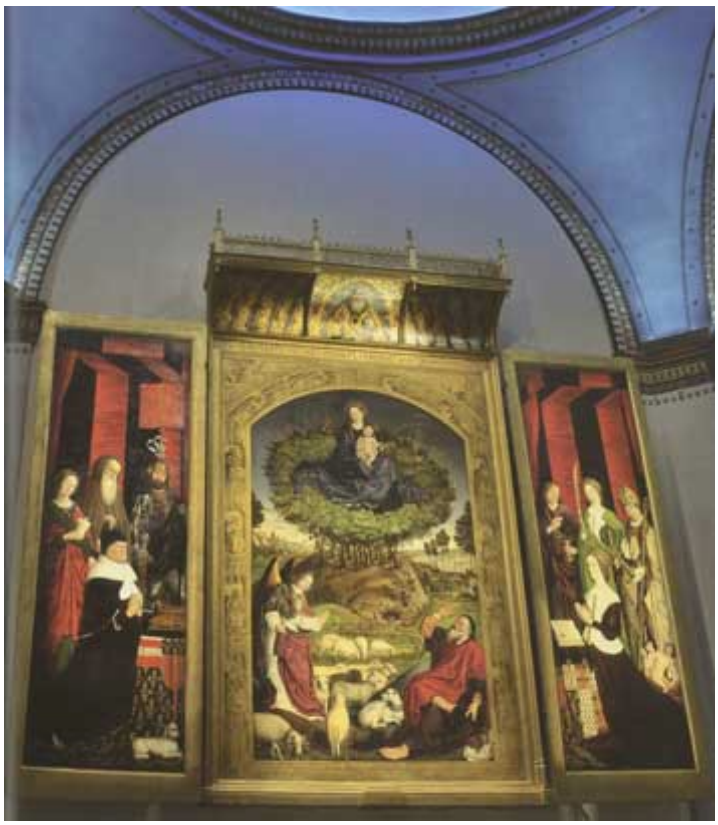
Nicolas Froment's triptych, *The Burning Bush*

Examination of paint layers during restoration

A little background

Between 1998 and 2010, the CICRP assisted the Direction Régionale des Affaires Culturelles (DRAC, regional cultural affairs department) for Provence-Alpes-Côte d'Azur with the restoration of the famous triptych representing the *Burning Bush* (the photo of the work after restoration, shown below, is courtesy of the DRAC), a major project focusing on an important asset of the region's cultural heritage, painted in the last quarter of the fifteenth century by Nicolas Froment and exhibited in the Saint-Sauveur Cathedral in Aix-en-Provence.



Before and during the restoration, temperature and humidity at the site where the work had originally been installed, at its restoration site and at the site where it was planned to be reinstalled were monitored regularly in order to ensure consistent environmental conditions when moving this large-sized work on wooden panels between these sites, as it is particularly sensitive to strong variations in thermo-hygrometric parameters.

The restoration of paint layers in a work of this type raises numerous issues. This triptych, painted with oils using the glazing technique and having already been the focus of at least two earlier restoration campaigns, required several sampling and scientific imaging sessions beginning in 2005 in order to gain an understanding of the paint material needed to properly carry out the new restoration.

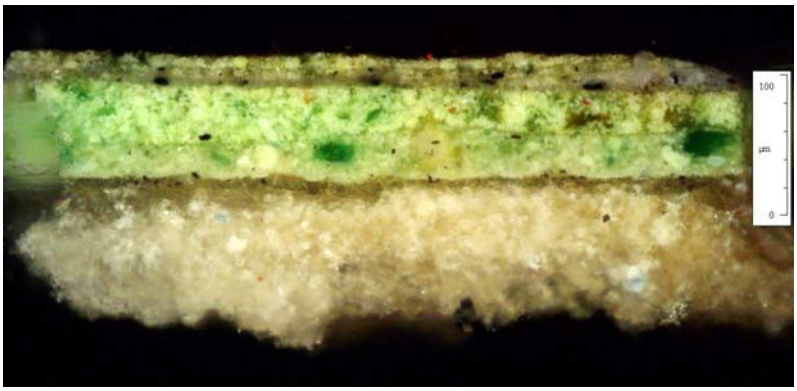
The CICRP thus worked closely with the painting restorer Monique Pomey to address issues relating to the nature and scope of the alteration phenomena affecting the original materials and those used in previous restoration work.

