

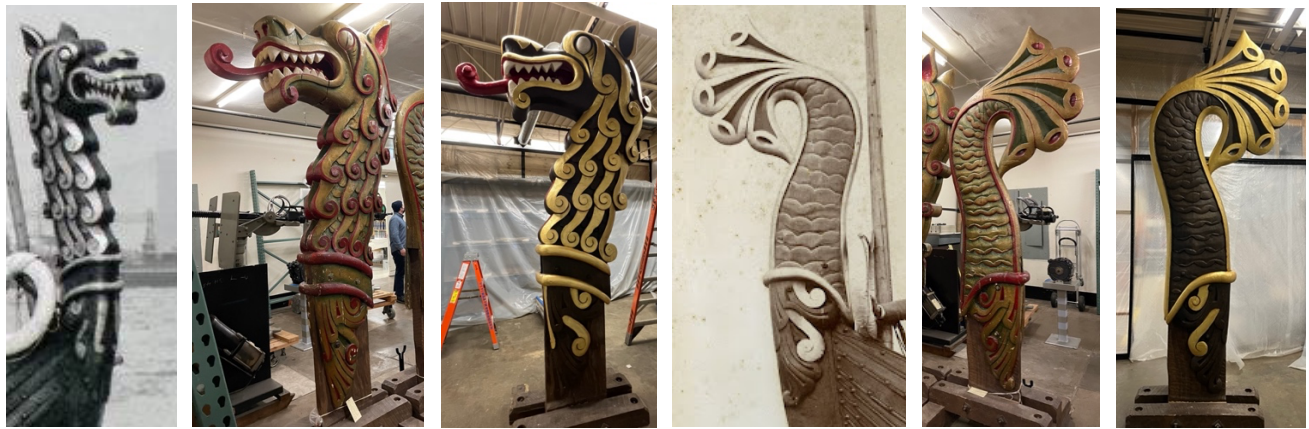


Date
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To
Friends of the Viking Ship
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Object

Analysis and Repainting of the Stempost and Sternpost of the *Viking* ship



Left 3 images: Stempost – Comparison of original 1983 appearance, 2022 before treatment, 2022 after treatment
Right 3 images: Sternpost-- Comparison of original 1983 appearance, 2022 before treatment, 2022 after treatment

Scope

This project included the conservation assessment, analysis, and treatment of the dragon stempost and sternpost of the *Viking* ship. The *Viking* ship was fabricated in 1893 in Sadefjord Norway by shipbuilder Christen Christenson. The ship is a replica of the *Gokstad* ship, which was built in 890 at the height of the Viking era and found and excavated by the University of Oslo. The ship is now in the University's Viking Ship Museum, which presumably would have been where Christenson would have gone to study the ship in order to create a copy. The *Gokstad* ship excavation however did not unearth the stempost and sternpost of the ship, so this dragon head and tail would have been a copy of something else. It is not currently known what Christenson would have copied these from, but this is an area of potential research.

The predominant goals of this investigation and conservation treatment included creating a technical analysis of the stempost and sternpost to determine the original paint layer, color scheme, and paint type as we were able to. Paint layers were removed to reveal the original paint in representative areas.

Analysis of the paint layers concluded there was an original gold leaf layer applied with an unidentified resin to the wood surface in areas consistent with the original images, a red paint layer on the chest that was based on vermilion (containing mercury), and a dark material containing a resin (likely linseed oil and/or pine tar), with a black material/pigment possibly composed of bone black or carbon black. Other layers of paint added over time included lead.

Testing to attempt to reduce the paint layers to reveal the original layers proved very time consumptive. That, in addition to the mercury and lead containing paint layers, helped the conservator and client conclude that it was more appropriate and safer to retain the historical integrity of the object's history and repaint the object to return it to its original appearance.

Object History

1893 Ship built in Sadefjord Norway by shipbuilder Christen Christenson. The ship is a replica of the *Gokstad* ship, which was built in 890 at the height of the Viking era and found and excavated by the University of Oslo.

“When the ship was excavated, 32 shields were fixed to each side of the boat, painted alternately in yellow and black. White woollen material with red cloth strips sewn on were found in the forepart of the boat, perhaps remnants of the sail. The ends of the bow and stern posts had rotted away so it is not clear how they were finished, but there is nothing to indicate that they were ever fitted with dragon heads. Even without dragon heads, the Gokstad ship must have been an impressive sight when appearing on the ocean horizon with full sails set.

<https://www.khm.uio.no/english/visit-us/viking-ship-museum/exhibitions/gokstad/the-gokstad-ship/index.html>

The description of the ship is as follows:

At the prow rises high in the air a great carved dragon's head, and the tail of the beast appears at the stern, both richly gilded and the splendor of the vessel is further increased by the row of shields along each bulwark, in yellow and black, and, when in commission, by the red and white striped roofing.

<https://drloihjournal.blogspot.com/2017/01/the-viking-ship-at-1893-chicago-worlds.html> Compiled by Compiled by Dr. Neil Gale, Ph.D.

