The Dream of Jacob - artist unknown - 16th century

Fig. 1&2. Before and after treatment.

Project number: 0.2016.071
Stichting Restauratie Atelier Limburg
Maastricht, July 2018
Name conservator: Lauren ten Wolde
Supervisor: Kate Seymour
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RESEARCH AND CONSERVATION REPORT

1. Identification

1.1 **Object**: Painting.
1.2 **Artist / allocation**: Unknown / Flemish.
1.3 **Title**: The Dream of Jacob.
1.4 **Date**: 1st half 16th century.
1.5 **Technique**: Oil paint on wooden panel.
1.6 **Description of the painted image**: The foreground shows Jacob from the Old Testament, sleeping in a rock-strewn landscape, using a large stone as his head pillow.\(^1\) He has a red mantle wrapped around his body. In his left hand he holds a scroll. Next to his right side lays a helmet of ‘Eastern’ origin with gold decorations, typical of the Persian army of the 16th century, folded into a white cloth. Jacob dreams of a ladder reaching the heavens. This can be found on the right side of the painting. Three angels are holding onto the ladder. On top of the ladder stands God, bathed in yellow light and opening the clouds. The background consist a fictive city view influenced by Southern Europe, with small houses, large towers and green landscaping.
1.7 **Signature and inscriptions**: None present.
1.8 **Measurements** (height x width x depth): ±79 x 109,2 x (0,5-0,7) cm. The measurements of the width are consistent with each other. The height of the left and right side of the painting are not equal to another. Also, the thickness of the panel varies with a variation of 0,2 cm.
1.9 **Frame**: Frame is present, but added at a later time and therefore not original. It is made from wood and decorated with two gold lines.
1.10 **Owner**: Parish of the *Our-Dear-Lady (Onze-Lieve-Vrouwe)* basilica.
1.11 **Place of preservation**: Treasury of the *Our-Dear-Lady* basilica.
1.12 **Inventory number**: Absent.

2. Treatment data

2.1 **SRAL number**: 0.2016.071
2.2 **Treatments prior to transport**: The placement of facings on the areas with flaking paint to minimalise the risk of paint loss. Japanese paper has been attached to the painting with the use of methylcellulose. The facings were applied on the day of transport: 8th of February.
2.3 **Date arrival**: 8th of February, 2017.
2.4 **Date start of conservation**: 8th of February, 2017.
2.5 **Date end of conservation**: 11th of July, 2018.
2.6 **Date departure**: 13th of July, 2018.
2.7 **Performing conservator**: Lauren ten Wolde.
2.8 **Agreements with owner**: A treatment proposal and accompanying invoice was made and agreed upon by both parties.

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\(^1\) Genesis 28:10-19
3. **Support / technique**

3.1 **Sort of wood:** Based on the wood grain and presence of wood cells such as ‘mirrors’ and the construction period of the painting, the wood can be identified as oak wood.

3.2 **Construction:** The panel was originally constructed out of 3 boards glued together. Placed horizontally.

3.3 **Sawing method:** Radial.

3.4 **Sapwood:** No sapwood has been identified, although woodworm has appeared in certain regions across the panel. The woodworm damage could be an indication of enclosed sapwood.

3.5 **Knots:** Not present.

3.6 **Attachment of original parts:** The boards are glued together. Three dowels are placed along each joint.

3.7 **Traces of working process reverse:** The reverse has been thinned down during the application of a cradle and the original production traces have been lost. Traces of butterfly inserted buttons used to support the splits are situated below the cradle, but are part of a previous conservation treatment.

3.8 **Chamfered areas:** Originally present, but in its current state reduced during the application of the cradle.

3.9 **Captions / inscriptions:** Absent.

4. **Support / condition**

4.1 **Attachment of non-original parts:** On the reverse, wood inserts, called butterflies, were applied to support the re-joined splits in the upper and lower board as part of a previous conservation campaign. Probably during another conservation treatment, these butterflies were removed and the insertions were filled with a wood filler.

4.2 **Additions:** A cradle has been added to the reverse of the painting, probably in the mid-20th century. This was done in order to straighten the curvature of the panel and provide additional support to the re-joined and split panel. The cradle consists of 7 horizontal members and 9 sliding vertical members. In order to apply this lattice work, the reverse of the panel was planed down to create a level in-plane surface and afterwards the horizontal members of the cradle were glued in place. The glued parts have been explicitly placed over the joints and splits. The sliding members no longer function and the construction has created a build-up of tension in the panel support leading to further damage.
4.3 **Fissures:** The upper and lower boards both present a long horizontal split midboard that extends through the entire width of the painting (horizontally). These have occurred due to restriction of the wood’s natural movement, presumably by inadequate fixings into a frame that did not allow the panel to move in response to fluctuations of relative humidity. It is likely that this occurred when the panel was presented in a different frame than the current one. Furthermore, the restrictive presence of the cradle has allowed additional smaller cracks to develop.

4.4 **Broken-off parts:** The wood has split in all the corners of the panel. However, only the upper left corner, seen from the front side of the painting, has a small piece broken off.

4.5 **Dents:** None.

4.6 **Damaged edges:** Due to friction against a frame rebate, the edges have become rough and some areas, especially the corners, have lost paint.

4.7 **Deformation:** The joints and splits have been re-glued/re-joined in the past. There is an out-of-step step alignment in each joint and split which means the panel surface is not in plane. This has added to the visual disturbance of the surface since the different height levels of the boards are clearly visible. The process of gluing the cracked boards back together was done poorly. The re-joints and application of the cradle did not take into account the natural warped
curvature of the panel. Thus the surface has a washboard profile. The internal stress caused by the cradle has further increased this misalignment problem. The deformation is especially visible in the areas where the boards are joined. They have started to warp. Also, the newer cracks have added to the deformation of the painting.

![Image of The Dream of Jacob](image)

Fig. 5. Detail of warped profile. Photograph taken with raking light.

4.8 **Joints:** The joint between the boards are closed with an adhesive and a filler material, but a difference in height is noticeable.

4.9 **Swollen fibres:** Not applicable to wooden panels.

4.10 **Loose veneer:** Not present.

4.11 **Moisture barrier:** The painting has a thick varnish on the front side and traces of varnish on the reverse.

4.12 **Woodworm damage:** Yes, but not active. Flight holes and damage are particularly evident in the lower board, left side.

4.13 **Deterioration by mould:** No.

5. **Ground layer / technique**

5.1 **Material between support and paint layer:** Present.

5.2 **Pre-gluing:** Probably present, but not visible. The painting technique used on *The Dream of Jacob* conforms to period practice. The wooden support would have been prepared before the application of ground layers.

5.3 **Ground layer:** Present on the whole surface.

5.4 **Method of application:** Applied with a large brush. The horizontal brush strokes in the ground layer can be seen with the IRR image. They run along with the wood grain of the panel.

5.5 **Material:** The SEM BSE analysis identified calcium in the ground layers, which can be seen in the topography of the accompanying images (see section 14 Research methods). The spectra of the SEM EDX confirms the presence of calcium. Typical for the time period of the painting’s creation is the use of calcium carbonate.

5.6 **Structure:** The structure of the ground layer is coarse and irregular in thickness and is applied in one layer.

5.7 **Scratching or punching:** No.

5.8 **Colour:** Chalk is white. No additional pigments are found in the ground layer.

5.9 **Layers:** Cross-sections removed from representative areas show only one ground layer.
5.10 **Absorption**: Relative absorption. The ground layer had glue as its binding media.

5.11 **Imprimatura**: Present in a slight brownish colour, which lies on top of the ground layer (as can be seen in Figure 6). The imprimatur is oil based. It contains lead white and ochre/black as additional pigments.

6. **Ground layer / condition**

6.1 **Attachment**: The panel support is under tension due to the restriction of the cradle. This has led to compression forces developing, which have resulted in a loss of adhesion in specific areas. Tenting, cleavage and blind cleavage deformations are present and will continue to develop until tension is released in the panel support. The deformations follow the wood grain. In some areas, the ground/paint layers have become detached. This had already resulted in paint loss.

The presence of at least two filling materials in the losses surmises that this problem is ongoing and has been present for many years.

6.2 **Powder**: No.

6.3 **Blistering**: No.

6.4 **Flaking**: Yes, which has resulted in paint layers that are no longer attached to the support and various lacunae.

6.5 **Cupping**: No.

6.6 **Fillings**: Many fillings are present around the edges of the painting, especially on the bottom edge where there is woodworm damage in the panel support. The re-joined horizontal split in the upper and lower boards and the joints have also been filled during a previous conservation. This is especially evident in the area around the waist of the middle angel.

The fillings by the cracks are also meant to camouflage the height difference (out-of-set alignment) of the boards. This is why they have been partially placed on top of the painted composition.

6.7 **Impregnation**: No.

6.8 **Discolouration**: Not visible.

6.9 **Cracks**: A craquelure pattern runs across the entire surface. This is dominant in the horizontal direction corresponding to the direction of the wood grain of the support.
6.10 **Lacunae:** Present. Some have been filled during prior treatments, but new ones have formed since then due to internal stress as described above.

6.11 **Scratches:** A few scratches are present. Some are deep and have impacted the ground layers.

6.12 **Dents:** No.

6.13 **Mould:** Not present.

### 7. Underdrawing

7.1 **Raster/grid:** Absent.

7.2 **Underdrawing:** Some parts of the underdrawing are visible though observations with the naked eye. For example, some lines are visible through the clothing of the angel on the bottom side of the painting. This is a result of the paint layers becoming more transparent over time. The rest of the underdrawing can be imaged using infrared reflectography (IRR), which is explained in more detail in the section Research Methods. The artist made a first version of the composition with a sketch. The sketch is made in ink applied with a brush. The figure of Jacob and the buildings are executed in simple lines. The shadow areas of the cloak of Jacob contain rougher lines. Two of the angels also have an underdrawing, which show that the artist followed his original plan during the painting phase, with only small alterations.

![Fig. 7&8. Detail of bottom angel. Comparison between underdrawing and painting.](image)

7.3 **Material:** As the underdrawing media is observed using IRR, it is likely that it contains carbon. The brushstrokes visible suggest a fluid medium such as ink. Washes of ink are also observed.

7.4 **Layers:** One layer.

7.5 **Colour:** Monochrome

7.6 **Method of application:** The underdrawing has been executed with a brush. The lines are smooth and thicker in the middle compared to the end of the lines, which have a fine, thin tip. The underdrawing is a sketch and does not contain many details. Hatching and washes indicate shadow areas in some details.

7.7 **Deviation with underdrawing and/or painted image:** Mostly, the painted image coincides with the underdrawing. The only visible deviations can be found by Jacob’s face, his right shoulder, his left foot and the position of the
The head of the bottom angel. A small adjustment was made here during the execution of the painting.

8. **Paint layer / technique**

8.1 **Paint / binding media**: Oil paint.

8.2 **Method of application**: Two methods of application have been used by the artist with a brush, namely wet-in-wet and single layer applications. The image below shows how two layers of paint, a white and a red one, slowly flow together.

![Paint sample. Two paint layers, wet-in-wet applications.](image)

8.3 **Pasty**: The image is finely painted with a smooth finish. A slight relief is visible in the darker, green areas, such as Jacob’s sleeves, where the paint applied is more dense and thicker.

8.4 **Layers**: The painting technique used consists of both opaque and transparent layers.

8.5 **Consistency**: Thin. The structure of the wooden support is visible in raking light. The thickness of the paint and ground layers was insufficient to hide the relief of the wood grain.

8.6 **Construction order**: Mainly, the artist painted from light to dark. Colour areas are spared out. Details are applied on top of underlying paint layers. The image underneath shows the most common painting sequence, where the shadow was put on top of the red area.

![Microscopic enlargement. Painting sequence. Dark was painted on top of lighter coloured areas.](image)

8.7 **Pentimenti**: Present. On the right side of the composition, the artist made corrections that became visible over time due to the paint layers becoming more transparent.
Fig. 11. *Pentimenti*. The top arrow shows greenery becoming visible again, due to the sky area becoming transparent. The bottom arrow shows the mountain reappearing because the yellow colour of the house lost part of its opaqueness.

8.8 **Pigments**: With the assistance of SEM EDX a range of pigments have been identified, namely lead white, vermillion, red ochre, yellow ochre and azurite, among others. This is discussed in more detail in the Research Methods section.

9. **Paint layer / condition**

9.1 **Cracks**: Present. The cracks have been formed by the time the panel was restrained and follow the wood grain.

9.2 **Attachment between layers**: The paint layers are still attached to each other and to the ground layer. However, the attachment with the wooden carrier is fragile due to internal stress caused by the cradle. Paint loss has already occurred as described above.

9.3 **Tenting**: Present and spread across the entire surface. There are areas visible where the paint has been pressed together from its sides, causing it to stand up. Conservation terminology describes them as cleavage, blind cleavage and tenting.

Fig. 12. Detail of tenting paint layers.
9.4 **Cupping:** Yes, but only slightly.
9.5 **Open cupping:** Not present.
9.6 **Flaking:** Present. Losses of paint have occurred as has been described above.
9.7 **Lacunae in paint layers:** Yes.
9.8 **Scratches:** A few scratches are visible.

![Fig. 13. Detail. Scratches in the paint and ground layers.](image)

9.9 **Bleeding:** No.
9.10 **Deteriorating binder:** There is no visible occurrence of a deterioration of the binding media of the oil paint.
9.11 **Powder of paint layers:** No.
9.12 **Decolouration:** Yes. The colours now are not the same as at their time of application.
9.13 **Increase in transparency:** Yes. Especially in the areas with the lead white pigment. The pigment particles of lead white are bound in an oil medium and can form complexes with the free fatty acids in the oil medium resulting in the formation of lead soaps or lead salts.

![Fig. 14. Microscopic enlargement. Dark craters created by lead soaps.](image)

The translucency occurs as soaps are formed in the paint matrix and as the refractive index of the oil medium changes as this oxidises. The RI of the binding medium shifts more towards that of the pigment and the RI of the soaps are closer to that of air. Thus the paint matrix has become more translucent.

9.14 **Reattachment of paint layers:** The treatment of reattaching/consolidating paint layers has been performed during a prior conservation. Documentation from the last treatment in 1988 indicates the use of a synthetic resin. However,
due to internal stress of the wood, the paint layers are coming loose again. Not only in new areas, but also the regions that have been treated before.

9.15 **Pressed paint**: The paint has not suffered from pressure above, but the edges of the boards do contain wood compression as well as pressed paint. This occurred during the re-joining process of the joints and splits where too much pressure was used while regluing the panel.

9.16 **Overcleaned**: Yes. There are areas visible with the stereomicroscope where paint has been removed.

![Microscopic enlargement. Detail of green. An overcleaned area is visible.](image)

9.17 **Fillings**: The joints and splits are filled, as well as various lacunae as described above.

9.18 **Retouches**: Retouches have been applied on the filled joints and splits, as well as on other various areas that were deemed disturbing.

9.19 **Overpaint**: The retouches are not interpreted as overpaint. However, around the joints and splits, retouches have been made that overlap with the original paint layers.

9.20 **Change in shine / opacity**: Yes, due to natural ageing and the process of overcleaning.

9.21 **Mechanical damage**: Scratches are visible, which penetrate the paint layers and also the ground layer underneath.

9.22 **Mould**: Absent.

9.23 **Dirt**: A black layer of dirt lies across the entire surface. Also, several stains and insect excrement are present on the surface of the varnish.

10. **Varnish / technique**

10.1 **Varnish**: Two layers of surface coating can be determined.

10.2 **Material**: The upper varnish layer consists of a natural resin varnish. The fluorescence of the painting showed an overall green appearance, suggesting that it received a varnish of a natural resin. This has been confirmed with the assistance of ATR. During a closer examination of the painting around the edges, a slight orange glow became visible in the UV-fluorescence. This indicated that there was a different layer of varnish lying underneath the previously examined one. It is likely that the older varnish is made from a lacquer, which would explain the
orange appearance. However, the lower varnish layer could not be identified with ATR. More details can be read in section Research Methods.

Fig. 16&17. Details of varnish layers, seen with UV. The left image shows a relative young varnish, while the right image shows an older varnish, which became visible after the younger varnish had been removed.