The other major area of interest for these analyses was the stratigraphy of the paint layers, in particular to distinguish varnishes, lacquers and superimposed glazing.

Bringing together the lessons learned through in situ observation with the analysis of the samples taken resulted in a better understanding of Nicolas Froment's technique and aesthetic intentions.

A. Analysis of the canvas support

A length of canvas, impregnated with a glue of animal origin, covers the front of the central panel and the side panels both front and back, in order to lend the support a uniform and flat surface and lessen the impact on the paint layers of the opening and closing of the wooden structure. On the exterior of the side panels, the canvas is visible not only on the painted surface, but also on the frame. On the central panel and the interior of the side panels, it stops at the edge of the frame already in place. The canvas was glued to the structure before the frame mouldings were decorated with gilt work. Then it was covered with the ground preparation. This specific chronology was deduced from the observation of the original gilt work on the interior edge of the frame after the removal of the mastic used in the restoration by Marc Joseph Gilbert in 1858: at the joins, this compound overlaps the gilt work.
The original ground preparation, white in colour, applied in a maximum thickness of about 200 micrometres, is composed predominantly of calcium sulphate (or gypsum) and animal glue. Silica (silicon dioxide), most likely in the form of quartz, and magnesium aluminosilicates were used as an initial preparation surface. This preparation corresponds to the Italian gesso technique. It was preferred by the painter to the preparation of the surface using calcium carbonate (chalk), which was traditionally used by painters in northern Europe during this period.

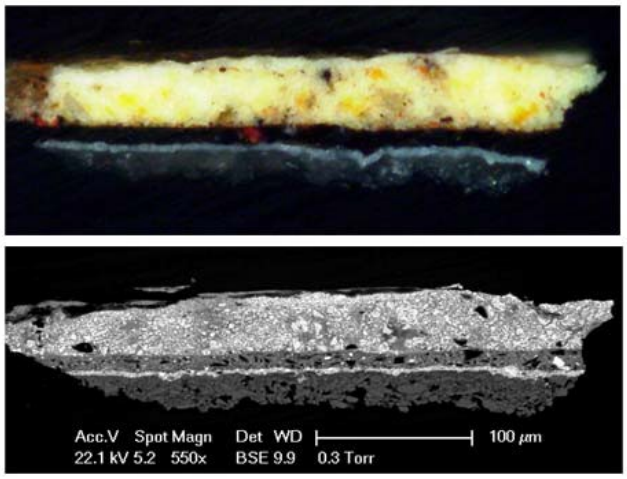


Stratigraphic cross-section of a sample of the original pale-green paint matter examined by optical microscopy. White gypsum-based preparation (gesso), covered by several green-coloured layers applied using the glazing technique.

This was a common choice by painters working in Provence, but Nicolas Froment, who had completed a portion of his training in either Flanders or northern France, would have been perfectly familiar with both techniques. The decision to use this technique was therefore a deliberate one. In general, gesso (made from calcium sulphate) is softer than other types of preparations using calcium carbonate. The consistent particle size throughout the entire thickness of the preparation indicates that the gypsum was uniformly crushed and that the surface preparation was applied in a single operation. The areas where samples had been taken in the ground and the paint layer were initially stabilised by using facing papers (Japanese paper with highly diluted sturgeon glue), thus ensuring good compatibility with the original paint material as well as good reversibility.

B. Preparatory work

The artist's preparatory sketch, examined using stratigraphy, appears in the form of black particles, visible just over the ground in samples taken from the drapery of the Virgin's blue mantle and Moses' red cloak. These particles were identified as carbon black. This technique of setting up the composition is consistent with that used by northern European primitives, who very often drew preparatory sketches on the ground itself before adding any other layers, including the priming coat.
A priming coat is present between the ground and the paint layers. It consists mainly of lead white dissolved in a high proportion of binder, giving the mixture good drying properties.



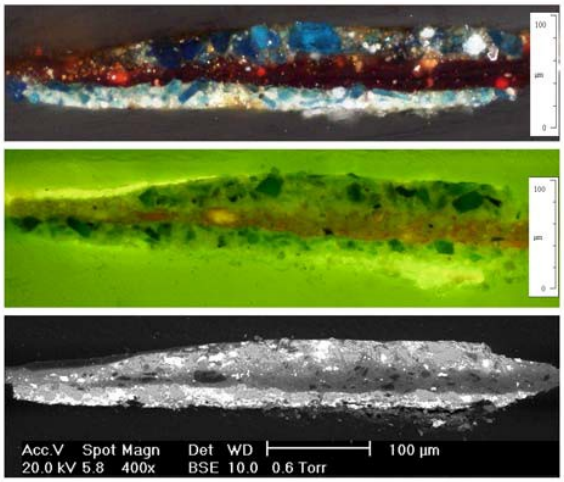
Stratigraphic cross-section of a sample of the original yellow paint material (cross of Saint Nicolas) examined under an optical microscope (top) and under a scanning electron microscope (bottom). Visible between the deepest part of the ground and the paint layers is a fine layer of priming coat consisting of lead white.