Areas of potential research: What reports exist that describe the head as gilded. What type of gilding might have been in use in the 1890's, and what might Christen Christenson have copied the dragon head and tail from.

1893 The *Viking* sailed from Norway to Chicago via the Erie Canal and the Great Lakes and was exhibited at the World' Columbian Exposition. She was then towed through the Illinois and Michigan Canal, down the Illinois River, then the Mississippi River, and to New Orleans, and finally returned to Chicago and presented to the Field Columbian Museum an exhibited outside of the museum.

1920 The Federation of Norwegian Women's Societies began a restoration effort.

“After her repair and restoration, the Viking was relocated to Lincoln Park in 1920, placed under a fenced-in, wooden shelter, and transferred to the care of the Commissioners of Lincoln Park which later consolidated into the Chicago Park District.

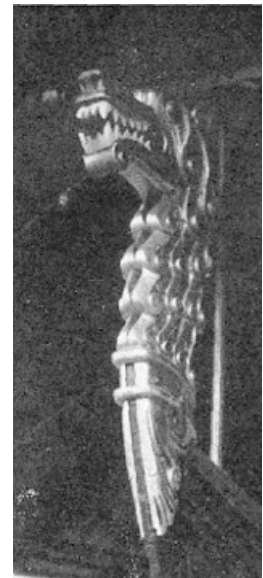
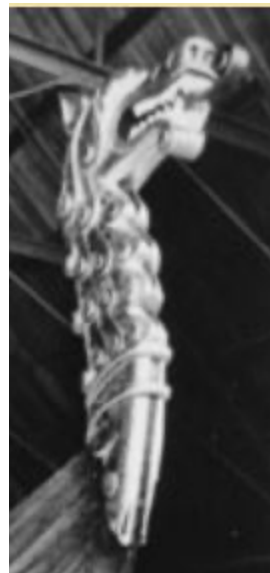
Source: <https://drloihjournal.blogspot.com/2017/01/the-viking-ship-at-1893-chicago-worlds.html>

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1920 – 1978 During this time, the stem and stern posts were likely repainted several times.

“Although the legal trustee of the Viking ship, the Chicago Park District set aside no funds for maintenance of the boat or its shelter. For many decades the Norwegian-American community provided maintenance to the ship.

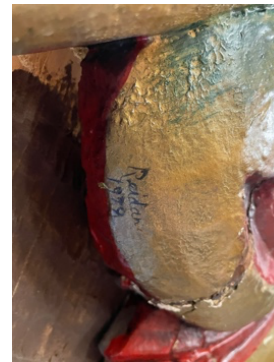
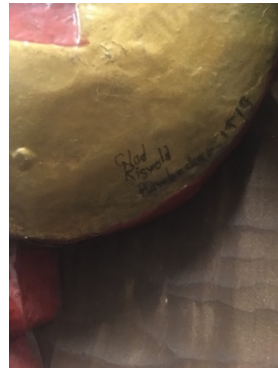
But as the years passed, the Viking began to suffer. In 1978 the Scandinavian-American community rallied by forming The Viking Ship Restoration Committee, whose goal was to restore the Viking and find suitable permanent housing.



1977 In disrepair. The image to the right shows the stempost in Lincoln park, with substantial paint loss, cracking, and weathering, as well as areas of incomplete forms.



1979 Restored to current state. Exhibited and the stem and stern posts remained at the Museum of Science and Industry. It has been in storage here ever since. The object is signed in 3 locations on the head and tail: "Glod Risvold Hawbecker Reidon 1979" (Stempost, along back under upward curls), "Glod Risvold Hawbecker 1979" and "Reidon 1979" (Under bottom curls, sternpost)
[Spelling for all 3 is unclear]



Condition- Before Treatment (Updated during treatment)

Condition -

The object was in mostly stable condition structurally overall. There were many smaller areas around the chin of the underside of the dragon that were in immediate danger of detaching.

Update: It was noted during treatment that the tongue was also not structurally stable as it was being held in place with a cantilever with hardware. Ethafoam was in place to help hold the tongue up. The hardware holding the tongue in place was unable to hold the weight as some of the material had been lost. This hardware was modern, appearing stainless steel. The hardware was held in place by one of two types of putties found throughout the object.

- The putty in this area was an orange, crumbly material. Since it was added on top of the hardware, it is assumed that any paint layer found on top of this putty was not original and likely part of a later restoration than the one done in the 1920's.
(see image to the right)



A second form of putty, a smoother, off-white putty that appeared fairly stable was also found throughout. This putty was also found to cover areas of paint (such as the likely original red paint on the chest), as well as being used to complete forms in areas where the wood had degraded substantially.

This reinforced the conservator's belief that a significant amount of the original paint scheme as well as some of the original carved forms were no longer present.



There is extensive cracking throughout both in the wood and paint layers; many of the wood cracks are not mobile and contain material within them both from previous restorations and debris collected over time. If an attempt to close the gaps was made, it would likely negatively impact another more stable area. These areas can be stabilized and supported with adhesives and fillers.