10.3 **Method of application:** The upper varnish has been applied irregularly with a large brush. This is visible when observing the surface under ultraviolet light. The top layer is thick, but it does not have a consistent thickness. Signs of trickling varnish are visible. UV research shows a spotted appearance of the varnish, a result of it reticulating.

Fig. 18. Detail of the upper varnish layer.

10.4 **Original or not:** The underlying varnish is thicker in some areas than others indicating a past cleaning of the surface. The original varnish was removed during prior treatments.

10.5 **Amount of layers:** The painting has two layers of varnish, which emit different fluorescence, applied at two different time periods. The top layer shows a green fluorescence when it is examined with UV-lighting, while the layer underneath has a more orange appearance.

10.6 **Coloured:** No.
11. **Varnish / condition**

11.1 **Lacunae:** UV research has shown that two areas in the red cloak of St. Jacob are partly deprived of the upper varnish. This is probably caused by a local cleaning treatment.

![Fig. 19. Lacuna in the upper varnish layer.](image)

11.2 **Scratches:** A few scratches are visible.

11.3 **Yellowed:** The upper varnish has yellowed strongly, while the lower varnish has become brown.

11.4 **Blue:** No.

11.5 **Deteriorated:** Yes.

11.6 **Cracks:** The varnish does not show a craquelure pattern.

11.7 **Flaking:** No.

11.8 **Increase in matteness:** No.

11.9 **Staining:** No.

11.10 **Mould:** Not present.

11.11 **Surface dirt:** Present. Besides dust that lies on top of the varnish, there is also dirt which has become imbedded with the varnish.

11.12 **Wearing:** Not visible.

12. **Frame / condition**

12.1 **Material:** The frame is made from wood. It consists of four wooden members joined with mitre joints. The joints are still sound, but the frame is in need of cleaning.

12.2 **Original:** The style of the frame is not in accordance with the 16th-century and therefore not original.

12.3 **Attachment in the frame:** The painting is placed inside the frame with metal strips.

12.4 **Protection for the painting:** There is no protection present in the frame rebate, which has resulted in traces of wear around the edges of the painting.

12.5 **Hanging method:** On both sides of the frame, an eye bolt is placed. Between them a metal cord is strung. This method is outdated.
13. Damage Map

Fig. 20. Damage map made with Photoshop CS5 highlighting the different sorts of damage.

<table>
<thead>
<tr>
<th>Color</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>Cracks, splits, fissures</td>
</tr>
<tr>
<td>Red</td>
<td>Scratches</td>
</tr>
<tr>
<td>Yellow</td>
<td>Tenting paint</td>
</tr>
<tr>
<td>Purple</td>
<td>Losses and retouches</td>
</tr>
</tbody>
</table>
14. Research methods

14.1 Stereomicroscope

A microscope is an aid to someone’s vision, enabling, with the use of reflective lenses, an enlarged image. Because *The Dream of Jacob* does not have a polished or smooth surface, it is not only the reflected light that is being observed, but also a diffusion of light. The stereomicroscope that was used to examine the surface of the panel painting in question had an *Olympus DF* objective with a magnification of x2.0. When looking at the green background on the left side of the painting, namely the bush in front of the small house, it was noticed that its colour was not as bright compared to the surrounding green areas. In fact, it appeared to be dull. The stereomicroscope revealed that the area was overcleaned, which had happened during one of the prior conservations. Two ratios of damage could be seen. First, there was an area visible that was completely deprived from its pigments. Here, only a brown underground was still visible. Secondly, there were areas that did still contain pigments, but only blue coloured ones. The cleaning process had probably resulted in a removal of the more sensitive green pigments, which were still present in other green parts of the painting. The stereomicroscope revealed a sign of deterioration, which had gone unnoticed if the painting had only been examined through simple observations alone.

![Microscopic enlargement. Result from overcleaning.](image)

Some of the retouched areas of the painting have been investigated with the stereomicroscope as well. It revealed a complete different consistency in comparison to the original 16th century paint. While pigments were visible in the authentic paint layers, with their specific outer appearances regarding substance homogeneity, size of pigment particles, pigment shape, colour and state of aggregation\(^2\), the retouching agent did not contain these characteristics. In the retouched areas, no pigments could be found. This is probably due to the fact that in modern day paints, the pigments are either too finely pulverised or the paint is made from colourants, which contain no pigments at all. In this case, when dealing with uncertainties, the stereomicroscope could shed light on the question whether the conservator is dealing with an original area or a retouched area. Examination through the microscope helps in distinguishing paints.

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\(^2\) Aggregation refers to how the pigment particles are attracted and attached to each other.
Next, the cloak of Jacob was examined. The stereomicroscope had to reveal the build-up of the red colour. Where the area was damaged, a clear distinction could be made between the opaque red paint underneath and the red glaze that was put on top to saturate the colour. The fact that there are two different layers present was supported by the different refractive index of the two layers. The glaze showed a lot more reflection of the light and had a certain gloss, while the opaque red layer almost had no shine at all. The varnish in this section had already been removed, so the difference in gloss was not caused by an irregular varnish. Furthermore, in the shadow regions, it became even more evident that the artist had worked with multiple layers. Here, the shadow was put on top of the red with one fell swoop of the brush, which could be identified with the stereomicroscope.

Lastly, the skin tones of Jacob and the angels have been examined and compared. The faces of the angels showed a white/pink substance with a relative fair amount of blue pigments in it; accompanied with only a few red pigments. In contrast, Jacob’s face showed a complete different composition. The image shows a red/orange substance with many red and brown pigments. No blue was present. This showed that the artist composed different paints for his figures. Also, the microscopic approach revealed a sign of deterioration. The skin of Jacob showed the process of soaping, which was happening to the
white pigments. In some areas, the soap particle was no longer adhered to the red/orange substance and had fallen off the painting, leaving behind a dark crater in the paint layer. This form of decay happens to lead white. A lead soap is an organic compound which is formed by the interaction of lead pigments and driers together with the fatty acids of the drying oils used in the paint. In this case, the soaping occurred because the artist did not use the correct ratio between pigment and binding media and used too much oil paint, resulting in a too high quantity of fatty acids.

Fig. 24&25. Microscopic enlargement. The left image shows the skin colour of the angels. The right image shows the skin colour of Jacob.

14.2 **Reflectance Transformation Imaging**
Prior to this technique was the examination of the painting with raking light. With it, the conservator can see distortions of the surface or any small detachments. However, raking light only shows the dramatic changes of the object’s surface, while RTI gives all states of change, along with the structural issues. RTI enhances the appearance of all the surface’s subtle details.

Fig. 26. Front side of *The Dream of Jacob*, before treatment, seen with raking light.
RTI works with a series of digital photographs, which are shot from a stationary camera position. In this case, the painting was laid down on the floor, with appropriate cushioning underneath, and photographed with a camera attached to the ceiling. A Nikon D7100 with an AF-S Nikkor 18-70mm lens was utilised for this purpose. The subject was then illuminated under various lighting conditions.

The technique refers to an imaging processing method where each pixel in the image contains information about luminance as a function of the direction of incoming light. This process produces a series of images of the same object with varying highlights and shadows. This is done to reveal the surface’s true shape. In total, 48 images were made of *The Dream of Jacob*. The painting was approached from 12 directions, working with the clock method. The 4 angles used were the ground state, 12, 27 and 42 degrees.

With the RTI, the painting technique of the artist came into view. Not only the fibres and the grain of the wood became visible. Especially in the green coloured sleeve of Jacob’s clothing, the brushstrokes and relief of the paint could be seen.

The RTI has revealed that the painted surface has different kinds of crackle patterns. Multiple sorts were detected. Also, this imaging process has shown the actual extent of the out-of-step alignment of the boards. Not only did the splits have a different height level, but the original joints as well. This would suggest that the boards have been separated before and have been re-glued during one of the previous conservations. Furthermore, certain fissures have a different height level compared to their surroundings, which is an indication that the wood is under a lot of pressure and that there is a risk of the fissure cracking further and becoming a split.

The RTI examination has also shed some light on the quality of the old fillings, which were applied during prior treatments. It had become clearly visible that the fillings were not at the same height level compared to the rest of the painted composition. This meant that they could not be re-used and had to be removed before the retouching treatment could commence.
14.3 **Ultraviolet fluorescence**

UV fluorescence imaging is a technique to examine the surface of an object. It does not penetrate the layers of the painting, as would happen with infrared and X-ray, but UV-fluorescence is still a good technique to show the retouching, overpaints and varnish that lay on the surface of the painting. Also, residue of glue and other spots of either dirt or old conservations can be made visible through UV fluorescence.

The fluorescence of *The Dream of Jacob* showed an overall green appearance of the painting, suggesting that it received a varnish of a natural resin. Remarkably, there were parts present that did not fluorescence at all. Certain retouches, especially those applied on the joints, were dark. And, on the bottom of Jacob’s cloak, a cleaning test was found. Here, the varnish had been thinned down, and therefore, it did not have the same green fluorescence as the rest of the painting.
There were also retouches that had become very bright, as can be seen in the clothing of the angel in the middle. For these retouches, the conservator made used of zinc white, which has a very strong ultraviolet absorbency.

Fig. 30. Detail. Fluorescing retouches.

The application of the varnish is very uneven and many irregularities can be seen. It was probably applied with a large brush when the painting was in an upright position. There are areas visible where the varnish started to run, as was already described in section 11 Varnish condition. These are especially visible in the tree in the centre of the composition in the form of dripping varnish. This could have been prevented by laying the panel horizontally and letting the varnish dry before putting it back up.

Examining the painting even closer, around the edges, the UV-fluorescence showed a slight orange glow. This indicated that there was a different layer of varnish lying underneath the previously examined one. In this case, examination with ultraviolet light revealed that the object was varnished twice. Probably once during the conservation treatment at the beginning of the 20th century and again when it was conserved in 1988.

14.4 **Infrared reflectography**

Infrared reflectography is a non-destructive method that reveals some of the aspects of a painting that are hidden underneath. It reveals underdrawings, preliminary sketches, and with it, last-minute compositional changes.

At the SRAL, a Nikon (Micro-Nikkor 55mm f/1:2.8) lens was mounted onto a Hamamatsu camera head. The actual infrared process took 510 recordings of the whole painting, which then had to be composed into a coherent image using the program PTGui. IRR imaging has revealed the compositional techniques of the artist and, with it, has shown that he made a very elaborate underdrawing for his painting.
When comparing the painted image with the infrared image, it becomes obvious that the artist did not divert very much from his original concept. He only slightly altered the appearance of Jacob’s face from a saddened expression to a more neutral one and he may have altered the thickness of the trees in the background. The only other changes he made are the position of the heads of the angels, lifting them a bit more up or down during the actual painting process.

Besides answering questions, the IRR findings have also led to more questions. Remarkable is the fact that the head and wings of the angel, positioned halfway on the ladder, are nowhere to be seen in the infrared image. A clear explanation for this occurrence cannot be given. It can only be suggested that the artist either did not feel the need to include this angel in his drawing and that he would construct the head and wings as he progressed with the painting, or that he run out of carbon-containing ink and continued his drawing with a material that does not absorb the infrared rays. Since it is unlikely for this artist, who made such an elaborate drawing, to suddenly skip the head of the angel, it is assumed that he made a drawing with a different material.
To broaden the research field concerning the panel painting *The Dream of Jacob*, it had been decided to perform X-radiography. This is a non-invasive method that helps gain a substantial amount of information without harming or intervening with the object.

Thanks to the high penetration power of X-rays, which are high-energy electromagnetic waves able to traverse the artwork in all its thickness, X-radiography is a fundamental imaging technique for the perception of the integral structure of the object. In other words, X-radiation is able to penetrate the entire painting, from its surface all the way through to the panel carrier. This means a thorough depth investigation of the painting can be performed. The X-ray image not only shows the different layers of which a painting consists, it also reveals the development of a painting, such as damages and repairs.

The painting is presented in a white, grey and black colour scheme. What immediately becomes evident is the cradle construction applied to the reverse of the panel. The image shows that the horizontal slats are precisely placed onto the splits and joints of the panel.
Thanks to the *EZE Platypus* software, in the original X-ray image, the lines of the cradle were removed. This made a better examination of the X-ray possible.

Fig. 37. X-ray image of *The Dream of Jacob*, with the cradle partially hidden.

The most striking are the lighter painted areas, such as the white cloth around the helmet, the angels, the clouds surrounding God and the face of Jacob, which appear white in the X-ray image. This suggests that the artist made use of paint containing lead. Also the small details, such as the two pearls decorating the saint’s collar, are highlighted in the X-ray image. It is highly probable that they were made with paint containing lead-tin yellow. Even the folds in Jacob’s red cloak appear white in the X-ray image. This is because the paint contains mercury (see section 14.7 SEM EDX research), which has a comparable molecular weight as lead and also blocks the X-rays in a similar fashion. This distinction needs to be kept in mind when examining the painting with X-radiography. They will both appear in a white manner on the X-ray image.

Some light can also be shed on the painting sequence. In this case, the artist painted in multiple colour schemes. For example, when examining the sky, it becomes obvious that he painted the sky and trees next to each other. In other words, there is no overlap between these two colour ranges. This can be seen thanks to the lead component in the paint for the sky. The lead absorbs the X-rays, while the brown earth pigments of the trees do not (because they are composed out of lighter elements). This is why the sky area appears more white and the trees appear dark. If the artist had decided to first paint the sky and afterwards place his trees on top of it, then this would have become visible with the X-radiography. The trees would then have had a more white appearance, which is not the case. Instead, the artist decided to paint the background in a separate sky-tree-sky-tree sequence.

Imaging with X-radiography has also shown how the three boards of the panel were originally attached to each other. In six areas, there are signs of the use of
dowels; an extra method to strengthen the joint and to make sure that the boards would not shift while the adhesive was curing. However, not all of them are still present. The X-ray image has clearly shown that some of the dowels are missing, leaving behind a hollow area. This meant that the joints have been opened before and then glued again during a previous treatment. This is not only proven by the fact that there are hollow areas present, where the dowels used to be. There is also an out-of-step alignment noticeable on the X-ray image. The lower board has shifted slightly to the right in relation to the middle board.

Fig. 38. Detail of the dowel. Its bottom halve is missing.

This gave reason to re-examine the front side of the painting and see what kind of effect the shifting of the boards had on the painted composition. Looking at the bottom angel, a misalignment in the registration of the painting became obvious.

Fig. 39. Detail. An interruption in the registration of the painted image.
The X-ray image has proved to be a necessary tool for imaging the previous conservations *The Dream of Jacob* has undergone, which are not visible with the naked eye. For example, the top and bottom boards of the panel have cracked and split in half. From the outside, it can be seen that the boards have been reattached with glue. The clear white appearance in the X-ray image shows that the gap-filling adhesive must contain lead. Subsequently, this imaging technique has shown that the splits were strengthened with butterflies. This was probably done to make sure the boards would not shift while the adhesive was curing.

![Image of X-ray image](image)

Fig. 40. Detail of a wood incision called a ‘butterfly’, an outdate conservation technique.

However, the butterflies were removed during another conservation treatment and the holes were afterwards filled with a filler material. This becomes clear when examining these regions, because there are some openings present of where the butterfly used to be.

In the case of *The Dream of Jacob*, X-radiography was also a vital technique to help examine the structural integrity of the panel. At the back of the painting it had become obvious that it had suffered from a woodworm infestation. Fly-out holes were visible at multiple places. In these areas, the consistency of the wood could be compromised. Because the damage consists of small holes (and tunnels) in the wood, the X-rays will go straight through them and they will appear black on the X-ray image. For the conservation of the painting, it is important to know how extensive the woodworm damage is and whether the wood has become fragile in these areas. With X-radiation, an assessment can be made whether the wooden carrier is in need of a consolidation treatment or not. Unfortunately, although the X-ray images showed multiple dark spots, indications of the fly-out holes located at the sapwood areas, no tunnels could be recognised. This was due to the fact that the fillings, applied during a previous conservation, were covering up the image. Therefore, an assessment of the damage could not be made.