Its purpose was to isolate the thin and porous animal glue ground[1] so as to ensure that it would not absorb the upper oil paint layers, which would thus have become thinner and would have lost some of their glossy appearance. Due to the thinness of this layer and the difficulty in separating it out from the rest of the paint material, it was not possible to analyse the chemical composition of the binder used. However, writings of the period indicate that it could have been either oil, glue or even egg.

C. Analysis of the paint layers

The colours of the painter's palette are revealed through the analysis of the pigment components of samples of the original paint layers. The blue pigments used are azurite and lapis lazuli.

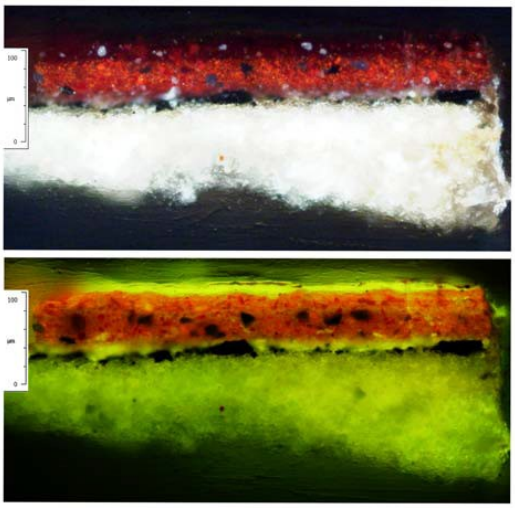
In the Virgin's mantle, the use of these two blue pigments varies: the deeper layers are comprised mainly of azurite, and to a lesser extent of lapis lazuli. Conversely, a larger proportion of lapis lazuli is present in the surface glazing to modulate its appearance. Azurite was the most widely used pigment in both northern Europe and Italy during this period. Lapis lazuli, used sparingly due to its rarity and its high cost, was generally reserved for the clothing of the Virgin, Christ, God the Father, or royal figures.



Stratigraphic cross-section of a sample of the original blue paint material (mantle of the Virgin) examined under an optical microscope using direct light (top), using ultraviolet fluorescence (middle) and under a scanning electron microscope (bottom). Succession of glazing layers on the surface of the paint layer. From bottom to top: mainly azurite with lapis lazuli; red lacquer; mainly lapis lazuli with azurite.

Blue overpaint has been identified on the Virgin's mantle. Although pigmented with ultramarine blue (most likely artificial) and azurite, as used in the original composition, there is barium sulphate in the mixture, which allows us to date this substance after the first quarter of the nineteenth century. Moreover, this overpaint is covered by a thick varnish identified as a dammar resin, also very widely used in the nineteenth century. Consequently, this overpaint was very likely added by Gilbert.

Two types of green pigment are revealed. Copper resinate[2] (copper acetate mixed with oil and resin), which was very popular in the fifteenth century, was applied using the glazing technique for the darkest shades of the landscape. Verdigris was used, mixed with lead-tin yellow, for the lighter shades. This pigment was widely used during the period, much more so than malachite. The way in which the colour green was composed unquestionably evolved over time and, even using today's most sophisticated analysis techniques, it is particularly difficult to distinguish a number of copper greens that are close in chemical composition. The analysis of green overpaints reveals the presence of a copper green that cannot be used to precisely date these overpaints. The extent of oxidation of the covering varnish suggests that these overpaints may have been added before the nineteenth century.
The colour red is produced through the use of vermilion and a red lacquer, most likely garance[3]. The shadows and nuances of the drapery in the cloak worn by Moses are obtained thanks to the subtle use of transparent glazing made of lacquer over a more opaque layer painted with vermilion.