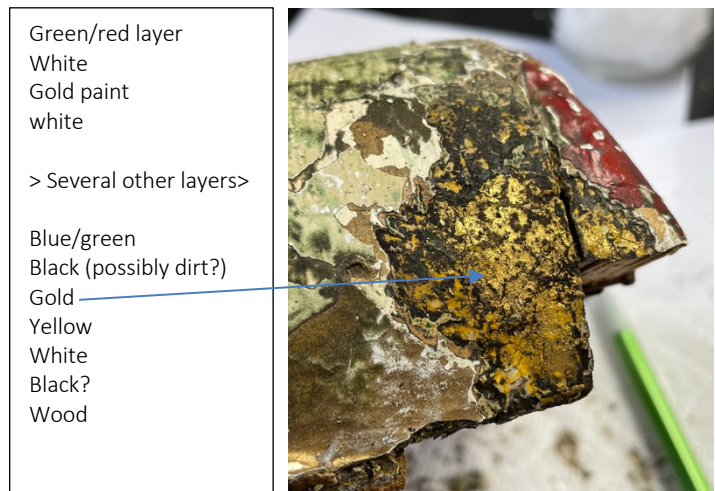
Additionally, on many interior edges and in some areas where paint was removed but between layers, there was a black, almost fibrous material. This may be a dirt or fungus build up. This was initially thought to be “luting” (referring to tar or pitch with hair used to waterproof joins in the wood), but more likely as “boat soup”, a waterproofing agent used on Scandinavian ships, composed of a mixture of boiled linseed oil, pine tar, and turpentine.

This material may help the conservators identify original layers of the paint as it would have been applied during its use in the water, and not necessarily again after it was taken out of the water.

Initial observations of paint layers

The paint layers are in poor condition overall. There are many losses throughout that demonstrate the many substantial layers of paint from the restorations over time. A small section of the back of the dragon that had been detached was taken by the conservator for experimentation. Through preliminary experiments, it was found through visual examination that in some areas, a gold layer was on top of a of a yellow layer (likely a primer, possibly for oil gilding), was quite possibly the original paint layer. It was found that the aforementioned black material and a green layer on top of that may separate a significant golden paint or gilding layer from the rest of the layers. Below the gold layer is also a yellow, white, then black layers, which possibly were primer layers or additional layers of paint.

As will be discussed in the Analysis section, another gold layer existed right up against the wood and not on top of the yellow primer layer. This was most likely the original layer, and not the gold layer on top of the primer.



A gold layer was revealed below many layers of paint. The layers below it appear to be preparatory layers of yellow and white.

Later analysis of samples from this fragment actually indicated another very thin gold layer below all of these layers, directly on the wood.

Aesthetically, the current paint scheme is inconsistent with historically documented Viking materials and it is likely that the restoration in the 1970’s took some liberties with the color schemes and shading. The dragon and tail as currently painted would look out of place with the rest of the ship and tell a story inconsistent with the reminder of the object.

Research question: What was Christen Christenson copying? Where did he get the idea that the dragon head was gilded? There appears to be historical documents describing dragon heads as gilded, do not know yet of artifacts of remaining gilding <https://avaldsnes.info/en/viking/drakeskip/>

Phase 1 Treatment & Analysis

Treatment Intent

It was expressed by the client that the intent of the treatment would be to determine the original appearance and to return the object to as close as that appearance as possible within reason. The conservator would like to retain the object's historical integrity by first determining through analysis what the original appearance was and which paint layers are original, and then exposing those layers in small areas to fully understand the context.

While it would be intriguing to remove all of the historical paint layers and fills to reveal the true 1893 surface and further define the intricate carving, that treatment would have been very time consumptive, costly, and risky to that original layer. Additionally, during the investigation's excavation of paint layers, it was determined that many of the carved surfaces were manipulated by the restoration efforts over the year- as indicated primarily in the tail's texture. It was unclear if any of the original surface would have actually remained on the tail, as during excavation a substantial amount of putty was underneath the paint layers, and not carved wood.

At this time it was determined with the client that the ideal scenario would be to repaint the object once the original paint scheme is determined, and to retain and document the evidence of the original layers.

Treatment Steps & Analysis

Treatment and analysis proceeded in an iterative process. As more information was learned through testing and analysis, it informed treatment methodologies.

Phase 1: Condition assessment, minor stabilization, cross sections, wood analysis (At Museum of Science and Industry & Offsite)

Documentation

1. Thoroughly documented the current iteration of the object. The 1978/9 (green and red) restoration visible in early 2022 is part of the object's history and the community's interaction with the piece, but it has been determined likely an inaccurate portrayal of the original appearance. This was documented through high resolution photography.

Minor Initial Treatments

2. Vacuumed and cleaned with water overall
3. Areas of structural instability were stabilized utilizing consolidation with Butvar B98 and Paraloid B72. These adhesive choices were dependent on the solubility parameters of the majority of the paint layers, which were not sensitive to acetone and ethanol. Tests performed on the sample of exposed gold on the detached fragment (image above) were sensitive to solvents, but it was believed that this gold layer was quite friable and fragile, and once it was exposed it was sensitive to everything.
4. Testing conducted to attempt to reveal the original paint layers revealed that the best method to expose the original paint layer was to use a scalpel to mechanically remove the brittle paint layers. There was a very indurate white paint layer (likely lead based) that was very difficult and time consumptive to remove with solvents – this inhibited the more careful removal of paint layers that was hoped for. Solvents, paint strippers, none of them were careful enough to utilize to expose only the first paint layer. Mechanical was determined the best and most efficient method, but also had risks due to the possibility of scratching the surface of the wood and requiring very skilled hands.