14.6 **Sampling**

A historic painting will often show a complex multi-layer build-up with heterogeneous mixtures of organic and inorganic compounds. To see them, an embedded cross-section is required. The surface is examined under a microscope in search of a loss area in the desired colour range where the
sample can be taken. It is easier to extend the damaged area ever so slightly compared to creating a whole new damaged section. With a scalpel, the paint layers are lifted up until they break off and a sample is obtained. In this case, the extra loss was minimal, but large enough for an examination under the microscope with a x20 magnification.

Two areas were probed, the red cloak of Jacob and the pinkish red roof of one of the houses in the composition. The aim was to analyse the red pigment used by the artist. Red is known for being a sensitive colour when it comes to cleaning and varnish removal. Some red pigments are more resistant to solvents than others, and vice versa. By gaining information about the pigment, the choice of solvents can be adjusted accordingly.

The sample of the cloak has shown that the red paint is an almost homogenous substance. The red pigment particles had about the same size and shape and were accompanied with only a few other coloured pigments. A few larger sized black pigments were also present.

![Fig. 41. Sample. Ground and paint build-up. Sample taken from Jacob’s cloak.](image)

Something could also be stated about the ground layer. The artist created a fatty ground layer, containing a lot of the oil binding medium. This could be seen by the large, round-shaped molecules.

The sample of the red roof revealed a bit of extra information. On top of the ground layer, the artist applied a thin *imprimatura* layer; probably to cover up his underdrawing. This transparent, brown layer would ensure that the artist’s initial sketch remained visible during the actual painting process.

![Fig. 42. Sample. Ground, *imprimatura* and paint build-up. Sample taken from a pink roof.](image)

With the samples, an interpretation of the artist’s painting method could be made. While examining the red roof compilation, it became obvious that he first applied a layer of lead white and afterwards a red layer. Since the two
colours flow into each other, this is proof that the artist painted with the wet-on-wet method (*alla prima*).

14.7 **Scanning Electron Microscopy Energy Dispersive X-ray spectroscopy**

With the SEM EDX technique, the surface of a sample is scanned with a high-energy beam of electrons. The electrons then interact with the atoms of the sample and produce signals that contain information about the sample’s topography and chemical composition. Especially the secondary electrons carry vital information.

The red cloak of Jacob has been examined. Only a small portion of the sample itself was needed for the SEM imaging, as can be seen below.

![Image of Jacob's cloak](image)

**Fig. 43. Sample of Jacob’s cloak.**

In the topography images, the different elements are highlighted in their own colour. The carbon had the brightest image and was the most present in the sample. This was due to the preparation phase, which happened before any measurements could be taken. In order for the element detection to perform properly, the surface of the sample needed to be entirely covered with carbon. Carbon particles had to make the sample conductive, so that electrons could pass through it.

The carbon result will be ignored in the interpretation of the rest of the SEM images and graphs. The other elements that the sample contained were mercury (Hg), silicon (Si), sulphur (S), calcium (Ca), lead (Pb) and iron (Fe), which are visualised below.
The Dream of Jacob, artist unknown, 16th century, O.L.V. basilica

Fig. 44 (carbon) & 45 (mercury) & 46 (silicon) & 47 (sulphur) & 48 (calcium) & 49 (lead) & 50 (iron).
After examining the coloured images, a few comments can be made. First, it must be noted that only in the ground layer the element calcium can be found. It makes up the chemical compound called calcium carbonate, CaCO$_3$, which is a common substance found in chalk; and chalk was the main ingredient for the ground layer of Netherlandish 16$^{th}$ century paintings.

Concerning the paint, it contains mercury, sulphur, lead and iron. These four elements can be used for the identification of the pigment. However, the quantity of each element cannot be measured with these images. It only shows that they are present in the paint sample.

And thirdly, the silicon image does not give a lot of information, but it does suggest to have a look at the accompanying graphs of the SEM EDX research and see how large the peak for this element is.

For the spectra, two indicative points in the cross-section were selected in order to obtain a clear overview of the different components present in the paint. After multiple tries, and after adjusting the parameter for carbon so that its peak would not appear as strong, the two measurements gave results without any discrepancies. The two main elements that were present throughout the paint were identified as mercury and sulphur; as can be clearly observed in spectrum 30. In spectrum 18, lead was also found, but not as much as the two previous elements.

Fig. 51&52. Graphs from the SEM EDX.
The elemental composition revealed by the SEM EDX is a high indicator of what kind of pigment was used for the red paint. With the help of the *Pigment Compendium*, it has been identified as vermilion. Vermilion is the historical term for the synthetic form of the mineral cinnabar. It is won from the brick-red coloured ore of mercury(II) sulphide, with a HgS formula. The presence of lead in the graph could be an indication that the artist mixed his pigments, for example, with lead white or even red lead. This was not an uncommon practice in the 16th century and was done to cheapen the painting process, since vermilion was quite a valuable pigment. However, this remains only an assumption, because in SEM EDX examination the value for lead can overlap with the value for sulphur. Also, it is said that vermilion turns black when it is mixed with a lead component, which is not the case for *The Dream of Jacob*. With the small presence of iron it is possible to assume that the artist used his vermilion in combination with red ochre. But again, this cannot be stated with complete certainty.

14.8 **Attenuated Total Reflection**

This research method allows the chemical characterisation of organic and inorganic materials. The result from an infrared analysis is a spectrum, where the percentage of transmission and absorbance of the sample is plotted in a graph against wavenumbers (cm⁻¹). An instrument called the *Golden Gate* is used, which probes the surface layer of the sample with a range of 0.5 to 3µm. For *The Dream of Jacob*, a sample was taken from the top varnish layer. The young (yellowed) layer, which was probably applied during the conservation of 1988, was very flexible and easy to remove with a scalpel. This young varnish layer had a positive reading. The *OMNIC* program showed a graph with distinguishing peaks that were recognised as ketone resin N.

![Fig. 53. ATR spectrum of upper varnish layer.](image)

Some of the peaks were analysed and their functional molecular groups were identified as three oxygen containing compounds and one nitrogen containing compound.
Running the results through the database revealed a 78.27% match with ketone resin 67200 from Kremer, which confirmed the hypothesis described above. Ketone resin was a common varnish used in the 1980’s. To use it, it was solved in turpentine with a small percentage of a non-drying oil. It was used as a final protective coating after all the other treatments, such as retouching, had been completed. It can be assumed that a similar varnish to this ketone resin was used during the 1988 treatment. For the current conservation, this result meant that removing the yellowed varnish would not prove too difficult. Alcohols would be sufficient to dissolve the varnish. Regrettably, the second varnish could not be identified. The sample was taken in a different method compared to the upper varnish. A cotton swab was sterilised and then dipped in acetone. The area where the young varnish layer had been removed, revealed the old varnish layer. The cotton swab was applied to it and with rotating movements a small portion of the varnish was removed. Afterwards, the cotton swab was pressed until a drop of varnish and solvent was formed. After the solvent had vaporised, a sample of the brown varnish could be taken. Its functional groups did not give a conclusive answer to the question of what kind of varnish this layer consisted of. This was due to the fact that the graph did not contain recognisable peaks that corresponded with varnishes in the database. The unconventional method of taking the sample was probably one of the reasons why a proper reading was not possible.

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15. **Conservation proposal**

**Treatment panel**
- Application of facings over loose paint
- Removal of surface dirt
- Consolidation of tenting and flaking paint/ground layers
- Removal of varnish and old retouches
- Removal of old fillings
- Removal of cradle
- Separation and re-joining of boards – if realisable
- Application of new fillings
- Application of base tone
- Application of a first (saturating) varnish layer
- Retouching damages to paint layer
- Application of final varnish

**Treatment frame**
- Removing the painting from the frame
- Cleaning of frame
- Adjustments to frame in order to support the panel
- Reframing the painting

**Documentation / research**
- Photography in visible light
- Damage mapping
- Microscopic examination
- Reflectance Transformation Imaging
- Photography under ultraviolet radiation
- Infrared Reflectography
- X-radiography
- Sampling: observations with visible and ultraviolet light
- Scanning Electron Microscopy and Energy Dispersive X-ray
- Attenuated Total Reflection

**Total**
- 562 hours (documentation and treatment)
16. **Conservation report**

16.1 **Application facings**
Facings have been applied to protect the flaking paint during transport. These were made from Japanese paper and adhered onto the surface with methylcellulose. This step in the conservation ensured that the already loose and fragile paint layers would not fall off before treatment could commence.

Fig. 55. Detail. Facings.

16.2 **Surface cleaning**
The cleaning process of the surface has been performed with iso-octane. To ensure that the solvent had the desired effect, tests were first executed. A cotton swab was dipped slightly in the solvent and then gently rubbed over the surface in a rotating motion. Multiple locations of the painted surface have been tested, namely the sky areas, the brown and green vegetables and the red cloak of Jacob.

For the tests, approximately 10 to 15 rolling movements were used for each cotton swab. This is not a standardised method, so comparison between the swabs cannot be made. However, the results shown in the table below reveal the extent of the dirt that was present on the painting’s surface.

| Surface cleaning with iso-octane |
|---------------------------------|-----------------|
| Nr.   | Area                        | Result |
| 1.    | Blue sky; top left          | ![image](image1.png) |
| 2.    | Brown tree; top left        | ![image](image2.png) |
| 3.    | Dark vegetable; bottom left | ![image](image3.png) |
4. Red cloak; centre

5. Green vegetable; right side

6. Pinkish roof; right side

7. Blue sky; top right

Fig. 56. Table showing results of the surface cleaning.

Other hydrocarbon solvents were also tested, such as White Spirit and Shellsol T. However, these products did not have the desired effect. Even with ongoing and sustained rubbing, the cotton swab only absorbed a small quantity of dirt. Compared to iso-octane, the other two solvents did not give the anticipated result. For an optimised cleaning, the process of cleaning with the iso-octane was issued twice. This ensured that also the remaining dirt residue was removed.

Despite the fact that the painting was quite dirty, and the cotton swabs contained a lot of soil, there was not a noticeable difference concerning the appearance of the painted image before and after cleaning. However, a surface cleaning is essential in the conservation of the painting. A cleaning ensures that the dirt will not be mistaken for paint during the treatment of varnish removal. Also, cleaning the surface is necessary to degrease the varnish so that it will not impede the solubility of the varnish.

16.3 **Consolidation paint layers**

The consolidation process was executed with sturgeon glue, with a 4% concentration (weight to volume) in water. The consolidation was carried out using raking light to highlight areas of cleavage and tenting. The glue was first allowed to run into the crack. The area was warmed with a hot air pen set at 40°C. Once the ground and paint layers had become more flexible, the raised section was gently pressed downward.

The spatula had a silicone head. The silicone head was self-made and attached to the metal head. The silicone was from the brand Aquasil Ultra Digit (Dentsply), the LV Regular set. The silicone was created out of a two component mixture, which was mixed together while pressing out the components of the container evenly with a syringe dispenser. With this small silicone head, there was a softer point of contact between the spatula and the painted surface and the surface was rendered non-stick. Also, there was no longer a need for a sheet of Melinex, so the consolidation process could be observed more carefully.

The loose paint layers could be consolidated by applying the sturgeon glue. The glue needed a short period of time to let it set, so that the glue would sink through the cracks and small holes and underneath the paint layers. Afterwards
it was pressed down with the spatula, which had been warmed up, to secure the paint layer in place.

![Fig. 57. Securing and adhering the loose paint layer.]

Some areas were difficult for the glue to reach. To solve this problem, the painted surface was first wetted with a solution of water and ethanol (a 10% concentration) before the glue was applied. This would help the glue to creep underneath the paint layer. The tent shaped raised areas of paint were approached more carefully. They could not be pressed down that easily without breaking the fragile paint. They were first damped with the glue and heated with the hot-air pen; of which the air stream and temperature could be regulated. This would ensure that the rigid paint would become flexible. Afterwards, the tenting paint was pressed down with the spatula and fixated.

16.4 Varnish removal
Before the actual removal of the varnish could begin, tests were performed in order to establish the solubility of the upper and lower varnish coatings. Since each varnish layer consisted out of different materials, it meant that both would need a different approach for its removal. This is why testing was necessary in order to choose a suitable cleaning method and minimise potential risks.

16.4.1 First varnish removal
Isopropanol, ethanol and acetone were employed for the removal of the upper, younger layer of varnish, which was probably applied during the conservation of 1988. Cotton swabs were dipped into the solvent and then rubbed over the surface.
First, the blue sky was tested on the upper left side. This area was chosen because it contained lead white, which makes it more resistant to solvents compared to dark and red colours. The isopropanol removed the varnish and it required 8 swipes in order to do so. The ethanol gave the same result, but needed a shorter working time (6 swipes) compared to the isopropanol. The acetone had the strongest effect among the three solvents and only required 3 swipes to remove the varnish.
Secondly, the brown rock formation in the left bottom corner was tested. Without effort the isopropanol removed the varnish. Only a small amount of rubbing was needed. The ethanol also easily removed the varnish and only a few swipes with the cotton swab were necessary. The acetone had a strong
effect and blanched the surface. The paint layers were not affected, but it was a result of the solvent reactivating the old layer of varnish underneath. The testing revealed that working with acetone would be the fastest approach to removing the varnish, but its effects could not be easily determined compared to the approach with isopropanol and ethanol.

The red cloak was also tested. The left far end of Jacob’s cloak was subjected to isopropanol. The solvent removed the varnish, but red traces were visible in the cotton swab. It was not expected that the treatment of the varnish in the red area with isopropanol would also result in a removal of small quantities of paint. This is why the area was examined under the stereomicroscope. It revealed that the red traces on the cotton swab were from a retouch that was hardly visible to the naked eye. This meant that the testing with the isopropanol was a success, since only the varnish and some of the overpaint were removed. However, as a precaution, the remaining two solvents were not tested in the area of the red cloak, because they had the potential to dissolve the oil paint. More risk was involved compared to isopropanol. Their effect on the red paint could not be predicted, and therefore, they were exempt from the testing phase.

Next, the red roof was tested in order to see whether the red paint would be affected or not. Fortunately, the red paint remained intact and proved to be resistant against all three solvents. This was due to the fact that the red paint used on the houses was not a glaze, but a mixture of pigments, such as lead white, vermilion and red lake pigments. Concluding the testing phase for the upper, younger varnish layer was the green area on the right side of the painting. The varnish was removed with the isopropanol without difficulty.

<table>
<thead>
<tr>
<th>Varnish removal (younger layer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area</td>
</tr>
<tr>
<td>Grey sky; top left</td>
</tr>
<tr>
<td>Brown rock; bottom left</td>
</tr>
<tr>
<td>Red cloak; left side</td>
</tr>
<tr>
<td>Red roof; left side</td>
</tr>
<tr>
<td>Green tree; top right</td>
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</tbody>
</table>

Fig. 58. Table showing removal tests of the upper varnish.

It was decided to remove the varnish from the entire surface with isopropanol, because it would do no visible harm to the paint layers. The varnish residue on the cotton swab had a very yellow appearance, which was a sign that it was either a natural resin varnish or a ketone resin varnish.
The red areas of the painted composition needed to be approached more carefully. Not only because it was part of the main subject of the painted composition, but also because ultraviolet light examination had shown a lesser fluorescence compared to the surrounding composition; revealing that Jacob and his cloak had been cleaned before. The process of removing the varnish was observed closely under the stereomicroscope. The close surveillance with the microscope revealed that the younger varnish was safely taken off the surface with isopropanol.

### 16.4.2 Second varnish removal

During the first testing phase, it became clear that the older layer of varnish was more resistant to the solvents that were used to remove the upper varnish layer. A different approach was needed. It was decided to work with a solvent-gel-system, since the liquid solvents did not manage to solve the varnish. It was the speed of evaporation that was considered the disadvantage of using liquid solvents. A gel does not increase the potential of a solvent to dissolve the varnish, but it holds the solvent onto the surface so it has more action time to interact with the varnish material.

Thanks to its high viscosity, a gelled solvent will be held more on the surface and will not penetrate into the lower layers through capillary action. The solvent will reach the paint layers through diffusion and will fill wide cracks. The activity between the solvent and the varnish is held on the surface. This allows the gelled solvent to be more effective.