Stratigraphic cross-section of a sample of the original red paint material (dark red of the cloak worn by Moses) examined under an optical microscope using direct light (top) and using ultraviolet fluorescence (bottom).
The vermilion layer is covered with a layer of red lacquer whose orange fluorescence under ultraviolet light is similar to that of madder. Black carbon particles corresponding to the preparatory sketch are visible between the ground and the priming coat.

As a general rule in this work, lead white is used by itself for the white pigments and mixed with other pigments for the light tones. Black carbon is present in the darker and greyish tones.

D. Painting technique

Linseed oil was used by the painter as a binder for the coloured layers. Painters in northern Europe had a marked preference for linseed and walnut oil, and seldom used egg tempera, except for sub-layers in the mixed technique. The oil was used, alone or mixed with a resin, as the painting medium. It is possible that this addition helped paintings to dry faster, but it is more likely that the aim was to alter the medium's refractive index and thus obtain better colour saturation.
Painters employed slightly caked-up white heightening to give their representations of jewellery made of gold, pearls and precious stones their full brightness, and used glazing in varying lightness to suggest transparency.

Two of the main issues addressed by the analysis were to identify the nature of the various varnishes and lacquers and to gain an understanding of the superimposed layers of glazing. The aim was to determine the extent of cleaning to be carried out so as to preserve as much of the original paint material as possible while also respecting the artist's technical and aesthetic intentions. The glazing technique involves the applications of several fine and transparent layers over an opaque sub-layer.[4] This can be noted, for example, in the drapery of the Virgin's mantle, tinged with violet and blue, achieved through the application of a series of fine layers using azurite, lapis lazuli and red lacquer on an alum base, especially for the deep shadows.

Detail of the drapery of the Virgin's mantle illustrating the effects obtained using the glazing technique.

Effects of depth and transparency are achieved throughout Froment's *Burning Bush* triptych. The painter's subtlety is fully evident in the smooth and unblemished faces of the Virgin, Queen Jeanne, the female saints and the archangel painted by applying a succession of very fine glazing layers. The final layers, tinged with pink, breathe life into the figures depicted. This treatment differs markedly from the realism in the faces of King René, God the Father, Moses and the male saints, where small bits of impasto are added using a light and precise touch on the final glazing layers, thus detailing all of the imperfections wrought by age.

Differing treatment of male and female faces:
on the left, the face of Queen Jeanne and on the right, that of Moses.

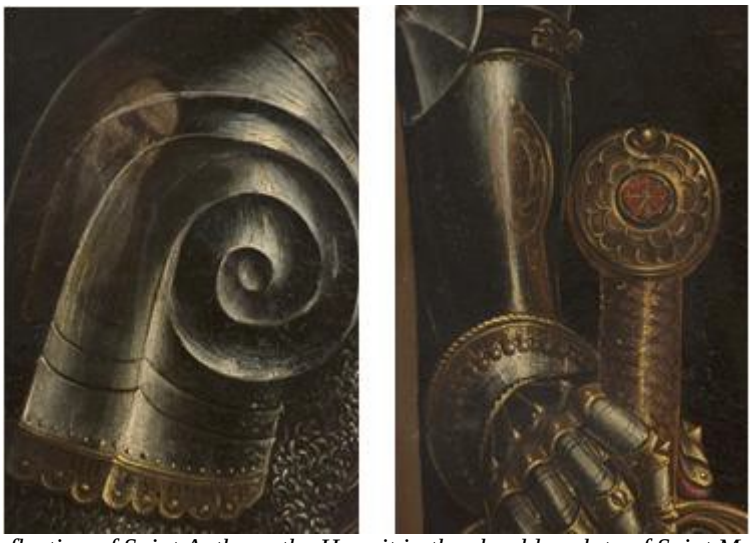
The use of a complex succession of very fine layers of pigmented glazing and lacquer gives an additional depth to the drapery of the clothing worn by the figures, especially that of the king and queen, suggesting velvet. On the king's cloak, the presence of runs of paint bears witness to its fluidity. In general, great care is exercised in rendering textures and motifs. The highly detailed sacerdotal robes of Saint Nicolas are painted using small vertical brush strokes, giving the impression of woven pieces or gold and silk thread embroidery, the lushness of brocade.

Brocade of Saint Nicholas's cope.

Conversely, a pattern of fine black lines, judiciously distributed over the red cloak of Saint Mary Magdalene, express the roughness of wool. Small strokes with a very narrow brush are also well represented in the coats of animals, impressive in their realism.

Detail of the dog guarding the flock of sheep.