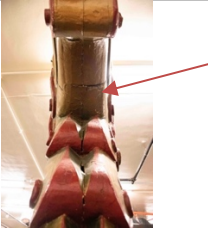



Analysis & Experimentation

2. Wood analysis was performed by cutting appropriately sized sections from detached fragments and sending them to Alden Identification Service for wood identification.

Results Of Alden Identification's Microscopic Analysis

Samples taken March 30th

The full report from Alden is attached- this table serves as a synopsis of the results

Sample # and Name	Sample Location Image	Image of sample	Results
1 – Under Chin			Red Pine Group (<i>Pinus sp.</i>)– likely Scots Pine (aka Deal) (<i>P.sylvestris</i>)
2- PL (proper left side) Tongue			Red Pine Group (<i>Pinus sp.</i>)– likely Scots Pine (aka Deal) (<i>P.sylvestris</i>)

Discussion

From the Alden Report: “Pine (*Pinus* spp./Pinaceae) is composed of at least 93 species world-wide and can be separated into three groups based on their micro-anatomy; the Red Pine Group, the White Pine Group and the Yellow or Hard Pine Group. The Red Pine Group contains about 18 species that grow in Asia (10), Europe/Mediterranean (5), Central America (1) and North America (1). To my knowledge, there are two commercial species, Red Pine (*P. resinosa*) from North America and Scot's Pine, Scotch Pine or Deal (*P. sylvestris*) from Eurasia. All species in this group look alike microscopically.”

3. Representative areas of the paint schemes were explored.
 - A. Cross section samples were taken and sent to McCrone. This would included areas where the paint was likely more stable over time and thus hopefully not include areas of past loss that had been repainted. 3 samples were sent for analysis, which would produce a thick and a thin section of paint layers, which would then be analyzed to determine the types of paint applied early on in the object's history. It would be useful to identify the first primer layer, the first 1-2 paint layers, and hopefully the 1920's restoration.
 - B. Additional samples (8-10) were taken, cast into resin and made into thick sections in order to be compared with the results from McCrone and to further confirm the stratigraphy throughout.
 - C. Areas where there is existing instability in the paint layers (likely near cracking and loss) from representative areas were explored further by additional removal of paint mechanically.

Results Of McCrone's Analysis

The full report from McCrone is attached- this serves as a synopsis of the results.

Sample # and Name	Sample Location Image	Image of sample	Results
1 – Front Chest The green/gold side is the exterior side, the red side is the interior. The red is what we believed was the original red paint layer. This red layer was below some putty, which helped indicate it was original.			-The red layer is composed of mercury sulfide, consistent with cinnabar. -Binder was not indicated in the analysis.

2- PL Back

This sample was from the detached piece from the back of the stempost, where we had found a substantial amount of gold- The red layer is the exterior, the wood side the actual wood from the object. We're interested in if there is a gold layer (and the composition of it) or whatever might be on the surface of the wood.



-A metallic gold layer in the form of flakes (so applied as leaf form) found against the wood below a lead paint layer
-A heterogenous mix of kaolin clay, a sulfate (like gypsum), a resin or shellac consistent with gilding media.

3- Black Layer

This sample was from the detached piece of the head's bac; this was an interior edge that would have mated with another piece of wood. This layer was on interior crevices.



-The black layer's binder is an ester based material like a resin or shellac. Comparing FTIR with Linseed oil is very promising.
-Pigment was not clearly indicated; report indicates layer contains primarily carbon and oxygen, but also silicon, lead, iron, sulfur. This may indicate common black pigments like carbon black or lamp black.

Discussion

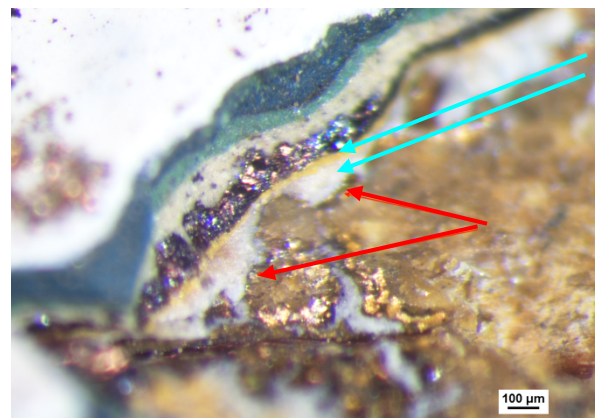
Sample 1

McCrone isolated the layer of interest and conducted FTIR and SEM/EDS on the layer. "The red layer of Sample 1 was composed of major amounts of carbon (C), oxygen (O), and Hg, and minor amounts of S (Figures 4 through 7). The atomic ratios suggest that mercury sulfide is present in cinnabar form (HgS), which was found in a known pigment vermilion. The IR spectra were consistent with calcium sulfate like material such as gypsum and possibly cellulose." The red paint layer was very brittle and not well bound to the surface, so it is possible there was not much of the original binder available for analysis. Gypsum was used in gesso, so there is a possibility that this paint may have been applied like a gesso/primer layer.