Other types of gelled cleaning systems are also available. These are based on aqueous solutions which are designed to work at a specific pH value. By using a specific pH, the varnish molecules can be ionised or encouraged to de-bond to adjacent molecules, allowing the solution in a co-solvent to occur more easily. The macromolecules of the varnish can be reduced in size and these smaller molecular masses are more easily put into solution. Aqueous solutions of predetermined pH are also effective at solubilising oil media for the same reason. The pH of the solution should be stabilised using a buffer to ensure that the pH of the cleaning solution does not change during application.

#### 16.4.2.1 The first step

The first step was performing tests with different solvents thickened in an aqueous Pemulen gel. The TR2 product was selected because this delivers a polar solution. Three versions were made, which varied from each other concerning their pH level.

For the pH=6.5 version, 2g of the Pemulen TR2 was suspended in 50mL of demineralised water. This would create the gel. Then, 1.575g of triethanolamine was solved in 47.5mL of demineralised water. To create the stock gel, the two mixtures were combined and stirred vigorously. Next, to prepare the 1% working solution, the gel was diluted with an aqueous solution with a 1:1 ratio (volume : volume). For 5g of Pemulen gel, a 5mL aqueous preparation was needed. The aqueous solution was made from 2mL of concentrated bis-tris hydrochloric acid (10% molar concentration) and 3mL of distilled water.

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4 The recipes for the Pemulen gel-system were given by Chris Stavroudis, a paintings conservator in Los Angeles, during his workshop ‘The Modular Cleaning Program’.
Bis-tris is the buffer. This is another material from the HCl, which is used to adjust the pH to the desired working pH. After some stirring, the gelled mixture was ready for use.

<table>
<thead>
<tr>
<th>Pemulen pH=6.5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stock gel</strong></td>
</tr>
<tr>
<td>Compound 1</td>
</tr>
<tr>
<td>2g Pemulen TR2 in 50mL demineralised water</td>
</tr>
</tbody>
</table>

| **Working solution** |
| Compound 3 | Compound 4 | Mix of 3 and 4 |
| 5g Stock gel | 2mL bis-tris hydrochloric acid (10% molar concentration) in 3mL distilled water | Combine compound 3 with compound 4 to create working gel-system |

Fig. 59. Table explaining the preparation of the Pemulen pH=6.5 working solution.

16.4.2.2 For the pH=7.5, a higher concentration of the ingredients was necessary. To the Pemulen mixture (2g Pemulen TR2 in 50mL water), a combination of 2.95g tri-ethanolamine and 45mL water was added to create the stock gel. Again it had to be stirred strongly. Afterwards, the rinsing agent was prepared, which contained 2mL of tris hydrochloric acid (10% molar concentration) and 3mL of ionised water. For the working gel, the 5mL aqueous solution of the rinsing agent was added to 5g of Pemulen gel.

<table>
<thead>
<tr>
<th>Pemulen pH=7.5</th>
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<tbody>
<tr>
<td><strong>Stock gel</strong></td>
</tr>
<tr>
<td>Compound 1</td>
</tr>
<tr>
<td>2g Pemulen TR2 in 50mL demineralised water</td>
</tr>
</tbody>
</table>

| **Working solution** |
| Compound 3 | Compound 4 | Mix of 3 and 4 |
| 5g Stock gel | 2mL tris hydrochloric acid (10% molar concentration) in 3mL distilled water | Combine compound 3 with compound 4 to create working gel-system |

Fig. 60. Table explaining the preparation of the Pemulen pH=7.5 working solution.

16.4.2.3 The last gel that was made, had a pH=8.5. Again, 2g of Pemulen TR2 was combined with 50mL of water. Then, 5.24g of sodium hydroxide (10% molar
concentration) was added to 42.5mL of water. With extensive stirring, the Pemulen gel and solution were mixed for the creation of the stock. For the preparation of the working gel, 5g of the Pemulen was combined with an aqueous solution, which also functioned as the rinsing agent. It consisted of 2 parts of bicine sodium hydroxide solution (10% molar concentration), which serves as a buffer, and 3 parts of water. The same combination of gel and aqueous solution was maintained as with the other two gels, namely a 1:1 ratio (volume : volume).

<table>
<thead>
<tr>
<th>Pemulen pH=8.5</th>
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</thead>
<tbody>
<tr>
<td><strong>Stock gel</strong></td>
</tr>
<tr>
<td>Compound 1</td>
</tr>
<tr>
<td>2g Pemulen TR2 in 50mL demineralised water</td>
</tr>
</tbody>
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<table>
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<tbody>
<tr>
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<tr>
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</tr>
</tbody>
</table>

Fig. 61. Table explaining the preparation of the Pemulen pH=8.5 working solution.

16.4.2.4 To check whether the gelled mixture maintained the desired acidity, pH-strips were employed.

The varnish removal process was followed closely with the microscope. The gelled cleaning mixture was applied with a brush and then spread across the surface that was to be treated. It was important to keep the gelled cleaning mixture in motion in order to enhance its solubility properties.

The mixture functions as follow: It has a protonating effect on the molecules of the varnish. The regular chain of the molecule ends with the -COOH functional group. The acidity of the gelled cleaning mixture adds a proton, which results in a separation of the molecule into an H+ and a COO-. This first process of ‘breaking’ the varnish apart was necessary for its eventual removal. After the varnish had begun to react to the treatment, the gelled cleaning mixture, together with the loosened varnish, was removed with a cotton swab. The area was then cleaned even further and neutralised with the same aqueous solution that was needed to make the gel system.
The pH=6.5 version needed a fair amount of time to remove the varnish. Strangely enough, the pH=7.5 showed almost no result. On the other hand, the pH=8.5 gel removed the most varnish. The speed of the process could be increased by adding a few drops of benzyl alcohol to the pH=8.5 gel.

16.4.2.5 Other gels were also tested for the removal of the second layer of varnish. The product Klucel G was employed for the process. The Klucel G powder was solved in acetone with a 3% weight to volume concentration. After stirring the mixture for 10 minutes, a thickened solvent mixture was obtained. The gel could be directly applied to the surface of the painting.

<table>
<thead>
<tr>
<th>Klucel G gel system</th>
</tr>
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<tbody>
<tr>
<td>Compound 1</td>
</tr>
<tr>
<td>3g Klucel G powder</td>
</tr>
</tbody>
</table>

However, after its application, it became obvious that this gel system would not work with this painting. The acetone evaporated too quickly, leaving the cellulose ether behind as a coating which did not have a solubility effect on the varnish. In other words, the Klucel G gel system did not have enough time to take effect. The varnish was only partially solved.

16.4.2.6 The testing phase was concluded with a third gel system, made with ethanol. The Klucel G was again solved in the solvent with a 3% (weight : volume) concentration. This solvent-gel-system was able to affect the varnish longer compared to the acetone gel system. The varnish could be solved with the ethanol gel system by slowly moving it across the surface with a brush and cotton swab. However, not all of it was removed and some parts of the varnish remained.
**Klucel G gel system**

<table>
<thead>
<tr>
<th>Compound 1</th>
<th>Compound 2</th>
<th>Mix of 1 and 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>3g Klucel G powder</td>
<td>100mL ethanol</td>
<td>Combine compound 1 with compound 2. Stir to create solvent-gel-system</td>
</tr>
</tbody>
</table>

Fig. 64. Table explaining the preparation of the Klucel G gel with ethanol.

16.4.2.7 It was decided to continue the varnish removal treatment with the *Pemulen* pH=8.5 gel system in combination with a drop of benzyl alcohol, since this gave the best result. A sticky brown varnish was removed as can be seen below.

Fig. 65. Removal of the lower varnish layer.

To prevent any risk to the paint layers, the effect of ionising was reduced as much as possible. This meant that after the application of the gelled cleaning mixture and its removal with the cotton swab, it would be given the appropriate amount of time to dry. Only after the evaporation of the water component of the gel system would the rinsing agent be used to remove the varnish.

This way, the water from the rinsing agent would have a minimal effect, because it was deprived of the chance to interact with the water from the gel system. This would prevent defragmentation of the paint layers. The treatment proceeded smoothly and the *Pemulen* gel system was efficient in the removal of the old varnish, as can be seen in the compiled image.
16.5 Removal old retouches
The painting knows at least two time periods of when retouches were applied. The most recent retouching treatment happened during the year 1988. These had become discoloured and matte. They were considered aesthetically disturbing and it was decided to remove these entirely. During the first varnish removal phase with isopropanol, these retouches were also removed, which proceeded with relative ease.

The older retouches were applied around the time when the splits were glued and filled. This process happened somewhere in the first half of the 20th century. It was assumed that the retouches were made with an organic binding media, such as oil paint, which had caused them to cross-link. They were more difficult to take off. Isopropanol did not provide enough solubility for their removal. But since they were also visually disturbing, it was not an option to leave them on the painting. The second varnish removal treatment also made it possible to remove these last retouches and revealed the filling underneath.

16.6 Removal old adhesive
During the conservation of 1988, the conservator worked with a synthetic resin to adhere the ground and paint layers back to the support. These glued areas appeared as a glossy substance lying on top of the surface and darkening the paint underneath. Because they had a higher level compared to the original paint layers, these glued regions could interfere with the future aesthetic appreciation of the painting. They would have a different reflective index compared to the paint layers.
Even though there was access to the treatment report of 1988, the conservator at that time made no comment of which product was used for the consolidation. This was unfortunate, because even after the first varnish removal treatment, the adhesive was still present. Subsequently, the gel used for the removal of the old layer of varnish also did not contain the correct properties to dissolve the aged resin. However, since the report did mention the use of a synthetic resin, it was highly probable that it was a PVA (polyvinyl acetate), which can be solved in an alcohol. A different gel was employed for the process of removing the aged adhesive. The mixture contained 2g Carbopol, 3.83g Ethomeen C/12 and 11.35g Ethomeen C/25, which were suspended in a solution of 60mL benzyl alcohol, 40mL xylene and 4mL water.

<table>
<thead>
<tr>
<th>Compound 1</th>
<th>Compound 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2g Carbopol</td>
<td>60mL benzyl alcohol</td>
</tr>
<tr>
<td>3.83g Ethomeen C/12</td>
<td>40mL xylene</td>
</tr>
<tr>
<td>11.35g Ethomeen C/25</td>
<td>4mL water</td>
</tr>
</tbody>
</table>

The gel was able to soften the aged glue. Only a working time of 5 seconds was needed. With a cotton swab, slightly dipped in acetone, the gel and glue residue were easily removed from the painting’s surface.

16.7 Removal old fillings

It was necessary to remove the old fillings due to the following reasons. First, with the assistance of raking light and RTI, it had become apparent that the fillings were not at the correct height level. Some of them lay below the surface and some above. There was too much of a difference between the fillings and the original paint layers for them to be re-used.

Secondly, during treatment, it became evident that a large portion of the fillings was not only applied on the lacunae, but also covering up original paint. This was especially noticeable at the joints of the panel, where the previous conservator had overfilled the losses and probably attempted to make the height differences less obvious by trying to create a smooth transition between the boards.

The process of removing the old fillings from the areas where the splits and joints were glued was approached mechanically. To soften the white filling, the Pemulen stock gel with a pH=6.5 was used. After half a minute, the filling
could be scrapped away with a scalpel. This was a delicate procedure and had to be dealt with caution to prevent any scratching.

Removal of the fillings on the left side of the bottom split had revealed the extent of the woodworm damage, which was much worse than was previously speculated. Much of the wood got eaten away and the panel was no longer able to support itself in this area (addressed in more detail in section 16.12).

16.8 Cradle treatment

A clear visible disturbance of the surface was noticeable, which was mainly caused by two factors. First, a restriction of the wood’s natural movement was caused by an insufficient frame and cracks were formed that run through the entire length of the panel. In this case, bad framing locked and fixed the panel, which made it difficult for the wood to react to fluctuations in the relative humidity of the surrounding environment. This issue was addressed during previous conservation treatments, which led to the second problem, namely the out-of-step alignment. The boards were not in plane anymore and a different height level was clearly visible. This influenced the aesthetic quality of the artwork in a negative way.

Furthermore, the condition of the support had been compromised. The back of the object was planed down by shaving off multiple layers of wood. This was done to make a flat surface for the application of a cradle. The cradle was intended to straighten the wood and to keep the panel in a flat position. However, the sliding battens of the cradle had become locked into position as this wood reacted to changes in relative humidity as well. As a result, both the effects of relative humidity on the original support and the inability of the cradle to deflect these movements, compression set has caused tenting in the paint layers and the creation of micro- and hairline fractures in the wooden support.

Tension by the cradle has led to a wavy appearance of the surface of the painting, called a washboard profile. The deformation is especially visible in the areas where the boards are joined, because their edges have started to bend. Especially with raking light, the deformation can be clearly seen. The visual disturbance of the surface is also caused by the different height levels of the boards. The process of gluing the cracked boards back together was done poorly during a prior conservation.

All this gave reason to remove the cradle and release the stress that had built up inside the panel.

16.8.1 Sliding battens

First, an attempt was made to only address the sliding battens of the cradle. If the tension could be released by treating the battens, and letting the wood of the panel move freely again, then this was preferred.

For the removal and treatment of the sliding battens of the cradle, the panel needed to be fastened onto a sturdy underground with a flat surface. A wooden board was selected, which was 40cm longer and 25cm wider than the painting itself. The painting needed to be placed face-down onto the wooden board. In order to protect the image, Japanese paper was placed over the painted surface of the panel.

Due to the deformation of the wood of the painting, namely a washboard profile of the surface, a cushion had to be devised to support the painting. A
sheet of felt, with a thickness of 6mm, was cut into the exact size of the painting and was placed between the board and the panel. To ensure it would not shift, the felt was stapled onto the wooden board. Afterwards, the cushion had to be adjusted slightly in order to compensate the wavy surface of the panel. Extra sheets of felt, cut into small sizes, were added around the edges of the painting in order to give additional support.

After the supporting underground was assembled, the painting was placed face-down onto it. The next step was to secure the painting and, with it, prevent the risk of it moving. Any movement could prove to be a danger to the painted image. Friction could lead to more paint loss. To avoid this possibility, a framework was built around it, keeping the panel in place. Onto the supporting board, and surrounding the painting, pieces of wood were installed. On the right and left side of the painting, long wooden slats were screwed into position. The areas where the sliding battens were located needed to be open, so on the top and bottom side of the painting, small pieces of blocks were installed. These were measured and precisely cut. They had a length of 6.5cm and a width of 5cm. They were placed between the openings of the sliding battens. The framework ensured that the painting could not shift or move into any direction.

Fig. 69. Visualisation of the fastening system.

The next step was to construct a method for pushing out the sliding battens with evenly applied force. With the use of three large metal clamps, with fixed positions, which bridged the panel over its entire width, the sliding batten could slowly be pushed out. The two outer clamps were tightened into position and were fixed onto the constructed framework. The middle clamp was attached to the other two clamps with the help of a metal bar, sliding through the three slots of the clamps. This was done only on one side of the clamp, the other side of the middle clamp remained unfastened. Afterwards, a thin metal plate was placed between the screw of the middle clamp and the sliding batten. By slowly turning the screw, the metal plate was pressed against the wood of
the batten. Continuing the pressure ensured that the batten was slowly pushed out of its tight enclosure.

Fig. 70. Removing sliding batten through a clamp system.

To ease the movement of the sliding batten, its top side, which contained a coating, was scrapped with a panel scraper. The coating, that hindered the batten moving through its slot, was taken off. After this process, the scrapped areas were cleaned with a vacuum cleaner, to ensure that the residue would not creep into the holes of the horizontal battens or underneath the battens themselves.

The removal of a sliding batten was done in multiple steps. After scraping away the varnish, the batten was once again pushed further by tightening the middle metal clamp. Whenever the screw of the clamp had reached its maximum extending capacity, the metal plate between the clamp and the batten would be replaced by a longer one. The size of the metal plates varied with a length of 9,5; 15; 20; 29,5; 39,5 and 60cm.

After a sliding batten had been pushed out of the cradle, it was fixed into a wood workshop bench and thinned down with a hand plane. By removing thin layers of wood, the batten would be enabled to slide with more ease through the slots of the horizontally placed battens. Its top side and its two flanks were thinned down. With the use of sanding paper, the wood of the batten was made smooth. Subsequently, the batten was placed back into its original spot.
Fig. 71. Thinning down the sliding batten.

