# Masterful mixtures

*Practical aspects of fifteenth- and early sixteenth-century oil paint formulation*

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# The Three Marys

# Chapter 9
# The material intelligence behind the use of processed oils and paint additives: practical insights from reconstructing The Three Marys at the Tomb

## Introduction

In the previous chapters we have zoomed in on the fine details of the production and function of various raw and processed linseed oils as well as some additives that, going on historical sources and scientific data, seem to have been common components of fifteenth- and early sixteenth-century oil paints. By comparing the minutest differences between various versions of the same material in systematic tests, we have gained practical insights on the effects of these materials, depending on how they are made. We also had a glimpse of the creativity that is implied both in their making and application. However, this is not enough to really understand the role such materials played in the painting process, let alone how they might have affected the development of style and technique over time. For that, we need to consider them in the more complex context of actual painting.

What we have learned from the case studies in this thesis is that historical artists' materials must have come in variable forms, depending on the availability and nature of raw substances, and methods of processing. Individual differences would have made them particularly useful in combination with specific pigments or techniques. To make good use of the materials they had, and combine them in a sensible way, craftsmen would have relied on their experience and that of generations before them. Unfortunately, most of this experience has gone lost, due to the upcoming of large-scale commercial paint manufacturers and a discontinuation in the use of certain materials. In my quest to understand the subtleties of fifteenth- and early sixteenth-century painting practice I tried to bridge that distance by asking questions such as: How does the combined use of such a variety of materials in a single artwork and the tailoring of every paint to a specific purpose affect the working process? Which choices does it imply? Which materials go well together, and how are they best used in a layered system? To what extent is the work flow affected by the use of (various) driers? Could it be true that a clever combination of materials would have enabled a painter like Jan van Eyck to achieve greater realism? And is the effect so spectacular that the introduction of any of these materials might have affected the development of style and technique over the course of the fifteenth and early sixteenth century?

To answer these questions, it was necessary to leave the control of single variable experiments, in favor of the layered complexity of real painting. I decided to put the best performing processed oils and additives from my case studies to the ultimate test, and evaluate them side by side in a life-size reconstruction of a real painting. As a model for this reconstruction I chose a 50 x 72 cm. section of *The Three Marys at the Tomb* (1425-1435, Museum Boijmans van Beuningen, Rotterdam 2449 (OK)), which is currently attributed to (the workshop of?) Jan van Eyck (c. 1390-1441) and his brother Hubert (?-1426).[1] **Figure 8.1.**

It may seem somewhat ambitious to choose an Eyckian painting for this purpose, yet, it also made sense given the longstanding questions about the role of materials in Van Eyck's work. Of crucial importance was the fact that this painting is well documented. I could base my reconstruction on a rich corpus of macro- and infra-red photographs (IR), IR reflectograms (IRR) and X-ray images, which were recently

[1] The authorship of this painting is a matter of debate. See: Kemperdick and Lammertse 2012: 293-295.

made public by KIK/IRPA.[2] These images were supplemented with Macro-X-ray Fluorescence (MA-XRF) scans,[3] a report on XRF and X-ray diffraction (XRD) point measurements,[4] as well as documents from a recent restoration, including photos of a number of paint cross-sections, of which some were analyzed with SEM-EDX.[5]

These data indicate the use of a typical fifteenth-century palette, containing lead white, lead-tin yellow, vermilion, red lake(s?), azurite, ultramarine, verdigris, a calcium containing black, another carbon black and some earth pigments, but remarkably no umber or other brown pigments.[6] They also show sparse use of mordant gilding and possibly the presence of zinc vitriol, in some of the draperies.[7] Van Asperen de Boer and Giltaij also report the presence of some pine resin in a paint sample from the green pasture.[8] The only thing that has not been analyzed extensively in this painting is the binding medium.

This open question, together with the draperies in five colors, their multi-layer structures, an abundance of details and imitations of various materials, and the suspected use of zinc sulfate as well as some resin formed a perfect case for the evaluation of different oils and additives.

The richness of a reconstruction like this, lies in the fact that one integrates the available analytical data to a point where one normally doesn't go; literally questioning and trying the material for every square millimeter of the painting. The one thing that constantly goes on in your mind is: how was this done? Therefore, the following report of my reconstruction of the *Three Marys* is also a detailed analysis of the original painting as well as a synthesized interpretation of a large body of data. I also ended up comparing sections of the *Three Marys,* with several other Eyckian paintings, again, making grateful use of the *Closer to van Eyck* website. While it was never my intention to get mixed into the debate about the attribution of the *Tree Marys*, the work on this reconstruction has nonetheless provided some valuable insights on that issue. Yet, I want to stress that the aim of this reconstruction is to evaluate the role of various materials, and not necessarily to claim anything about Eyckian technique.