Sample 2

McCrone created a cross section of the layers of interest and conducted SEM/EDS on the layer: "The only Au-containing layer observed was found right at the surface of the wood, and the other layers analyzed were lead (Pb) based" and likely from contamination from other layers. The flake morphology "was consistent with gold leaf instead of gold paint."

IR spectra of the gold layer area indicated a heterogenous mix of kaolin clay, a sulfate (like gypsum), a resin or shellac in addition to the gold, consistent with gilding media. The McCrone scientist stated that these gold flakes were found "embedded in the wood surface beneath the initial layers of lead-based paint."



Two layers of lead based paint on top of this layer were white and yellow, with a shimmery layer above it. To the conservator, this indicates that what was found was the original gold layer directly against the wood, and the scheme of white and yellow prep layers below a shimmery layer *above* the gold layer indicates the 1920's restoration.

The conservator notes that sometimes contamination from other layers can lead to misinterpretation, and it would be ideal to replicate this study with areas where it is known that the gold layer is inaccurate, such as the gold found on the scales of the tail where the investigators were confident the scales of the tail were not gilded in the 1893 images.

Red arrows point to where the original gold layer was found directly against the wood, below where the white and yellow lead layers are (blue arrows).

Sample 3

McCrone isolated the layer of interest and conducted FTIR and SEM/EDS on the layer: "The black material was consistent with an ester based material like a resin or shellac." Additional analysis determined the layer was composed "primarily of C and O, but it also contained minor amounts of silicon (Si), sulfur, calcium (Ca), iron (Fe), and lead (Pb) – the lead likely due to contamination from other layers.

Further analysis of the FTIR spectrum by the conservator found that the peaks in the FTIR analysis seemed very similar to linseed oil and pine tar; these materials however were likely evaporated or degraded, and analysis of many samples might be necessary to completely confirm this theory. The calcium and iron from the SEM/EDS analysis, paired with the physical morphology of the black material under the microscope, could also be from carbon black or bone black pigments.

The spectra are located in the attached McCrone report images, and spectra of linseed oil and pine tar for comparison are located:

Linseed oil: <https://spectra.chem.ut.ee/paint/binders/linseed-oil/>

Pine tar: https://spectra.chem.ut.ee/coating_materials/natural-and-synthetic-varnishes/

Results of Phase 1 Treatment, Decision-making Regarding Paint Scheme

Decision making regarding the final color scheme was based on several factors:

- 1) Viewing historic photos from 1893 in multiple lighting conditions/cameras. This indicated to the conservators that there were only 3-4 likely colors, and delineating the largest areas of design. Historic accounts also indicated the color scheme as "gilded".
- 2) Mechanical removal of paint layers, exposing the wood surface and visual observation
- 3) Microscopic and chemical analysis by McCrone

Complicating factors included:

A) This object had been repainted/restored several times; areas of paint loss may have been filled by a later paint layer. The original restoration likely changed much of the object's surface.

B) Historic photos in black and white could possibly show 2 colors with the same tone, which would appear the same. Lighting or the reflection from the ground, the camera, and filters on the camera could change the way the colors are perceived.



Example of a thick section of paint, where many layers and fillers/putties are overlapping. Areas like this will create confusion in analysis and identification.

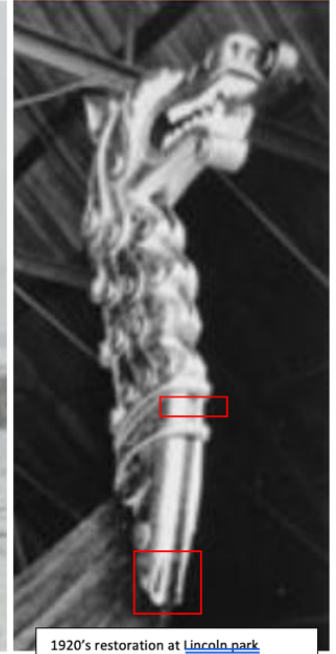
C) The analysis from McCrone was limited, as this is an expensive service. Ideally several locations in the same regions would be analyzed in this way to create a more thorough analysis campaign. It was confirmed that cross section selection had to be very careful, as some layers can overlap/underlap with each other as well as with putties. Which can create an incomplete picture of the stratigraphy of different layers

Final decisions and color schemes were confirmed in a meeting with David Nordin and Bjorn Rektorli

Gold

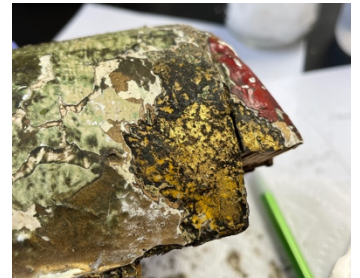
A gold layer was found in areas throughout this entire object, even in areas that did not appear to originally have gold in 1893. This includes the scales of the tail. The scales of the tail have also been re-shaped by putty (smoother, off-white) or carving in comparison of images now compared to 1893.