The result of this treatment was immediately noticeable. The wood of the painting could move again; although only to some extent. Applying minor pressure by hand on the joints of the panel resulted in a slight, but desirable movement. Enabling the movement of the sliding battens had resulted in a partial release of the stress that the painting was experiencing before. However, when a profile was drawn by tracing the edges of the painting, there was no visible change in its curvature. The dimensional response of the panel was still only minimal. This indicated that the panel had not yet received complete freedom of movement and internal stress was still very much present.

Fig. 72. Result after batten treatment.

16.8.2 Wood routing
After the first step in the treatment of the cradle, it became clear that thinning down the sliding battens was not enough to release the stress that had been building up in the panel. The painting remained in a forced straightened position. Therefore, it was decided that a complete removal of the cradle was necessary in order to ensure future stability of the painting.
The most efficient approach to remove the glued pieces of the cradle was to cut down into its wood and take away layer after layer. A wood router was issued for this purpose. The painting was still fastened in the constructed framework described above, which was essential for this phase of the treatment. The painting was not allowed to move while the router was used to hollow out the wood of the cradle. Any unwanted movement of the painting could lead to a removal of the original wood. This had to be prevented. To ensure that the wood from the painting was not affected, the machine was set up to remove 2mm at a time until only a thin layer remained.

The reverse of the panel was marked with yellow tape, in order to point out the weak areas of the wood, such as the areas that contained woodworm damage. Next, the course of the wood router was predetermined. The horizontal areas between the vertically placed sliding battens had to be removed. The sliding battens were kept in place as long as possible in order to keep the panel levelled. If the panel would start to curve during the cutting, it could compromise the routing process, since this would mean that the surface of the panel would have irregular height differences. Only after the entire reverse had been freed from the cradle, would the painting be released from the framework.

In order to ensure that only the horizontal bars were routed, a rectangle shape was cut out of a wooden board, which lay on top of the panel as a bridge. It was screwed onto the construction framework. The opening of the board was 9.5cm wide, which was 1cm shorter than the actual distance between the sliding battens. This meant that the sliding battens would remain fastened at several thin points and could keep applying minimal pressure to the panel, keeping it straight throughout the treatment of the cradle. On top of the board, two long slats of wood were screwed, creating a fixed lane for the router.

Fig. 73&74. Routing process.

After the necessary preparations, the process of routing the glued battens could commence. The wood router was manoeuvred by hand. A router of the brand DeWalt (number DW620) was used, together with a blade with an 8mm diameter. At 900W, the blade would have a rotation of 24000 spins per minute. With a zigzag movement, the wood of the cradle was trimmed until only 1mm remained.
16.8.3 **Sawing**

The vertical sliding battens were still held into position thanks to the remaining parts of the horizontal bars. During the 3rd phase, these were removed. With a Japanese saw, the remaining wooden squares of the cradle were sawn in half. After this was achieved, they could be bend into the opposite direction of the opening. With a little force, they were chipped off.

16.8.4 **Chiseling**

The panel no longer received downward pressure now that the sliding battens had been removed. Because the removal of the cradle had not yet been completed, an addition had to be made to the construction framework. A horizontal bar was screwed onto the framework that bridged the whole length of the panel. Underneath, slats were shifted into place. They were being pressed down onto the panel by the bridging bar. Some needed to be adjusted by placing extra pieces of balsa wood. This precaution ensured that the painting would not curve until the last step of the cradle treatment had been completed.
Even though most of the cradle had been taken off from the reverse of the painting, and only very thin rectangles remained, the treatment did not end there. In the areas where there was still a thin layer of the cradle remaining, the wood of the panel would react differently to fluctuations in temperature and relative humidity compared to the areas that are completely freed from the cradle. This would result in a worsening of the washboard profile of the panel. This meant that even the 1mm layer of wood had to be removed. This process was done manually.

With an adjusted chisel, the 1mm thick wood was thinned down even more. The hold of the chisel was bended slightly. This meant it could be placed flat onto the surface of the panel, ensuring that the original wood would not be chiselled away.

16.8.5 Removal of cradle’s adhesive
The final phase of the treatment concerned the removal of the very last layer of the cradle. This not only included the remaining wood of the cradle, but also the adhesive that had it adhered to the panel. First, the nature of the adhesive had to be determined. A cotton swab was wetted with acetone and swiped across an area where the adhesive was easy to access. No noticeable change was visible and the adhesive remained stiff and stable. With this test, it was concluded that the adhesive was not a PVA. Subsequently, the adhesive was moistened with water, which caused it to swell slightly and become sticky again. This test revealed that the adhesive, used to attach the cradle to the reverse of the painting, was animal glue.
With the assistance of an aqueous gel, the adhesive underneath the wood could be swollen. The product Laponite was employed for this approach. A 10%
concentration was made (weight to volume), by solving 1g of Laponite powder in 10mL water. Laponite is a synthetic clay which swells to produce a clear, colourless thixotropic gel when dispersed in water.\textsuperscript{5} It was applied with a brush and received 10 minutes of working time. After this time window, it became visible that the gel was slowly being adsorbed by the grain of the cradle’s wood. Another layer was then applied with the same amount of action time. Afterwards, the adhesive had also softened and, together with the remaining wood of the cradle, it could easily be scraped away with the chisel. This process was repeated until all the residue of the adhesive was removed. In the areas with woodworm damage, where the animal glue had deeply penetrated the wood of the panel, multiple tries were needed to remove it. With a small palette knife the remaining adhesive was picked away. Observing the painting under UV-light showed the effect of the removal of the glue specifically. The animal glue had a green fluorescence.

![Fig. 81. Overall view of reverse with UV. The top of the reverse shows the cleaned areas, while the bottom still contained the cradle’s adhesive.](image-url)

16.9 Cleaning reverse

After the cradle had been removed, the dark coating on the reverse of the panel was treated. It did not fluorescence under UV-light, which meant it was either a varnish of unknown origin or not a varnish at all. Neither was the coating a wax, which usually has a yellow appearance with UV-lighting. Solvent cleaning had to start without additional information about the coating’s characteristics. Fortunately, the first try with acetone proved to be very effective. A cotton swab was dipped in acetone and the surface of the coated wood was wetted. Due to the acetone’s fast evaporation, the action time of the solvent was short, but efficient nonetheless. The coating was partially removed. Where the coating had deeply penetrated the panel, through the veins of the wood, it could not be removed. However, its thickness, and with it its

\textsuperscript{5} https://www.researchgate.net/post/What_is_Laponite (visited on 18.09.2017)
influence on the panel’s absorption and desorption capabilities, was reduced significantly. The obvious gloss was removed and the panel’s wood even regained some of its original colour.

![Image of the panel with gloss removed](image1)

Fig. 82. Removing the unidentified coating from the painting’s reverse.

### 16.10 Observation panel movement

Removal of the painting’s rigid support had led to an unavoidable increase in convex curvature. After the cradle had been removed completely, the panel was given the opportunity to acclimatise and adjust dimensionally to its new situation. The framework was removed in steps. The downward pressure from the framework was released slowly over the course of a few days. These multiple points of release at different moments in time were necessary to prevent the panel from damaging itself. If the release of pressure was immediate, and the painting would curve too fast, it would have caused stress to the paint layers. This could result in a weakening of the adhesion between the paint layers and the wooden carrier, and eventually lead to paint loss. A slow adjustment of the curvature of the panel was required in order to protect the front side of the painting.

A visible change was noticeable. The panel had started to curve, especially around the edges of the left and right side of the painting. Drawing a new profile showed that the painting had bended in total with 8mm.

![Images of the panel before and after cradle removal](image2)

Fig. 83 & 84. Comparison between the situations before the cradle removal (left) and after its removal (right).
16.11 **Boards separation**
The panel originally consisted of three boards. Through extensive research it became clear that both joints had been re-glued in the past. Furthermore, the upper and lower boards had split in the middle of each board throughout the length of the painting. These splits had also been glued in a previous conservation treatment. The repair of the splits did not take into consideration a continuation of the surface and resulted in an out-of-step alignment of the profile.

Furthermore, the poorly executed re-joining process left its mark on the painted composition as well. While the adhesive was curing, the boards must have shifted, causing a discontinuation in the registration of the painted image. This is especially visible with the bottom board, as was emphasised in section 14.5.

After the cradle had been removed, a new assessment was made of the stability and structural integrity of the painting. To help in this evaluation, the illustration below was made.

![Diagram of the splits and joints of the painting](image)

**Fig. 85.** Visualisation of the splits (blue) and joints (green) of the painting, separating it in 5 boards (A to E).

16.11.1 The top split (1) was very weak and it could move upwards and downwards independently at its poorly glued areas. This was due to large openings in the glued split, which were especially visible from the reverse of the painting (previously covered up by the cradle). Leaving it in place would have been irresponsible, since the chance of it breaking off on its own was very high. The adhesive had failed over almost the entire length of the split. Slightly wiggling board A up- and downwards was enough for it to be separated from the overall panel without effort.

16.11.2 Secondly, joint 1 was assessed. This joint was still securely fastened. However, it was deemed necessary to separate the boards here as well due to the height differences between boards B and C. From the reverse of the painting the adhesive between the joint was mechanically removed with a scalpel. The adhesive was also securely scratched away from the front side of the painting. Ethanol was injected into the joint in order to dry out the animal...
The Dream of Jacob, artist unknown, 16th century, O.L.V. basilica

...glue that was holding the boards together. This resulted into the adhesive becoming brittle, which made it easier to pick it away with the scalpel. In the end, after enough animal glue was removed, only a bit of wiggling was needed to separate board B from the whole.

16.11.3 Thirdly, joint 2 was treated. This was where the boards had clearly shifted and where the painted image was interrupted. It was approached in the same manner as joint 1. There were a few areas where there were openings between boards C and D. This was where a thin spatula was inserted between them and used to push the opening further. After reaching the middle of the joint, the remainder of the joint easily gave out. The adhesive failed thanks to the amount of ethanol and board C was separated from boards D/E.

16.11.4 After separating the first split and two joints, only boards D and E remained attached to each other. Split 2 was the most difficult part to approach. Firstly, the integrity of the wood was compromised by extensive woodworm damage. Secondly, during a previous conservation, boards D and E were pressed together with a significant force, causing the boards to slightly overlap. And thirdly, the applied pressure caused the weak wood fibers to be crushed and wood compression was the inevitable result. This meant that, in certain areas, the scalpel and the pallet knife could not fit between the boards. The wood of board E was weakened and could not handle too much maneuvering of the scalpel and spatula. Difficulty in separating the boards was increased due to the fact that the split did not run in a straight line from front to backside. On the contrary, the split ran in a slanting angle, which hindered the process. This meant that the scalpel had to be pushed into the split in an angle as well. Also, because the edges of the boards dipped downwards and board D overlapped board E in its entire length, the boards were challenging to separate.

Concerning split 2, the separation of the boards was handled differently compared to the other split. Instead of ethanol, water was used here to slowly soften the animal glue and to make the wood fibers of the panel swell. The adhesive was scraped away from the reverse and from the face side of the painting. The right side of the split was opened without risk, but there were two areas in Jacob’s cloak where the split suddenly ran in a different direction, which complicated the separation process. The split ran upwards and compressed wood fibers prevented the spatula from reaching the front side of the panel while being placed into the opening on the reverse. Wiggling board E upwards and downwards, while having the spatula secured between the boards and pressing against them, slowly opened the split. This process was repeated until the boards could be separated from each other.
Consolidation wooden support

After the separation process, and creating 5 independent boards, the woodworm damage could be evaluated and treated. First, the edges of the boards had to be cleaned. The remaining animal glue would otherwise prevent the consolidation agent from properly penetrating the wood. It was therefore removed with Laponite. The Laponite gel was given 20 minutes to soften the adhesive before it could be scraped away. In order to clean inside the small grooves a steel brush was employed.

For the consolidation treatment of the woodworm infestation, the product Paraloid B72 was employed. For the appropriate consistency, 20g of Paraloid was solved in 100mL of Shellsol A. This solvent was chosen for its slow evaporation time, which would allow the consolidant to distribute well through the wood. The solution needed one day for the Paraloid pellets to completely dissolve while it was being stirred constantly. The resin had to be thin enough in order to properly penetrate the network of woodworm tunnels, as well as thick enough to give a certain body to the voids. This is why the viscosity of the consolidant could not be too high or too low. The eventual consistency of the resin was a syrup-like, but still fluid liquid.

The woodworm was no longer active, but it had weakened the structural integrity of the wood. In order to prevent wood compression during the rejoining process, where pressure needed to be applied, the Paraloid had to strengthen and stabilise the support. In other words, the Paraloid resin would have to ‘replace’ the missing wood fibers, ensuring that the wood would not collapse when pressure is applied. Also, the consolidation was necessary to ensure that the bottom board especially would be able to carry the weight of the boards above.

The Paraloid was injected directly into the flight holes with an injection needle. The networks of tunnels served as a distribution system for the consolidant. Through capillary effect, the consolidant was drawn deep into the wooden support. After the resin was given 10 seconds to penetrate, another
dose was injected until the tunnels were flooded. This would result in a proper impregnation of the wood.⁶

![Consolidation of woodworm damage.](image)

The consolidation took 2½ days to complete. Afterwards, the boards were left to rest for 3 weeks in order to let the solvent evaporate. The fact that the wood no longer felt ‘spongy’, and had acquired a certain hardness, indicated that the treatment was a success.

16.13 **Re-joining panel**

The splits in the panel, which were poorly re-joined in the past, required a conservation treatment. Not only was the painted image out of registration, but also an out-of-step alignment between the boards was clearly visible. This also included the original joints of the panel, since a difference in height between the boards was noticeable. Generally, panel paintings are re-joined in order to improve the structural integrity of the panel, while also preserving the object as a whole.⁷

16.13.1 **Re-joining split 1**

The first step of the re-joining treatment was executed under guidance of Ray Marchant.⁸ He visited the SRAL in December, 2017 for a week and during this time he shared his expertise and closely surveyed the re-joining process of *The Dream of Jacob*.

Split 1 was appointed first, re-joining boards A and B. The re-joining process had to be executed in several steps. First, a proper workspace had to be installed. The separate panels needed to be secured in order to prevent any shifting during the actual gluing phase. Two vertical boarding were placed underneath board A, giving it the needed support. Subsequently, a bridge system was installed, which would allow pressure from above and underneath with the help of wooden props. This would fasten the board, as well as ensuring a corrected height level. Then a rigid bridge was installed and clamped to the table. The bridge ran precisely above the joint that had to be glued. It would enable placing props and packers between the joint and the bridge and applying pressure where needed.

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⁸ Member of the Simon Bobak studio, Hamilton Kerr Institute, te Eburystreet in Londen.
A few dry runs were performed in order to get familiar with the re-joining methodology. With the first dry run, only pressure from above and from underneath was applied with wooden props. This was done to get a feeling for the procedure and also to learn about the wood’s flexibility. Where the two vertical boards were positioned were the locations of the focus points. The focus points secured the panel in place, not allowing it to move in any direction. Concerning all the other areas of the panel, the height could be adjusted with the wooden props. In order to decrease the washboard profile of the panel an overall curvature was necessary. This was held into consideration while putting the props in place.

The second dry run was performed while also applying pressure from the sides of the boards. This would be a simulation of the actual re-joining process, only without an adhesive. Certain props were placed in a different angle, sometimes even at a different position, compared to the first dry run.

After the second dry run was completed, the boards were released again. A thin layer of varnish was applied along the sides of the boards as a protective coating. This would ensure that the adhesive would not affect the painted surface. Furthermore, it would be easier to remove any adhesive residue from a varnished surface compared to an unvarnished surface. It was decided to work with Regalrez, a 20% concentration in Shellsol D40.
For gluing boards A and B back together, a gap-filling adhesive was issued. Marchant advised the use of fish glue in combination of coconut shell flour and phenolic microballoons. With this, the gap-filling adhesive would obtain an appropriate cohesion. In other words, it would receive a similar consistency as the wood that was going to be glued. When the wood of the panel reacts to changes in the surrounding climate, the adhesive has to react accordingly. If it is too hard, the adhesive will lead to tension and may cause the wood to break. This should be avoided. However, the cohesion of the gap-filling adhesive cannot be too weak. If it is too soft, a proper joining of the boards cannot be achieved. The adhesive needs a bulk so that it will be stiff enough and will not creep.

