the threads penetrated with isinglass glue. As a result, the adhesive melted and therefore permeated through to the front side of the silk support. Consequently, adhesive residues were the most visible on this sample.

Table 1: Material test – adhesion ability.

	KIZUKI KOZU	TENGUCHO	GIFU	MINO TENGUJO	MITSUMATA
STARCH PASTE					caused tention
ISINGLASS					
GELATIN					
KLUCEL G					
METHYLCELLULOSE					
STARCH PASTE + FUNORI					
I ISINGLASS + FUNORI					
GELATIN + FUNORI					

	ITALIAN SILK CREPELINE	FRENCH SILK CREPELINE	ORIGAM	RAW SILK
STARCH PASTE				
ISINGLASS				
GELATIN				
KLUCEL G				
METHYLCELLULOSE				
STARCH PASTE + FUNORI				
ISINGLASS + FUNORI				
GELATIN + FUNORI				

Adhesion ability: good | sufficient | not sufficient

2 CONCLUSION

The aim of this experiment was to find a compromise solution between Eastern and Western traditions of stabilizing local damage, i.e., mending tears in particular.

Sized silk specimens were prepared for exposure to experimental treatments in three steps: mechanical damage, local tear mending methods (paper patches, textile patches, “bridging” with textile threads) and tensile tests (the samples were placed on a board and experienced tension while drying and flattening).

Material testing revealed that the best combination of the paper specimens and adhesive was Japanese 9g/m² Mino Tengujo paper with isinglass adhesive; the most suitable combination of the textile specimens and adhesives was French silk crepeline and a solution of Klucel G in ethanol. Specimens made of machine-made paper proved better results in terms of appearance, due to their fiber structure.

The best material solution for the “bridging” method of mending tears was silk crepeline threads penetrated with isinglass glue. However, this method did not demonstrate satisfying results. Although the specimens tolerated the tensile tests during flattening on the board, after removal from the board, the threads tended to fall off the silk support when touched lightly. Therefore, on basis of the experiment, we can conclude that this method is not suitable for mending tear when repairing materials such as silk. The threads are too thin to keep the adhesive on its surface, which provides a very low adhesive ability. The glue activated by heat during the application process also tended to melt and permeate through the silk support, spoiling the aesthetic appearance.

The other two previously mentioned methods provided good strength during examination and are aesthetically acceptable in terms of appearance, especially if mounted on a light alkaline cardboard. However, the textile specimens were more difficult to work with because of their structure.

In general, this kind of local tear mending and stabilization of the silk support is suitable only if the painting is not severely damaged. If the condition of the painting is critical, the method of overall lining using one of the materials mentioned, either paper or textile, would be a better option to stabilize the painting support and prevent the occurrence of new damage in the future.

3 LIST OF USED MATERIALS

Paper:

- Kizuki Kozo, cream 100 %, kozo, 6 g/m² (Japico)
- Tengucho 7,3 g/m² (Hidaka washi)
- Gifu 100 %, Manila, 10 g/m² (Art Protect Brno)
- Mino Tengujo 9 g/m² (Ceiba)
- Mitsumata

Textile:

- French silk crepeline
- Italian silk crepeline
- Origam
- Raw silk

Adhesives:

- *Funori* 2%
- Isinglass 5%
- Klucel 5%
- Methylcellulose 5%
- Gelatin 4%
- Starch paste
- Starch paste + *Funori* 1:1
- Gelatin + *Funori* 1:1
- Isinglass + *Funori* 1:1

Figure 143. Example of an unlined painting on silk support assembled on a cardboard desk.

Figure 144. Detail of mechanical damage resulting in a tear on the painting on silk.

Figure 145. Example of an unlined painting on silk support assembled on a cardboard. Collection of Asian Art National Gallery Prague.

Figure 146. Example of an unlined painting on silk support with deterioration in the form of a tear. Collection of Gallery of Benedikt Rejt in Louny.

Figure 147. Materials used during the experiment: paper samples.

Figure 148. Materials used during the experiment: silk samples.

Figure 149. Materials used during the experiment: adhesives.

Figure 150. Preparing of the silk support for the experiment: The mechanical damage to sized silk.

Figure 151. Process of the experiment, application of “bridging” with silk crepeline threads using isinglass.

Figure 152. Process of the experiment, flattening the samples on a drying board.

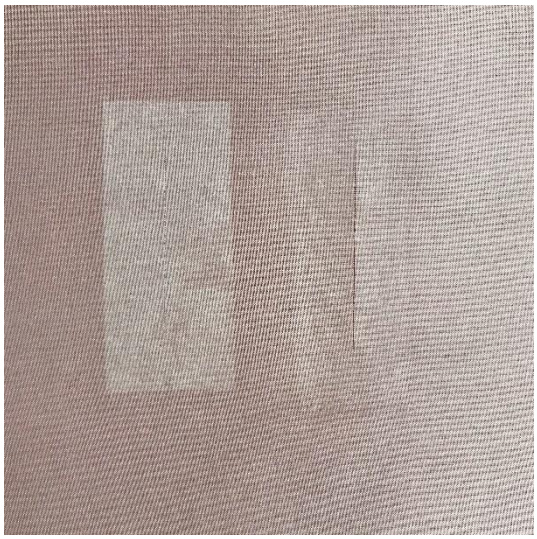

Figure 153. Surrogates with a tear along the weft direction mended with: a) paper patch; b) textile patch using adhesive Klucel G, dark background.