The 1920's restoration likely did an extensive amount of work. The putties mentioned earlier were also found directly on top of the red layer of the chest (to be discussed later), as well as on top of the black layer on the head, indicating that they were not original. Additionally, there were many areas that had paint and putty pop off of them, revealing an extensively worn surface, likely indicating that the original gold was likely remaining in very few locations (see next page regarding the black/brown analysis).

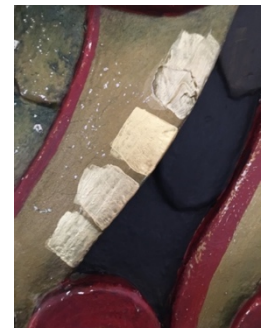


Through SEM/EDS analysis from McCrone, a gold layer found directly on top of the wood surface of the detached curved element of the back of the dragon stempost, was in fact real gold in flake form, thus applied as a leaf.

The gold in the image to the right had a primer layer below and was likely from the 1920's restoration, as it had the same yellow primer below the gold layer that was also present on areas of the tail that were supposed to appear dark but were gilded. This combination signals the 1920's restoration. In areas where the gold is directly on top of wood then indicates the original gold color scheme- but much of this could only be found under the microscope.



The challenge then remained as to what tone/color gold was to be chosen for the restoration. It is understood that this 1920's restoration was the first restoration, and if the expense was taken to re-gild this object with real gold and not a cheaper, fake gold (copper-based), the restorer may have hopefully been as close as possible to the authentic color scheme. Thus, the 1920's restoration was still used to help determine the ultimate gold color scheme. Since the conservator's restoration was to stay on budget and be removable, it was decided that real gilding was not to occur. Different imitation gold paints were tested on the surface of the prepared stem and stern posts, and the final gold selected by the client. "Golden SoFlat Matte Acrylic" in Naples yellow, followed by "Golden fluid acrylic iridescent gold (fine)" was selected as the gold color scheme.



Black/brown

The dark layer in the 1893 images had a fairly inconclusive analysis and was not found extensively throughout the object during the sampling and excavation phase in the areas where it was expected to be found. It is likely possible that most of the black layer was removed during the 1920's restoration, since most of the object was then gilded or painted gold during that time.

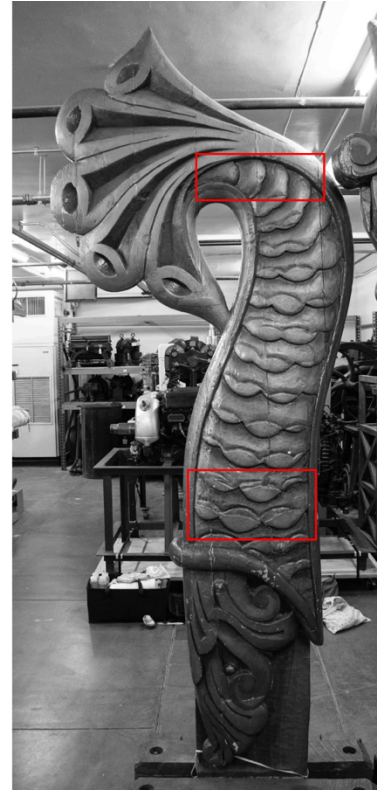
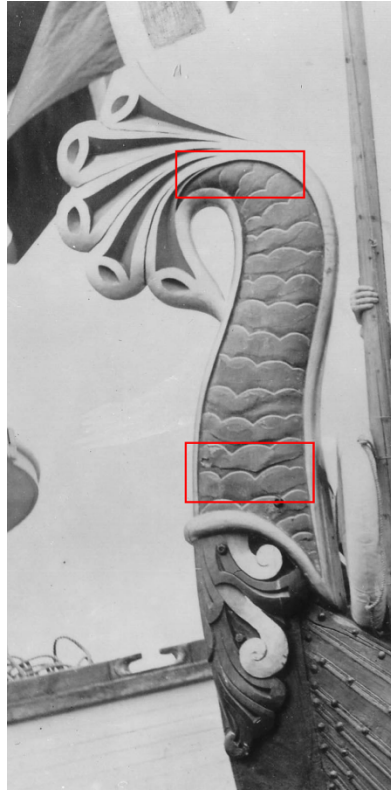
Since the conservators knew these regions were likely to be dark, and that a "boat soup" had been utilized on the remainder of the actual ship, the dark black material found on the interior of the detached piece from the back of the dragon stempost was utilized for analysis.

The analysis of this layer was initially summarized by McCrone as "consistent with an ester based material like a resin or shellac" with additional analysis determining the layer was composed "primarily of C and O, but it also contained minor amounts of silicon (Si), sulfur, calcium (Ca), iron (Fe), and lead (Pb). Further discussion between the McCrone scientist and the conservator regarding the results found that the spectra actually more closely resembled linseed oil and pine tar, with the other additions of turpentine being volatile and not likely remaining in the wood. The iron, calcium, and sulfur could also be from the elements found in carbon black or bone black pigments.