Furthermore, there has to be a good adhesion between the two substrates. The adhesive needs to contain filler materials in order to bridge the gap between boards A and B. Most of the time, an adhesive alone is not enough. If the distance between the two boards is more than 1 Angstrom, then an extra filler is needed to bridge the distance. This is why a correct balance between the adhesive and filler materials is essential.

<table>
<thead>
<tr>
<th>Adhesive</th>
<th>Filler</th>
<th>Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kremer fish glue No. 63550</td>
<td>Phenolic resin microballoons &amp; coconut shell flour</td>
<td>Fillers 1:1 (w/w) &amp; 1 g filler mixture in 5 mL adhesive</td>
</tr>
</tbody>
</table>

Fig. 91. Recipe used for the gap-filling adhesive.

The edges of boards A and B were first wetted with Kremer’s fish glue. This was done in order to give the gap-filling adhesive a little bit more time to dry. Applying the gap-filling adhesive onto a fish glued surface, wet-on-wet, would increase the working time, instead of applying the gap-filling adhesive directly onto the wood, wet-on-dry.

With a palette knife, the gap-filling adhesive was applied to the edge of board A. The board was then quickly placed into position against board B and the wooden props were placed back as was done during the dry runs. Pressure was
applied from all directions and the alignment between the boards was checked constantly.

![Image of checking the alignment between the boards.](image)

Fig. 92. Checking the alignment between the boards.

Once the newly glued split of boards A and B was given the right fit, the needed amount of pressure and adjusted height level, the residue of the adhesive was removed with a wetted cotton swab. Afterwards, the panel was left to rest for 2 days.
Once the gap-filling adhesive had set, the protective coating was again removed with Shellsol D40 and the re-joining treatment for split 1 was completed.

16.13.2 **Re-joining joint 1**
The re-joining process was continued with the re-joining of joint 1. During this stage, boards A/B and C were put back together.
Contrary to split 1, a wood plane had to be used for the edges of the joint, to ensure that no parts were sticking out and got in the way of a tight enclosure between the boards. Split 1 did not require to be planed since the jagged ends ensured an aligned fit.
With joint 1, there were some areas where the boards would not join, leaving an opening. In these cases, a wood insert had to be made. The inserts were made from oak wood and their wood grain ran in the same direction as the original panel. If the insert had a different direction of the grain, it would hinder the panel during fluctuations in humidity and temperature and cause unnecessary pressure. This is why the inserts had to be precisely made.

![Image of wood insert.](image)

Fig. 93. Wood insert.
Considering the panel’s deflection, during the re-joining of joint 1, props were put underneath the boards, elevating them for 8mm. Also, because board C had a twist, it had to be held into position with a clamp at its outer end, or else it would slightly flip up while applying pressure. The props and clamp ensured that the joint of the boards would be nicely levelled and would not drop at their edges. The curvature was necessary to prevent a washboard profile, illustrated underneath.

Right

Wrong

Fig. 94. Illustration of the desired and undesired curvature.

For the gluing stage, the same procedure was executed as described above. First, a few dry-runs were executed before actually attaching the boards back together.

16.13.3 Re-joining split pieces: Before boards D and E could be re-joined, the small fractures had to be treated. Both boards had edges with cracked wood sticking out. These small splits had to be addressed first, before the overall split could be re-joined. To complicate matters, these small splits were no longer at the same height level as the boards. Corrections in the out-of-step alignment had to be made as well.

Fig. 95&96. Split piece of board E.

The product Friendly Plastic from SCULPT was used to make a mould, which would redirect the pressure that was needed to put the split piece of wood back in place. If the pressure was applied directly, it would press down onto the thin piece sticking out, as is shown in the illustration below, and this could result in the piece breaking off or creating wood compression. The pressure needed to be applied in an angle from underneath to prevent the risk of fracturing the wood any further.

Fig. 97. Illustration showing where the pressure, for gluing the split piece, needed to be applied.
Friendly Plastic is a non-toxic modelling material that can be formed into any shape simply by using your hands. The pellets were first softened in water that was heated up to 60°C. They could be handled the moment they turned transparent. Within 5 minutes the plastic would start to stiffen, so the working time was considered quite short. To harden the material completely, after it was shaped in the desired form, it was put in a bowl with cold water. With this material, a specifically sculptured mould was made for the gluing process of the split wood.

Since the split did not run all the way through the width of the panel, it was problematic to get the adhesive deep enough into the crack. This is why sturgeon glue was first used to wet the area. A 15% concentration in water was used and applied with a thin brush. The sturgeon glue would ensure that the thicker gap-filling adhesive (higher in viscosity) would be pulled further into the crack. Props were then used to apply the right amount of pressure. The split pieces were given 2 days to harden.

16.13.4 Re-joining split 2

The bottom piece of the panel, boards D and E, was considered the most difficult part to re-join. Not only because of the extensive woodworm damage, which had weakened the wooden structure, but also because board E was heavily distorted. It had twisted throughout its length. When both boards were laid down flat on a table, it was clearly visible that they had different height levels at different locations along their length. This was caused by warping of the wood. Many props and packers had to be positioned on top and underneath board E in order to apply pressure in the right places and make it fit with board D.

Furthermore, the wood along the edges of the split were compressed, meaning that they dipped slightly downwards, and therefore, an exact alignment could not be achieved. A conservator in the past had corrected this issue by overlapping the pieces of wood to some extent and covering up the height differences with a filler material.

![Image of wood compression](image)

Fig. 98. Wood compression that resulted in a slanting angle of the connection between boards D and E.

As was mentioned before, the wood of board E had been compressed during a previous conservation. It also contained a different curvature compared to board D. If the connection between board D and E was made with a perfectly aligned height level, and with a continued surface between them, it would have resulted in a steep drop of board E. Having a perfect alignment would mean dealing with too pronounced of a curvature at the edge of the panel, as can be seen in the image below. If the re-joining process had proceeded in this
manner, it would have increased the curvature of the overall panel too much, resulting in a deflection of 4cm.

Fig. 99. Visualisation. The top example shows an unwanted, steep drop of board E. The bottom example shows a continuation of the curvature, but with a dip between board D and E.

It was considered inevitable to compromise during the re-joining process of split 2. It was decided to accept a small dip along the split when correcting the curvature of boards D and E, as is shown above. This was because board E would have to carry the weight of the rest of the panel. If the board was in a too distinct and curved angle, then the pressure on the newly glued split would be considered too high. By accepting the slight dip between board D and E, and reducing the curvature, the stress put on the joint was lessened. The deflection of the panel was also reduced to 2.3cm.

After deciding on the new curvature of D/E, the new connection between the boards was assessed. Unfortunately, split 2 had a lot of openings, which meant that there were many areas where boards D and E didn’t touch. These had to be filled up with wooden inserts. Small pieces of oak were cut in the desired shape, so that they would fit nicely into the gaps. Concerning split 2, inserts had to be made for the front and reverse of the painting. It was decided to glue the inserts for the reverse first onto board D. This would save time during the actual re-joining phase of the boards, since the wooden inserts are difficult to put in place when the boards are fastened in the table/bridge construction.

Fig. 100. Wooden insert glued to board D.

After 3 dry runs, and adjusting the props and packers where needed during every run, the preparations were ready. The edges of the boards were first wetted with fish glue. Then, the gap-filling adhesive was spread evenly over the edge of board D. The boards were then placed together, taking into consideration the painted composition’s registration. Then the props were put in position and pressure from the sides was arranged with clamps. The gap-filling adhesive was again left to set for 2 days.
After the gap-filling adhesive had received enough time to dry, the re-joined board D/E was taken out of the table/bridge construction. Remarkable was the observation that the left corner of the board still moved, although the newly created joint had hardened properly and was quite rigid. The minimal movement was caused by the woodworm eaten areas, which was the most extreme in this area. The wood here was very thin and there was a risk of it not being able to support the weight of the whole panel.

It was decided to strengthen the left corner. On the front side, the newly formed joint was reinforced with another layer of the fish glue with microballoons and coconut shell flour. This was only applied where the woodworm damage was the most evident, namely the first 12cm. Also, from the reverse, a second layer of the gap-filling adhesive was applied so that any air pockets would be filled. This step was then followed by a layer of Araldite carvable epoxy that would thicken the structure of the board and provide extra stability. Afterwards, the corner of board D/E could no longer wobble. This meant that the bottom board would be able to carry the weight of the whole panel.

16.13.5 Re-joining joint 2

During the last stage of the re-joining process boards A/B/C and boards D/E had to be glued together. Unfortunately, the winter climate had resulted in the
wood responding to the low content of relative humidity in the air. Both pieces had given off a portion of their water amount to the dry air. This meant that the wood had shrunk and curved, due to desorption, making it impossible to re-join the boards. Therefore, a hydration tent had to be made in order to increase the relative humidity.

![Hydration tent.](image)

The tent enclosed the panel in a fine containment. It was important to ensure that the air could not leak out. Inside the tent, several pieces of wetted cloth were placed. These made sure that the wood was given the opportunity to absorb some of the moisture that was present in the tent. By increasing the water content of the wood, the boards once again straightened themselves. Afterwards, they could be prepared for the re-joining process. In correspondence with the previously described re-joining, 2 dry-runs were executed before the actual gluing procedure. During this step it became clear that a nearly tight enclosure between the boards could be achieved. A few pieces of wood were sticking out from the edges, which could become a problem during the re-joining process. Therefore, they were skimmed off with a wood plane. Also, only two wooden inserts had to be made for small openings in the joint. Fortunately, only minimal adjustments were needed to gain an even height level between the boards.

![Close alignment between the boards.](image)

Extra attention was paid to the registration of the painted composition. This was done in order not to make the same mistake that had occurred during one of the previous conservations, where the board had shifted 2mm. The actual
The Dream of Jacob, artist unknown, 16th century, O.L.V. basilica

The gluing stage was performed without problems. The same method as before was utilised. Only a minimal amount of 11 props and packers were needed to level the boards. The gap-filling adhesive was given 2 days to cure and the result was an even surface of the overall panel.

![Gluing stage of The Dream of Jacob](image)

**Fig. 106. Final gluing stage of The Dream of Jacob.**

### 16.14 Fillings

After the structural issues of the painting had been addressed, the filling treatment could commence. This meant that all the newly formed joints, glued splits and losses had to be filled with a substance that consisted an adhesive and a bulking agent.

A filling has two purposes. First it is used to fill up losses where paint and ground layer have disappeared and create an even surface between the loss area and the surrounding paint layers. Secondly, a filling is meant to provide a surface onto which can be retouched, so that the damaged area can be reintegrated in the pictorial image and remains ‘invisible’.

For *The Dream of Jacob* multiple recipes were tested in order to find a suitable filling. A total of 16 different fillings were made and smeared onto a sheet of Melinex. They were all given the same length, width and height so that comparisons could be made. This simple test would not give scientific data such as wetting, shrinkage and tension properties, but it does visualise the suppleness of the fillings. By varying the proportions of the filler ingredients, the handling in terms of application could be examined. The mechanical strength could also be evaluated and the observation whether the filling had a ghosting\(^9\) effect after clearing the excess from the surface.

<table>
<thead>
<tr>
<th>Kaolin: 60g</th>
<th>Tylose 3000 (3%) + Evacon R</th>
<th>Tylose 3000 (4%) + Evacon R</th>
<th>Tylose MH300 (3%) + Evacon R</th>
<th>Tylose MH300 (4%) + Evacon R</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Tylose</strong></td>
<td>30g</td>
<td>30g</td>
<td>30g</td>
<td>30g</td>
</tr>
<tr>
<td><strong>Evacon</strong></td>
<td>0g</td>
<td>0g</td>
<td>0g</td>
<td>0g</td>
</tr>
</tbody>
</table>

\(^9\) Ghosting happens when the filler material creeps into the crackle pattern of the pictorial layer and appears as a white haze.
In this case, an aqueous system was mixed with a synthetic glue and a white inert mineral pigment. Preference went to the 4% Tylose 3000. This filling showed the least tears and shrinkage. How the filling for *The Dream of Jacob* was prepared is described in the table below.

<table>
<thead>
<tr>
<th>Materials</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>30g Tylose 3000</td>
<td>Carboxy methyl cellulose with a viscosity of 3000 mPa’s (at 20°C)</td>
</tr>
<tr>
<td>15g Evacon R</td>
<td>Ethylene vinyl acetate with a stabiliser</td>
</tr>
<tr>
<td>60g Kaolin earth</td>
<td>Hydrous aluminium silicate (mineral pigment)</td>
</tr>
<tr>
<td>5g burned Sienna pigment</td>
<td>Iron oxide and manganese oxide pigment</td>
</tr>
<tr>
<td>5g yellow Ochre pigment</td>
<td>Ferric oxide and clay pigment</td>
</tr>
</tbody>
</table>

**Preparation**
- 4% of the Tylose is solved in water (weight to volume).
- All materials are placed onto a marble slate and combined together with a spatula and panel scraper.

The filling mixture was combined with two pigments in order for it to look similar to the original ground layer used by the artist. After preparation, the fillings were applied to the loss areas of the painting with a small spatula. With the help of raking light, the height of the fillings could be determined. In total, each filling required 5 layers until a similar level was achieved as that of the surrounding paint layers. The filler excess was removed with a cotton swab dipped lightly in water. The texture of the fillings could also be adjusted so that it would coincide with the surface texture of the painting.
After the filling treatment was completed, the results were examined with the assistance of RTI. A comparison between the pictures from before and after treatment clearly shows the improvement of the curvature profile of the panel and its surface.

Fig. 111 & 112 & 113 & 114 & 115 & 116. RTI details. Comparison photographs of surface profile. Before treatment (column on the left) and after treatment (column on the right).
The fillings were given base colours that would make the retouching easier. It was decided to work with QOR watercolours. This product has an aquazol binder (Poly(2-ethyl-w-oxazoline)), which means it is more opaque compared to regular aquarelle, but still more transparent than gouache.

![Fig. 117. Detail of filler with base tone.](image)

QOR is known for its stability when exposed to accelerated light conditions and is, therefore, lightfast. The second advantage of QOR is its ageing properties. Controlled accelerated aging studies have been performed by the producer Golden. QOR was tested against the traditional binders, such as Arabic gums. The aquazol remained attached and flexible, while the exposed samples of traditional watercolours had become brittle and cleaved from the test supports.10

### 16.15 Between coating

It was decided to apply the between coating after the fillings had been made. Reason for applying the fillings first was to create a better adhesion between the substrate and the filler material, since there would be no varnish layer interfering between them.

It was also an option to first give the painting a layer of varnish and only afterwards apply the fillings. Reason for the second approach would be to prevent the filler material from creeping into the crackle pattern of the painting and creating a ghosting effect. However, it became clear that this could be avoided by fine tuning the fillings after their application with a wetted cotton swab. Removing the excess of filler material with a bit of water prevented the ghosting effect from happening.

Therefore, the fillings were applied first. After they were provided with a base colour, a varnish layer was brushed over the entire surface. The painting was put face-up on a table, in order to make the application easier. The varnish was first applied in a horizontal movement of the brush, followed by vertical strokes. The between coating was made by solving 15% Paraloid B72 in Shellsol A (weight : volume). This would form a barrier between the original paint layer and the retouches.

16.16 **Retouching**

The varnish used to close off the fillings was made with *Paraloid* B72. The retouching was also executed with *Paraloid*, but with a different recipe. It was decided to first solve the *Paraloid* in acetone. A 20% concentration was made, so that the retouches would have a certain shine to them. However, as a retouching agent, the solution vaporised too fast and could not be worked with. Therefore, 28% of di-acetone alcohol was added to the mixture. In other words, for every 25mL of *Paraloid*/acetone, 7mL of di-acetone alcohol was added. The rinsing agent for the brush was made out of pure di-acetone alcohol.

The retouches were made by combining the *Paraloid* with synthetic pigments. Small dots and stripes were laid over the joints, splits and losses in order to hide them. The abrasions of certain areas, which were considered disturbing, were concealed by giving them a half-transparent glaze. With accuracy and precision the damaged areas were integrated into the coherent image.