Reflection is an important theme in the composition. The painter demonstrates great appreciation for detail in his work. Examples of this include the reflections of Saint Anthony the Hermit in the shoulder plate of Saint Maurice's armour, the hilt of the latter's sword in his brassard, and Saint John's fingers in the bowl of the chalice.



Left: Reflection of Saint Anthony the Hermit in the shoulder plate of Saint Maurice's armour.
Right: Reflection of the hilt of Saint Maurice's sword in his brassard.

Painters employed slightly caked-up white heightening to give their representations of jewellery made of gold, pearls and precious stones their full brightness, and used glazing in varying lightness to suggest transparency.

Several samples were taken of the amber-coloured and satiny varnish noted during the restoration, which might be the original varnish, on the interior and exterior of the panel depicting Queen Jeanne. It consists mainly of diterpene resin, combined with oil.[5] This type of oil-rich resin might correspond well to the period when the work was painted, but its use continued up to the end of the eighteenth century. Although it is therefore not entirely certain that this varnish may be identified as the original one used by Nicolas Froment, its considerable extent of oxidation indicates that it is quite old.

E. Specific treatment of gilt work due to the demands of the commission

The analysis of the samples taken in order to ascertain the stratigraphy of the gilt work on the central panel and arched top reveals the use of various techniques depending on what type of result was desired for the different elements of the composition (central and side panels, frame, arched top).
Mordant gilding is present in the gilt arcade forming the border of the central panel. The gold leaf was applied over a primer with a heavy concentration of binder containing lead white and lead-tin yellow. This is the technique known as mordant gilding, described in several studies of fifteenth-century works by northern European artists. This type of gilding gives a richer yellow appearance than bole gilding, which is only present on the frame components. The border is ornamented with trompe-l'oeil statuettes, meticulously painted on the gilt work with a very dark-coloured organic material, complex in nature and unable to be precisely identified by the analysis. It may be a mixture of several organic colouring compounds.

Brush drawing of a king over mordant gilding on the central panel.

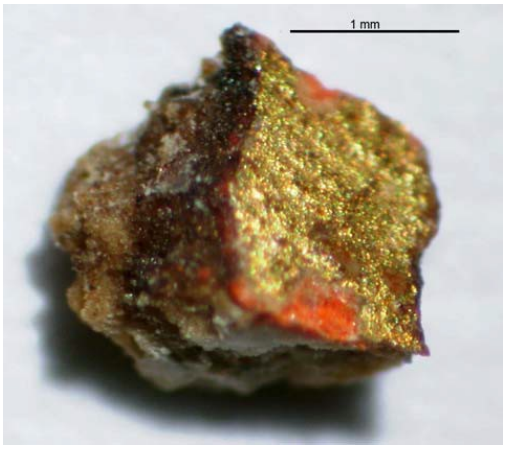
The effect of gilding is sometimes imitated using paint alone for the finery and attributes of the various figures on the central panel and the interior face of the side panels. The yellow pigment used in this case is lead-tin yellow. It is modulated to give darker tinges containing brown ochres and heightened with lead white for lighter tones.

Imitated gilding on the cross of Saint Nicholas on the panel depicting Queen Jeanne.

On the arched top overhanging the triptych's central panel, rays emanate from the bust of God of Father, illuminating the successive ranks in the hierarchy of angels, gilded and arranged concentrically. The ungilded areas in the background appear quite dark today. Analyses identified several earlier interventions in this part of the work, including the retracing of the luminous rays with gold bronze powder and the application of very dark brown overpaints of ochre and ivory black on the ungilded background. These overpaints were most likely applied with the aim of masking loosened material, presumably revealing dark ochre bole in places.

F. Chronology for the completion of the arched top

The analysis of several samples taken in the blackish areas of the arched top confirmed the presence of a residual silver layer between the red ochre preparation layer applied to the gesso and the surface layer, rather chaotic in appearance and partially reworked. The background here was therefore silver in colour at some point in the work's material history. The high sulphur content of this earlier silvering explains the black colour, due to the well-known reaction of silver in contact with sulphur-containing impurities to form black silver sulphide.
On the other hand, the gold leaf treatment of the angels is applied on two layers of mordant covering the dark ochre bole described previously. A first red layer made of minium and vermilion (together with a small quantity of red ochre), serves as the preparation surface under a fine layer of yellow mordant made of lead white and lead-tin yellow already identified on the central panel.



Photograph through a stereoscopic microscope (30x) of a small sample of gilding on mordant taken from an angel. Left edge of the right compartment of the arched top.