During conservation (post sampling/analysis) however, a large area of a putty/paint area on the top of the head became loose, and revealed a large section of a black material right up against the wood. The wood grain is also visible through the black material, consistent with how the wood grain appears in images from 1893.

A black paint layer was also found amongst the layers throughout this object, none of which appeared directly on top of the wood like this area and the area on the detached fragment – thus it was determined this was likely the original black layer and not from a later restoration.

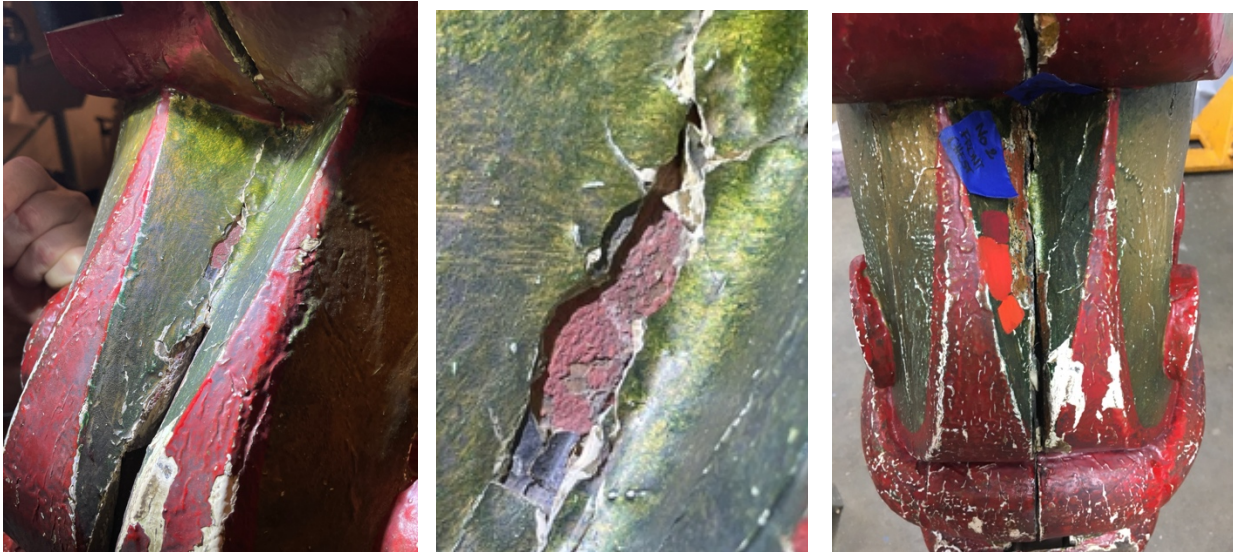
In conversation with Friends of the Viking ship, it was decided to go more brown in tone rather than purely black, due to comparisons of known black elements in photography at the time and the visibility of the wood below the black layer. It is known that photography of the 1980's is not perfectly comparable to current standards, and light angles, shading, light refraction and filters will all impact how the image appears. The brown hue felt more true to a possible black impregnated wood surface. Additionally, in comparison to how the rest of the Viking ship appears now, this would be more consistent.



Red on the chest

Finding a **chalky, vivid powdery red** directly on the wood surface on crevices of chest was surprising. There was also 1 smaller area on the back of the head, indicating this red may have been applied elsewhere, however unfortunately the conservators were not able to find any additional areas- leaving this a possible avenue of further exploration during a future treatment.

The thought that this red layer was original was supported by the fact that there were several areas where the red paint was under putty from the restorations found on the object. This putty, like along the scales of the tail, was added on the chest as well in a very thick layer. This red layer was analyzed, and determined to be cinnabar, thus vermilion the pigment. This exposed area and knowledge of what the pigment cinnabar appeared like was utilized to select the color. The inserts of the chest were selected to be painted red as these interior triangular elements were the only areas where this red was found during this examination.



Left: Location of the excavated area on the chest where the red was found.
to find the white layer below on top of the wood.

Middle: Detail of the chalky red layer on top of the wood, underneath putty. Right: Red test colors to match the original red. It should be noted that cinnabar does color shift over time.

Eyes

Through excavation of the perimeter of the eyes, a white layer was found closest to the surface of the wood. Additionally, the center of the eye was investigated to see if there was any evidence of a line in the eye, and there was not. It is also notable in images from the 1970's that some of the wood of the eyes had to be reconstructed with putty due to loss in the wood.



Left: Excavation of the eye to find the white layer below on top of the wood.

Middle: Dragon during the departure from h norsbryggen Kristiania, demonstrating no evidence of any lines within the eyes.

Right: Photomicrograph of the excavation of the layers of the eye within a crevice. In this photograph you can see at least 5 layers of different whites, and at least 2 layers of gold paint, as well as red, yellow and teal campaigns.