Fig. 118. Application of between coating.

Fig. 119. Detail photograph during the retouching phase.
After the retouches had been made, it became clear that some of them had a matter appearance compared to others. These matte retouches were more opaque and did not have the same depth of colour as other retouches. This was especially the case for the dark coloured retouches. Reason for this was the acetone component in the retouching resin. Acetone evaporates very fast, not giving the retouch the appropriate amount of time to create a film. Also, bone black, green and blue pigments have larger molecules and therefore absorb more resin, this in comparison to the cadmium pigments. This meant that the darker pigments required more Paraloid in order for them to be properly wetted.

To give the matte retouches a little bit of shine, a different Paraloid mixture was made. For this phase in the retouching process, 20% Paraloid was solved in 1-methoxy-2-propanol (weight : volume). The matte areas were slightly tipped with the new retouching agent, taking care not to dissolve the retouches, and received a more glossy appearance. This step was necessary, or else the matte retouches would remain visible even after applying the final varnish layer.

![Image of The Dream of Jacob](image-url)

**Fig. 120.** Overall photograph of The Dream of Jacob, with UV-light, after treatment. The areas that do not fluoresce are where the new retouches are located.

### 16.17 Varnish

After the retouching phase, a decision had to be made concerning the final varnish layer. The Dream of Jacob had changed visually throughout the entire conservation process and had now obtained a different appearance compared to its situation before it was treated. During the treatment, the original intentions of the artist were taken into account during the decision making process. The same was done in relation to the final varnish layer. In this case, a final varnish was necessary to close off the retouches, support the physical
characteristics of the painting and to serve as a protective coating. It was decided to select a range of different varnishes with different properties and apply test strips onto the retouched surface. After they were given a proper amount of time to dry, they were evaluated and the most suitable could be chosen.

The varnishes that are generally used contain a synthetic resin that is solved in a specifically selected range of solvents. For *The Dream of Jacob* it was important to make sure that the solvents of the chosen resin would not dissolve the Paraloid retouches. This meant, for example, that 100% aromatics had to be excluded from the selection.

16.17.1 *Regalrez* varnish no. 1

The first choice fell onto *Regalrez* 1094, a low molecular weight resin. *Regalrez* is a hydrogenated oligomer of styrene and alpha-methyl styrene. Although this product is quite resistant to scratching, it is a relatively brittle resin. This is why several other components were added to the varnish mixture in order to ensure certain flexibility. The *Kraton* that was added is a copolymer that serves as a modifier due to its rubber ratio. The *Cosmoloid* would also decrease the brittleness of the *Regalrez*, as well as reduce the gloss of the varnish. The amount of *Cosmoloid* decides how much of the gloss is reduced, since a highly reflecting surface is not desired for *The Dream of Jacob*. The solvents were also carefully selected. By adding a mineral spirit to the varnish mixture, the risk of dissolving the Paraloid retouches could be avoided.

<table>
<thead>
<tr>
<th>15g <em>Regalrez</em> 1094</th>
<th>80mL <em>Shellsol D</em>40</th>
<th>20mL petroleum ether</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.9g <em>Kraton</em> G1650 (6% of the resin content)</td>
<td>1.5g <em>Cosmoloid</em> H80 (10% of the resin content)</td>
<td>0.35g <em>Tinuvin</em> 292 (2% of the resin content)</td>
</tr>
</tbody>
</table>

Fig. 121. Table showing the 1st *Regalrez* varnish recipe.

16.17.2 *Laropal* varnish no. 1

Secondly, the product *Laropal* A81 was selected as a varnish. Just like *Regalrez*, it is a low molecular weight resin. *Laropal* is an urea-aldehyde that is solved in a range of solvents that is similar to that of *Paraloid*. This is why a mixture of solvents was necessary for dissolving the *Laropal* resin, while on the other hand, the *Paraloid* had to remain unaffected. To be on the safe side, tests were first performed in order to see which solvent mixture would dissolve the *Laropal*, but not the *Paraloid*.

Three solutions were made combining *Shellsol A*100 and *Shellsol D*40. The two solvents in different ratios were combined and the content was added to a plastic cup. Each cup received 5mL of the *Shellsol* solution and 0.5g of the

resin pellets. Afterwards, the cups were covered with a lid and left overnight. The next day, the pellets were evaluated based on their appearance and texture.

<table>
<thead>
<tr>
<th>Paraloid B72</th>
<th>Laropal A81</th>
</tr>
</thead>
<tbody>
<tr>
<td>30% Shellsol A</td>
<td>Remained unchanged</td>
</tr>
<tr>
<td>70% Shellsol D40</td>
<td>Completely dissolved</td>
</tr>
<tr>
<td>40% Shellsol A</td>
<td>Pellets became sticky</td>
</tr>
<tr>
<td>60% Shellsol D40</td>
<td>Completely dissolved</td>
</tr>
<tr>
<td>50% Shellsol A</td>
<td>Pellets became sticky and were partially dissolved</td>
</tr>
<tr>
<td>50% Shellsol D40</td>
<td>Completely dissolved</td>
</tr>
</tbody>
</table>

Fig. 12. Table showing test results of combining Paraloid and Laropal with different Shellsol solutions.

As the table shows, the Laropal dissolved in every solution, meaning that all three combinations could be utilised for the making of the varnish. However, the Paraloid was negatively affected by two of the mixtures. The 40% Shellsol A solution had made the pellets sticky, while the 50% Shellsol A solution had even started to dissolve the Paraloid. Fortunately, in the 30% Shellsol A solution, the Paraloid remained unchanged. Based on the results from the testing, it was decided to use the 30% Shellsol A variation for the Laropal varnish. For 100mL Shellsol (30mL Shellsol A and 70mL Shellsol D40), 20g of Laropal resin was added, making up a 20% concentration.

| 20g Laropal A81 |
| 30mL Shellsol A |
| 70mL Shellsol D40 |

Fig. 123. Table showing the 1st Laropal varnish recipe.

16.17.3 Laropal varnish no. 2

Thirdly, the selected Laropal/Shellsol mixture from above was combined with Cosmoloid H80. This micro-crystalline wax would serve as a matting agent, reducing the gloss of the varnish. Only a small portion of the Cosmoloid had to be added to the solution. Too high of a wax content would result in a milky varnish. The desired result should be a slightly ‘clouded’ varnish. This is why the percentage of the Cosmoloid was dependent on the weight of the Laropal resin that was present in the solution. There was 20g of Laropal in 100mL Shellsol. This results in 2g of Cosmoloid (10% of 20g) that had to be added to the varnish.

| 20g Laropal A81 |
| 30mL Shellsol A |
| 70mL Shellsol D40 |
| 2g Cosmoloid H80 |

Fig. 124. Table showing the 2nd Laropal varnish recipe.

16.17.4 Laropal varnish no. 3

Another version was made and tested with only 1g of Cosmoloid (5% of 20g Laropal in 100mL Shellsol).
For the varnish test strips, the tree and sky were selected. The selected region had to contain dark and light coloured areas, as well as retouched parts. By covering these three areas, their individual response to the varnish could be evaluated. It was considered essential that together, the three areas would form a coherent zone. In other words, the varnish would be deemed unsuitable if it would discolour the retouches, making them stand out from the surrounding paint layers. Instead, the varnish had to be able to saturate the entire composition, making it (nearly) impossible to distinguish the retouched areas from the original painted areas.

The Regalrez delivered a good result. It saturated the colours to a certain degree and achieved a successful integration of the retouches within the painted composition. However, the shine of the Regalrez varnish was leaning more towards a matte appearance than a glossy one, and therefore, a depth of colours could not be attained.

The pure Laropal resulted in a heavy gloss. The retouches were well integrated and the depth perception was outstanding, but the highly reflecting surface could be perceived as a disturbance. The lighting in the treasury of the Our-Dear-Lady basilica would not be able to accommodate the heavy reflecting surface of the painting.

The third varnish, the Laropal with the 2g Cosmoloid content, was considered too matte. The light coloured areas looked adequate, but the dark areas did not. It appeared as if a white haze covered the tree.

Afterwards, the Laropal with the 1g Cosmoloid portion was evaluated. Again, the retouches were hidden away nicely, but a real depth of colours could not be realised.

Laropal varnish no. 4

The conclusion was that none of the prepared varnishes were suitable as a final varnish and further testing was needed. Another recipe of Laropal was made in order to reach a balance between the pure Laropal version and the Laropal/Cosmoloid versions. This time, only 0,5g of Cosmoloid (2,5% of the resin) was added to the Laropal mixture.

Regalrez varnish no 2.

Furthermore, another Regalrez varnish was made. It was decided to use the same recipe as before, but to reduce the Cosmoloid content to 2,5%. In this case, after a mixture was made of Regalrez, Shellsol D40 and petroleum ether, together with Kraton G and Tinuvin, the 0,19g Cosmoloid was added.
15g *Regalrez* 1094
80mL *Shellsol* D40
20mL petroleum ether
0.9g *Kraton* G1650 (6% of the resin content)
1.5g *Cosmoloid* H80 (10% of the resin content)
0.35g *Tinuvin* 292 (2% of the resin content)

Fig. 127. Table showing the 2nd *Regalrez* varnish recipe.

16.17.8 Both varnishes had a fine gloss and saturation of colours, but a difference was also noticeable. The *Regalrez* did not completely hide away the retouches. In both the dark and light coloured areas, the retouching had a somewhat dullness to it, although only slightly, while the original paint layers did not. On closer inspection, one could see the minor changes between them, and even though the issue was small, it was reason enough to exclude this *Regalrez* version as a use for the final varnish.

On the contrary, the *Laropal* showed a good integration of the retouches. It was not as glossy as the pure *Laropal* varnish, and therefore its depth perception was also a little less, but it was still to an agreeable degree. This *Laropal* version gave the best result of all the tested varnishes.

After the *Laropal* varnish no. 4 was selected, the painting was prepared for the varnishing process. Again, the painting was laid down on a soft underground, with the painted image facing upwards. A different application method was chosen, compared to the application of the between coating. The painting’s surface was divided into 4 squares. After filling one square with varnish through simple brushstrokes, it was spread out with a *Kimtech* cloth. These 2 steps followed each other up directly and were repeated until the whole surface was coated.

The *Kimtech* was selected because this material does not leave behind any microfibers or other textile residue. With a rotating movement, the varnish was evenly applied. Working the varnish with a cloth, after its application by a brush, ensures a smooth transition and removes the brushstrokes. Subsequently, it moderates the gloss of the varnish, without reducing its saturation properties.

16.18 **Frame**

It is recognised that framing can directly affect the stability of a panel painting. It is significant that the painting is held securely and safely without there being any restriction on the dimensional changes of the painting, especially those perpendicular to the wood grain, which might happen during fluctuations in temperature and relative humidity.  

First, the frame of *The Dream of Jacob* was cleaned. The surface dirt was removed with a brush and vacuum. Afterwards, a wetted microfiber cloth was used to clean the more resistant dirt. After the cleaning process, the construction of the frame was assessed.

---

16.18.1 Due to the warping of painting, the frame no longer fulfilled its supporting role. After treatment, the panel had received a curvature with a deflection, seen from the front, of 1.3cm on the right side and 1.5cm on the left side. However, this was under ‘normal’ circumstances when the climate had a relative humidity lying between 35% and 50% and a temperature around 20-24°C. Measurements were taken during February and March, 2018, when the RH had dropped and varied between 26% and 29%. During this time period, 12 profile drawings were made. It became obvious that the deflection of the panel changed every day, ranging from 2.0cm to 2.3cm. Measurements were also made during the summer period of 2018, when the temperature rose above 30°C. During this time a deflection of 3.2cm was measured.

Fig. 128. Visualisation of 5 different deflections, seen from the left front side of the painting.
Red shows panel curve with the cradle.
Blue shows panel curves without the cradle during winter season.
Pink shows panel curve without cradle during summer season.

Besides the curvature, the panel also contained a twist. For The Dream of Jacob it was considered essential that the frame had to be adjusted so that it would give the painting the much needed additional support. It was important to take the different deflections and the twist into consideration when adjusting the frame.

After the conservation, the painting was placed back into its frame and the differences compared to the situation before treatment were evident. As expected, the panel no longer rested against the frame rebate, leaving noticeable gaps along the edges between the painting and the frame. This meant that the pressure points of the framing system, the ones holding the panel in place, were not evenly distributed. To achieve a balanced distribution of pressure, the rebate needed to follow the curvature as well. For this purpose, it had to receive custom-made components that would produce a negative of the shape of the panel. Giving the frame a curvature profile would offer the painting support along the whole perimeter. Also, another advantage is gained by adding a curvature profile to the frame, namely because the accumulation of dust is reduced since the width of the gaps will be lessened significantly.

The profile was made out of balsa wood. First, four slats of balsa wood were cut so that they would fit inside the frame rebate. Then, the left and right sides of the panel were placed against the slats and their curvature was drawn onto it. Through precise cutting of the balsa wood, a reproduction of the panel’s shape was made in its most natural state, namely when the RH and temperature were favourable and constant. A wood plane and sandpaper were used to make minor adjustments to the size of the balsa wood. The very fine modifications were made by adding balsa wood scrapings of 0.3mm thick, where there were still gaps between the frame and painting.

---

This was not done without difficulty, because during the frame adjustments, the painting kept reacting to small fluctuations of the RH in the studio. This meant that its dimensions changed throughout the frame’s alteration process. It was decided to work with the curvature profile of when the panel was in its straightest form.

The slats for the top and bottom of the frame rebate also took some time to make. Since the panel contained a twist, the slats could not be cut in a straight line. This would result in gaps between the painting and the frame. Especially the bottom of the painting required attention, as was already noticed during the re-joining stage of the treatment. Just like the frame, the balsa had to be cut in a wavy line.

The profile was then coloured with acrylic paint so that it would match with the frame. Afterwards, the profile was lined with black felt, which would prevent any abrasion to the surface of the painting, and then glued into the frame with Pattex wood glue. If the environmental conditions in which the painting resides stay stable, good contact between the painting and the frame rebate will remain.

16.18.2 After creating the curvature profile, a new fastening system had to be devised. It was decided not to clasp the panel inside the frame as was previously done. During its treatment, it had become obvious that the wood of the painting reacted strongly to fluctuations in the relative humidity, as can be seen in the different deflections visualised above. The panel reacted to even the slightest change in temperature and humidity and therefore swelled and/or shrunk on a day to day basis. Securing the panel with clamps would hinder the movement of the wood, resulting into internal stress and probably splitting of the wood. To prevent this from happening, it was decided that the painting had to be mounted inside the frame through a different manner. Flexibility of the frame was prioritised.

Decision fell onto working with an unattached auxiliary support. This system was developed and introduced by Ray Marchant. The support will ensure that the panel is kept in position only along the central axis in the direction of the grain of the wood. The method allows free lateral expansion and contraction and does not restrict concave deformation at the panel’s reverse.16 It is called unattached because nothing is glued onto the painting itself. An unattached

---

auxiliary support takes the continued behaviour of the panel’s warping into consideration. First, a build-up of the frame’s reverse had to be made, since The Dream of Jacob was sticking out of the frame due to its warping. The build-up had to be high enough in order to anticipate further warping of the painting. The maximum deflection of the panel was used as a guideline. The extra height to the four members of the frame was set on 2.3cm. The width would be 3cm, which was smaller than the frame itself. The horizontal length would be 115.7cm for the top and bottom members of the frame. The vertical length for the left side was 79.8cm, while the right member had to be 80.2cm. These measurements again emphasised the fact that the frame, just like the panel, had distortions due to warping.

The build-up was made from white pine wood from the fir family. The wood was cut with the help of a DeWalt bandsaw in order to acquire the right sizes. The build-up had to follow the frame’s warped lines, or else a close fit between the frame and build-up could not be made.

Especially problematic was the twist and warping of the top member of the frame, as can be seen in the photograph above. The pine wood could not be bend, and therefore, wedges were made for the left and right side, that would fill the gap. Afterwards, the areas of the frame, where the build-up would be adhered, were sanded with sandpaper. This was done in order to create a rough surface, so that a better adhesion between the two substrates could be created. The build-up was given a matching colour and then glued to the frame with a PVA and bulk material, namely coconut shell flour and microballoons (the same ratio was used as for the gap-filling adhesive during the re-joining process). Giving the glue an extra bulk would ensure that any eventual gaps between the build-up and frame would be filled and closed.