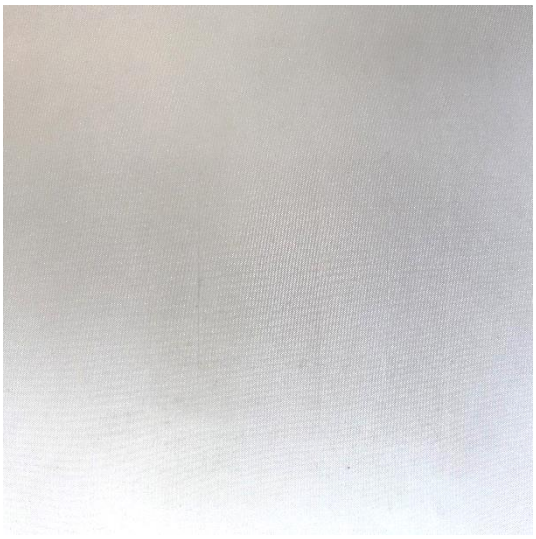

Figure 154. Surrogates with a tear along the weft mended with: a) paper patch; b) textile patch using adhesive Klucel G, light background.

Figure 155. Surrogates with a tear along the warp direction mended with: a) paper patch; b) textile patch using adhesive Klucel G, dark background.

Figure 156. Surrogates with a tear along the warp direction mended with: a) paper patch; b) textile patch using adhesive Klucel G, light background.

CONCLUSION

East Asian art has a long history and tradition which have been preserved to this day. Even though it differs from European art in many aspects, the unique beauty of art pieces of East Asian origin attracted the interest of Western collectors especially during the nineteenth and twentieth centuries, which is why a considerable number of collections of Asian paintings and scrolls exist in Europe. Poor knowledge of the aesthetic and practical meaning of those objects still remains a major issue. The art works often suffer from inappropriate handling, storage and conservation interventions which result in deterioration and aesthetic changes.

Only a few sources of literature are available for East Asian art, especially its conservation in Czech Republic. Sources written in English are common because the authors of many publications and articles have made their work accessible to others, although it may still sometimes be challenging and time consuming to find the needed literature. Therefore, the aim of the theoretical component of this master's thesis was to gather the basic knowledge concerning East Asian art and philosophy and the traditional methods and technologies of preservation and handling of handscrolls. All the aspects mentioned in the research are interrelated and have important roles in managing art pieces of East Asian origin.

The information presented in this work can help conservators understand the specifics of the materials and conservation approaches when dealing with East Asian scrolls or paintings on silk and in providing sufficient services while respecting the tradition, aesthetics and origin of the object.

Throughout the period of work on this project, I have been able to perform significant research of the literature, mainly with the support of the National Gallery Prague, which provided me with the access to gallery's library and various online databases. The considerable amount of literature I have researched has allowed me not only to closely understand the issues of conservation of Asian paintings on silk but also obtain a deeper knowledge of Chinese art, especially Chinese landscape painting, its philosophy, traditions and techniques. The knowledge I have obtained from the literature, in combination with the practical work at the National Gallery Prague, allowed me to conduct a quality conservation treatment of the painting I was entrusted with.

The theoretical section developed from the literature research, while practical conservation activity enabled the production of a comprehensive manual dedicated to Asian handscrolls, with a special focus on Chinese handscrolls and silk supports. In this section, some Chinese, Japanese and often Korean techniques, materials and methods of conservation and mounting were collected, described and compared. These differences play an important role in selecting the right material or traditional method of conservation. Information about the methods and materials used in Japan and China may therefore be useful in the field of conservation of Asian art to preserve the origin of the treated object.

The experiment was an important component of this work and helped me identify the characteristics of silk in combination with different materials, how they behave, the problems associated with the tear mending process, and other aspects. Some methods used throughout the experiment proved feasible and practical, while other methods, such as “bridging”, did not have a satisfying result and were unsuitable. All the positive and negative factors encountered during the experiment are described in the work, and consequently, this knowledge can be used by conservators to inform their expectations when using a particular method, adhesive or material and thereby save a considerable amount of time. The sample catalogue, as an illustrative example of the materials used and their combination, also forms a part of this master’s thesis and can be accessed in its printed versions.

The conservation of East Asian Paintings on Silk Support is a very extensive topic and can certainly be further developed. Topics such as paper toning or East Asian scroll mountings are very important aspects worth elaboration as individual subjects. The cooperation with conservation studios and institutions dealing with East Asian art would be an encouraging option which could contribute to the content of the work. The topic selected for the experimental section could be further developed in the context of chemical technology, for example, as a part of a major thesis work.

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Authors of the photographs: Laura Khaindrava, Department of Asian Art National Gallery Prague, Photography Department National Gallery Prague.

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APPENDIX C – SAMPLES