Teeth

Samples from the teeth were not analyzed by McCrone, because there were less questions regarding whether or not they were white in historic images. These were simply excavated mechanically. It was interesting during excavation to find the full range of colors exhibited throughout the object, including yellow, black and teal, in addition to layers of gold.



Left: One area of excavation of paint layers on the teeth. Middle: Detail of excavated area. Right: photomicrograph of the excavated area of the teeth. Note many different paint colors, with red arrow pointing to white layer on the wood

The teeth were covered in a yellowed varnish, so the varnish was knocked back with a bit of sandpaper during cleaning, and the teeth toned with the SoFlat Matte whites to help make them more brilliant, while still allowing the varnish to peek through to allow them an aged appearance.

The green arrow points to the white tooth used as a test for the color.



Phase 2 Treatment

Preparation for and implementation of re-painting

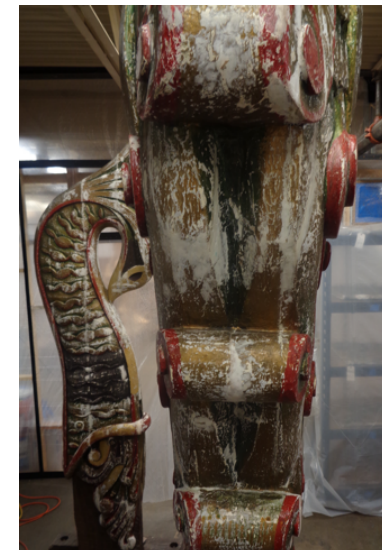
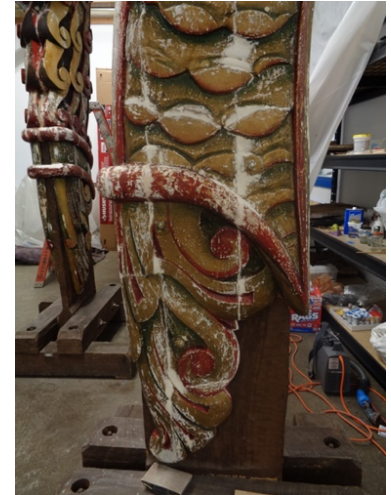
This phase was conducted after Methods & Materials moved the object back to their warehouse for storage and treatment. This work was based on the analysis and decision making above in Phase 1.

1. Documented before, during, and after treatment in written and photographic methods
2. Applied a consolidant and barrier layer in areas of flaking paint, wood, and exposed paint layers. This provided a reversible in case a future individual would like to expose the fills or most recent restoration. The varnish layer from the most recent restoration was abraded lightly to allow for the new paint scheme to be applied. Areas where the surface was very distorted were sanded down to be more consistent- so the 1970's restoration is not completely salvageable.
3. Applied gesso fills in areas of just paint loss, to a reasonable level the surface prior to repainting or gilding
4. Added larger fills as needed in certain areas to support the structural stability of elements. A barrier layer of Paraloid B72 in acetone was added to the wood to help aid in the future reversal of the fill. Fills were conducted with wood shims and tissue soaked in B72 to aid in reversibility for larger areas (like along the top of the head), woodEpoxy and Freeform Air (lightweight) for smaller but substantial fills that needed a polymer within the fill to help hold it in place (like the tongue).

5. Adjusted the hardware within the tongue assembly to hold the bolt in place better, followed by applying putty fills to cover and support the bolt. Putty fills were also used underneath the tongue to bolster areas of wood that were lost, that had been originally carved to hold up the tongue. These were then painted.

6. Re-painted elements corresponding to the above analysis
 - a. Gold: Base color of "Golden SoFlat Matte acrylic" Naples yellow (before the gold is painted on). "Golden fluid acrylic iridescent gold (fine)" on head and tail: (the swirling hair curls, outer lips, around the eyes, base trims of head, and outer edge trims of tail & fan shaped tail end). After all the gold had been painted on and completely dried, then applied a coat of Paraloid B67 with some dry pigments (raw umbers, slight green and brown tones) to give the paint layers some depth.
 - b. Body (scales, background dark color): "Golden SoFlat Matte" acrylic for body of dragon: Raw umber, burnt umber, yellow oxide and tiny bit of titanium white. Plus some "Golden fluid acrylic" (raw sienna). Then after all the acrylics paints have completely dried then applied Paraloid B67 varnish lightly brushed over the background surfaces to give the paint layers some depth.
 - c. Tongue: Golden SoFlat Matte acrylic: cadmium red dark
 - d. Teeth and eyes: Golden SoFlat Matte acrylic: titanium white + yellow oxide + slight hint of raw umber
 - e. Chest: Golden SoFlat Matte acrylic: Pyrrole red + cadmium red light + slight hint of raw umber

7. Since at this time the object will be stored inside, a borate based insect repellent was not applied. The wood has layers of lead and cinnabar, so it may not need additional insect treatment. This is to be determined at a later date.



During treatment images of sternpost and stempost with white fills

Images are provided in the following Google Drive link. The link will expire 2 months upon receipt of this final report.

https://drive.google.com/drive/folders/1dS7fHSWnzBtIQgP3c6ipfNXhXfHh1JDq?usp=share_link