Secondly, a central beam had to be installed horizontally. The right and left member of the build-up were given incisions where the central bar could be slid into. This way, the bar was at an even level as the build-up. The battens were glued underneath the bar and applied pressure to the panel in order to keep it in place. The outer ends of the battens received padding that would be placed against the reverse of the panel. They were made out of balsa wood and Plastazote. Each batten had its own customised padding. The width and length were 5cm, while the thickness varied depending on the length of the batten (explained below).
As a last step, the horizontal bar was attached to the build-up with screws. This way, the unattached auxiliary support can be easily removed when needed. This reinforcing structure was necessary to help strengthen the panel and assist in spreading the stresses more uniformly. Secondly, in this situation, the auxiliary support would function as a mediator by allowing curvature changes to occur in a controlled manner and within predetermined limits. This could only happen if the battens were of the correct length, width and thickness. This is why a lot of calculations went into the design of the battens. Marchant introduced a formula for calculating the required flexibility of the battens. However, his method only applied to an attached support, while an unattached support was needed for *The Dream of Jacob*. This is why Marchant’s system was used as a guideline and some of the variables of the formula were changed, such as the calculation for the load (W). The battens needed to deliver a form of restraint in order to properly keep the painting inside its frame. Simultaneously, its bending force cannot be too low, or else the batten will be too stiff and convey too much pressure against the panel and hinder the warping of the wood. This is why the batten is required to deliver only slight resistance in cases where the panel wants to curve. It is impossible to predict the resistance to bending that *The Dream of Jacob* will endure before it fails. However, the load that a batten can deliver can be assessed, while considering the strength of the painting. After specifying all factors, which are listed below, a safe limit for the deflection of the panel and for the batten restraint could be determined. This information was then converted into a suitable thickness for the battens.

---

### Factors

<table>
<thead>
<tr>
<th>Factors</th>
<th>Explanation</th>
<th>Data of <em>The Dream of Jacob</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel deflection (Δ)</td>
<td>Measure the curvatures when the RH is at its lowest and at its highest. The difference in millimetres is the maximum possible deflection.</td>
<td>32mm</td>
</tr>
<tr>
<td>Panel weight</td>
<td>Weigh the panel after conservation is complete.</td>
<td>3.2kg</td>
</tr>
<tr>
<td>Number of battens</td>
<td>Self-assessed. Evaluate where the painting needs to be supported and assess how many resting points the reverse needs.</td>
<td>5 (1 long, 2 medium, 2 short)</td>
</tr>
<tr>
<td>Length of batten</td>
<td>Self-assessed. While determining the length of the battens, it is important not to let their outer ends rest on weak points of the panel.</td>
<td>Long: 700mm Medium: 600mm Short: 400mm</td>
</tr>
<tr>
<td>Width of batten (b)</td>
<td>Self-assessed. For the formula, this number is multiplied with 0.8.</td>
<td>50mm</td>
</tr>
<tr>
<td>Cantilever length (L)</td>
<td>Halve the length of the batten.</td>
<td>Long: 350mm Medium: 300mm Short: 200mm</td>
</tr>
<tr>
<td>Load (W)</td>
<td>Measuring the weight at the end of each batten. Use the total weight of the panel and multiply it by 2. Then, divide this by the amount of battens, again multiplied by two. After, multiply this number with 9,80665 (gravity).</td>
<td>(3,2 x 2) ÷ (5 x 2) = 0,64 0,64 x 9,80665 = 6,276256</td>
</tr>
<tr>
<td>Modulus of elasticity (E)</td>
<td>Use <a href="http://www.wood-database.com">www.wood-database.com</a> to find the wood that is used for the auxiliary support. This is represented in lb/in² and needs to be converted to n mm². Multiply the number with 0,0068947.</td>
<td>Western red cedar. E = 1110000 lb/in² 1110000 x 0,0068947 = 7653,117n mm²</td>
</tr>
</tbody>
</table>

---

**Fig. 132. Table showing the data needed for the calculation of the battens’ thickness.**

---

**Formula**


*Formula*

\[
I = bd^3 \div 12 \quad \Rightarrow \quad \Delta = WL^3 \div 3EI \quad \Rightarrow \quad I = WL^3 \div 3E\Delta \quad \Rightarrow \quad d^3 = 12WL^3 \div 3E\Delta b
\]

\[d = \text{thickness of batten in mm.}\]

The results are rounded up.

*Fig. 133. Table showing the formula used for calculating the battens’ thickness.*
Due to the splits running through the entire length of the panel, and the fact that the original boards did not have an equal width, the battens had to be given different lengths, and with it, different thicknesses. It was important to not place the pressure points onto the weaker areas of the panel, such as the woodworm damage. If all the 5 battens had received the same length, then too much pressure would have been directed onto the lower part of the panel. Furthermore, the corners of the panel were not allowed to curve too much, or else large gaps would form between the painting and the frame rebate. This is why 3 different battens were devised for the unattached auxiliary support. For cutting the battens to the desired thickness, a DeWalt planer-thicknesser was utilised, that made it possible to remove only 0,3mm of wood at a time.

---

**Calculation**

- **Long one in the middle: 700mm**
  
  \[
  d^3 = \frac{(12 \times 6,276256 \times (350^3))}{(3 \times 7653,117 \times 32 \times 40)} = \frac{322913712}{29387969,28} = 109,8794436
  \]
  
  \[
  d = \sqrt[3]{109,8794436} = 5mm
  \]

- **Short ones in the middle: 400mm**
  
  \[
  d^3 = \frac{(12 \times 6,276256 \times (200^3))}{(3 \times 7653,117 \times 32 \times 40)} = \frac{602520576}{29387969,28} = 20,50228685
  \]
  
  \[
  d = \sqrt[3]{20,50228685} = 3mm
  \]

- **Medium ones at the panel’s edges: 600mm**
  
  \[
  d^3 = \frac{(12 \times 6,276256 \times (300^3))}{(3 \times 7653,117 \times 32 \times 40)} = \frac{2033506944}{29387969,28} = 69,19521811
  \]
  
  \[
  d = \sqrt[3]{69,19521811} = 4mm
  \]

Fig. 134. Table showing the results from the calculation for all 3 battens.

---

Fig. 135. Reverse of painting, after treatment. Unattached auxiliary support especially devised for The Dream of Jacob.
16.18.3 Concluding the adjustments to the frame was the making of a spacer, a back protection and a new hanging system. For the spacer, a thin slat of Multiplex was cut. It had to guarantee that the panel will not shift down when it is hanged. At the same time, it must allow the panel to curve when needed and not hinder it. This is why the spacer, after it was painted, was polished with an agate stone. Polishing was done to smoothen the surface of the spacer, ensuring that the panel will easily slide over it and not get stuck. Afterwards, the spacer was attached to the bottom member of the frame rebate.

In order to include extra space for the panel’s movement, the back protection was given a certain height. It was made from a 3mm thick Plastazote strip and 5mm thick slats of Multiplex, giving the painting an extra 8mm to move. The Plastazote is a soft material and would serve as a buffer against climate changes. On top of these, a board of Kapaline was placed, completely closing off the reverse of the painting. Double sided tape was used to attach the parts together. The back protection was then screwed onto the build-up.

Afterwards, distance holders were made and adhered to the back protection. Small rounds of cork were carved and glued to the bottom of the Kapaline. These would ensure that the back of the frame would not touch the wall. It is highly probable that a microclimate is generated when there is a close fit between the wall and frame. A microclimate is a very local set of environmental conditions that differ substantially from the surrounding area. The result would be a small region behind the painting where growth of mould could happen. Distancing the painting from the wall with only 15mm, making air circulation possible, will prevent this from happening.

The final step involved a new hanging system. The choice fell on giving the painting 2 hanging points instead of 1. In the previous situation, the object hang on the wall by a hook and a metal string. It was considered safer to distribute the weight over 2 contact points. First, a small hole was drilled in the left and right members of the original frame. Next, an open bolt, with grooves on the in- and outside, was screwed into the holes. Afterwards, the eye bolt could be easily screwed in. For hanging the painting on the wall, 2 L-shaped screws were provided.

Concluding the adjustments to the frame was an aesthetical treatment. The traces of wear were retouched with aquazol (10% in ethanol) and synthetic pigments. This would ensure that the attention of the viewer would be directed to the painting and not towards any disturbing abrasions on the frame. The frame then received a final finish with a Renaissance micro-crystalline wax. Only the painted areas, and not the gold leaf, were polished.
17. **Condition after conservation**

17.1 **Before and after treatment photographs**

![Before and after treatment photographs](image)

Fig. 137&138. Detail middle angel. Before (top) and after (bottom) treatment.
Fig. 13 & 140. Detail Jacob. Before (top) and after (bottom) treatment.
17.2 Stability carrier
In the situation before treatment, the structural integrity of the painting was greatly compromised by the cradle. It blocked the movement of the panel, which resulted into tension, which again caused the wood to fracture and split. During the current conservation, the cradle has been removed, which has benefitted the stability of the painting. The panel has regained its natural curvature. Since it can now move freely during fluctuations in the relative humidity and temperature, no more stress is being built up internally. Risk of cracks and future paint lose have been minimalised. The consolidation treatment of the woodworm damage also contributed to the improvement of the stability of the wooden carrier. Especially the bottom of the panel needed strengthening, so that it would not succumb under its own weight.
Thirdly, the new adhesion between the boards was a necessary step in the conservation treatment in order to support the preservation of the object as a whole. The old glue/bond between the boards had weakened significantly and was no longer able to keep the parts together. With the re-joining process of the splits and joints, a strong adhesion could be created, ensuring future stability of the painting. During this phase, the washboard profile was also corrected, including the out-of-step alignment of the surface’s overall height level.

17.3 Condition painted image
In the situation before treatment, there was a severe case of tenting paint layers. Due to internal stress and pressure from all four sides, the paint layers were pressed together and had no other direction to go than up. The adhesion failed and the paint layers were pushed away from the carrier. Paint loss was the inevitable result. This condition has been improved by removing the cradle. The painted image now no longer experiences pressure and the danger of paint loss has been reduced considerably.
Secondly, there was a case of a discontinuation of the painted image. This was caused by a poorly executed gluing process during a previous conservation, where the boards had shifted while the glue was curing. During the current re-joining treatment, the registration of the painted composition has been corrected.

17.4 Montage
The frame has received a succession of adjustments, so that it can now properly support the painting. Through an unattached auxiliary support, the panel is mounted inside the frame. Concerning the montage of the painting to the wall in the treasury, two hanging points were created. Two holes were drilled into the wall, into which plugs and L-shaped screws were inserted, where the eyebolts of the frame could be positioned.

17.5 Advice for loan and passive conservation
A wide range of damage has been addressed during the current conservation treatment and *The Dream of Jacob* can now return to the basilica in a much improved condition.
The basilica is advised to monitor the painting on a regular basis. It has become obvious that the panel strongly reacts to even minor fluctuations in the relative humidity and temperature. This means that the dimensions of the painting change on a daily basis. The frame is designed to support the movement of the panel and let the curving of the wood happen in a controlled and limited manner. Nonetheless, a monthly check-up of the painting’s curvature, especially during the change of the seasons, is advised. This includes an inspection of the unattached auxiliary support and whether it still fulfills its function.

17.6 **Performed work**

<table>
<thead>
<tr>
<th><strong>Treatment panel</strong></th>
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<tbody>
<tr>
<td>Application facings</td>
<td>2 hours</td>
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<tr>
<td>Surface cleaning</td>
<td>6.5 hours</td>
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<tr>
<td>Consolidation paint layers</td>
<td>9 hours</td>
</tr>
<tr>
<td>Removal facings</td>
<td>0.5 hours</td>
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<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; varnish removal</td>
<td>10.5 hours</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; varnish &amp; old retouches removal</td>
<td>36 hours</td>
</tr>
<tr>
<td>Removal old adhesive</td>
<td>0.5 hours</td>
</tr>
<tr>
<td>Removal old fillings</td>
<td>19.5 hours</td>
</tr>
<tr>
<td>Cradle battens treatment</td>
<td>16 hours</td>
</tr>
<tr>
<td>Cradle removal</td>
<td>48 hours</td>
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<tr>
<td>Cradle glue removal</td>
<td>19.5 hours</td>
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<tr>
<td>Reverse coating removal</td>
<td>8 hours</td>
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<td>Panel boards separation</td>
<td>124 hours</td>
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<tr>
<td>Woodworm consolidation</td>
<td>17.5 hours</td>
</tr>
<tr>
<td>Re-joining boards</td>
<td>89 hours</td>
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<tr>
<td>Application fillings</td>
<td>59.5 hours</td>
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<tr>
<td>Application base tone</td>
<td>18 hours</td>
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<td>Application between coating</td>
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<tr>
<td>Retouching</td>
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<td>Varnish research</td>
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<td>Application varnish</td>
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<td><strong>Total: 624.5 hours</strong></td>
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<table>
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<tr>
<th><strong>Treatment frame</strong></th>
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<tbody>
<tr>
<td>Curvature profile</td>
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<tr>
<td>Build-up</td>
<td>28 hours</td>
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<td>Auxiliary support</td>
<td>25 hours</td>
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<td>Final adjustments</td>
<td>4 hours</td>
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<td><strong>Total: 85 hours</strong></td>
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<table>
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<th><strong>Documentation</strong></th>
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<tr>
<td>Microscopic analysis</td>
<td>2 hours</td>
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<tr>
<td>Photos before treatment &amp; UV</td>
<td>6.5 hours</td>
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<tr>
<td>Infrared Reflectography</td>
<td>28 hours</td>
</tr>
<tr>
<td>X-radiography</td>
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<td>SEM EDX</td>
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<tr>
<td>ATR</td>
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<tr>
<td><strong>Total: 85 hours</strong></td>
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The Dream of Jacob, artist unknown, 16th century, O.L.V. basilica

<table>
<thead>
<tr>
<th>Writing report</th>
<th>68.5 hours</th>
</tr>
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<tr>
<td><strong>Total</strong>: 119 hours</td>
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Fig. 14. Table showing the working hours per treatment.

**Total**: 828.5 hours
### 18. Used materials

<table>
<thead>
<tr>
<th>Product</th>
<th>Material</th>
<th>Manufacturer</th>
<th>Delivering party</th>
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<tbody>
<tr>
<td>Acrylic Colours</td>
<td>Acrylic paint</td>
<td>Winsor &amp; Newton, Harrow</td>
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<tr>
<td>Evacon-R Adhesive</td>
<td>Evacon</td>
<td>Acros Organics, Geel, Belgium</td>
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<td>Kaolin earth</td>
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<tr>
<td>Kraton G 1650</td>
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<tr>
<td>Methyl cellulose, viscosity 3000</td>
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<tr>
<td>Museum Art Foam EV 50 zwart</td>
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<td>Innosell b.v., Borne</td>
<td>Innosell BV, Borne</td>
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<td>Paraloid B72</td>
<td>Ethyl-methacrylate co-polymer</td>
<td>Röhm &amp; Haas, Darmstadt</td>
<td>Van Ginkel, Zwanenburg</td>
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<td>Kremer Pigments</td>
<td>Pigments synthetic</td>
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<td>Fa. Dr. Georg Kremer, Aichstetten</td>
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<td>Woodglue</td>
<td>PVAc</td>
<td>Pattex</td>
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<td>QOR watercolours</td>
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#### Solvents

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<tbody>
<tr>
<td>Acetone</td>
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<td>Acros Organics, Geel, Belgium</td>
</tr>
<tr>
<td>Benzyl alcohol</td>
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<td>Iso-propanol</td>
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<td>Shellsol D40</td>
<td>Fa. Dr. Georg Kremer, Aichstetten</td>
<td>Fa. Dr. Georg Kremer, Aichstetten</td>
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</table>

Fig. 142. Table showing the materials used during the conservation of *The Dream of Jacob.*
19. Bibliography


20. List of figures

Fig. 1. The Dream of Jacob before treatment
Fig. 2. The Dream of Jacob after treatment
Fig. 3. Cradle construction
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