Although the gilt layer is contiguous with the rays of light and the angels, indicating that the gold leaf was applied in a single operation, the stratigraphy of the rays shows that the gilding is applied over the mordant, which is applied over the silvering.

Detail of an angel in the arched top showing that the gilding layer is contiguous between the rays of light and the wing of the angel. The irregular black aspect of the altered silver leaf can be observed between the rays. The dark ochre bole peeks through the gaps in the gilding on the mordant (upper portion of the wing).

By bringing together all of these findings, the chronology for the painting of this section may be established. The ground, consisting of one or more layers of gesso was first applied to the glued canvas. Next, the painter drew his preparatory sketch, planning out the figures to be gilded and the background areas to be silvered. The entire surface was then covered with a distempered dark ochre bole. Once the silvering was applied to the background areas, the artist applied his mordant to the remaining figures, and on the silvering of the light rays, too thin to be left uncovered. Gold leaf was then applied to the mordant for the figures and the light rays. Lastly, the details for the angels were painted over the gilding. Originally, the arched top would thus have radiated luminous effects of gold and silver, enlivened by the flickering of candles.

Final thoughts

This first scientific approach to the techniques used by the painter Nicolas Froment for the *Burning Bush* triptych improves our knowledge of this artist from Avignon whose practice has been little studied and is even less well known. It brings to light the technical processes employed by the Flemish primitives, but also other specific characteristics, resulting from the persistence of techniques owing a great deal to Italian traditions, ably assimilated by Nicolas Froment, as they were by other painters native to the north of France or Flanders also active in Provence.
At the conclusion of its restoration in 2011, this triptych was reinstalled in the chapel devoted to Saint Lazarus at Saint-Sauveur cathedral, which was also renovated in order to provide a fitting backdrop for the restored masterpiece. The results of the scientific investigations were published as part of a monograph entirely dedicated to the triptych (see references below).

***For further information*…**

Cranga, Yves, ed. 2011. *Le Triptyque du Buisson Ardent*. Paris: Actes Sud.

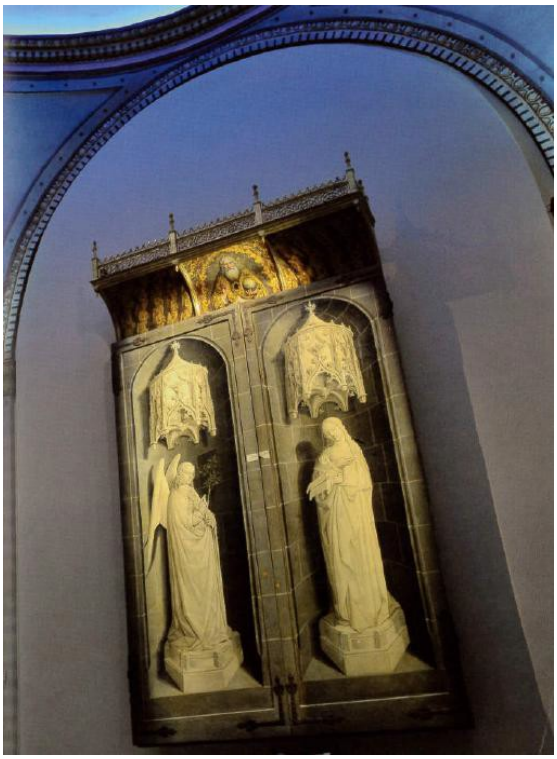
Bouillon, Nicolas, Elisabeth Mognetti, and Monique Pomey. 2011. "La réalisation du Triptyche, la couche picturale". In *Le Triptyche du Buisson Ardent*, edited by Yves Canga, 60–66. Paris: Actes Sud.

Project participants

CICRP: **Nicolas Bouillon, Odile Guillon, Elisabeth Mognetti, Jean-Marc Vallet**
Owner of the cultural property: **Conservation Régionale des Monuments Historiques (CRMH) for Provence-Alpes-Côte d'Azur (PACA), the regional board for the conservation of historic buildings and sites**
Control authority: **CRMH PACA**
Restorers: **Monique Pomey (paint layers), Gilles Tournillon and Philippe Duvieuxbourg (structure)**

Main phases of the restoration project

2003: Removal of triptych from site
2003–2008: Restoration of the structure
2008–2011: Restoration of paint layers



Closed view of triptych (Photo courtesy of DRAC).