## Methods and materials

I started my work on this reconstruction by synthesizing the available analytical data and the results from the previous chapters in a hypothesis about the way the studied oils and additives would have come useful in creating a painting like *The Three Marys*. **Figure 9.1 and table 9.1.** The reconstruction process that is described in this chapter, functions as a way to challenge this hypothesis. The whole process was documented by means of extensive logbook-notes and photographs that were taken with every new paint that was prepared or applied. I took note of every material I used, where, when and how I used it, and the reasoning behind it, as well as any (hind) thoughts, feelings or observations.

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[2] <www.closertovaneyck.kikirpa.be> Accessed February 18th 2019. Earlier technical research, including a description of paint cross-sections, was published in: Van Asperen de Boer and Giltaij 1987: 254-276.
[3] Scans were made by Geert van der Snickt, Joris Dik, Eva van Zuien, and Annetje Boersma, using the Bruker M6 Jetstream MA-XRF scanner.
[4] Rousselière and De Viguerie 2013.
[5] Boersma and Van Zuien 2012. Keune, Katrien and Annelies van Loon, SEM-EDX reports of the Three Marys at the Tomb "overview SEM_EDX A161_11 and A161_12," Unpublished, undated.
[6] Some of these pigments were also mentioned by Van Asperen de Boer and Giltaij 1987: 266-267. For the typical fifteenth-century palette see: Billinge *et al*. 1997: 34-40.
[7] See chapter 8.
[8] Van Asperen de Boer and Giltaij 1987: 266 and 272 (note 46).

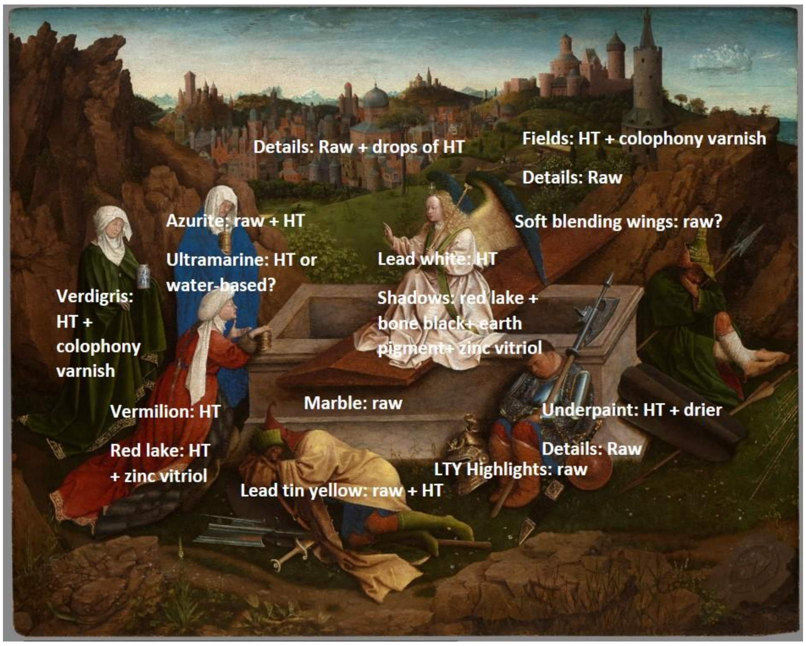


**Figure 9.1** Hypothesis on the use of various processed oils and additives in: Jan and Hubert van Eyck (workshop), The Three Marys at the Tomb (1425-1435), oil on panel 71,5 x 90 cm, Museum Boijmans van Beuningen, Rotterdam 2449 (OK). Photo: Museum Boijmans van Beuningen. Abbreviations: raw linseed oil (raw), heat-treated linseed oil (HT), lead tin yellow (LTY).

To make a 'faithful' reconstruction of a painting like the *Three Marys*, one needs much more than just oils and additives. To prepare genuine historical representatives each of those materials and tools would require intensive research and time-consuming reconstructions, so inevitably I had to make some practical concessions.

Whenever possible, I used pigments that were made by myself or direct colleagues according to period practice. In other cases, I relied on suppliers like *Kremer Pigmente*, *De Kat* and *Natural pigments*.[9]

All paints were ground manually, using a glass slab and muller to represent the stone ones that would have been employed in the past.[10] I chose not to weigh pigments, oils and additives, because this would have interrupted the working process, disturbing my focus on the process and what the paints actually felt like. Paints were collected with metal palette knives and mixed on modern palette paper. To apply them, I used modern round brushes with soft hairs and a pointed tip.[11] Although they probably didn't exist in the fifteenth century, I used flat brushes to apply size and ground layers. Occasionally I also blended paints with a soft flat brush, but later I found that a round brush actually works better for this purpose, as it leaves less of an imprint at the onset. During painting and drying, the oakwood panel was fixed on a wooden easel, in vertical position. **Figure 9.0.**

Absolutely indispensable for this reconstruction was use of the *mahlstick*. Although it is not certain such a tool was used in the early fifteenth century,[12] in my experience painting the countless little details in *The Three Marys* would have been impossible without a support for the painting hand. I also realized that the use of a *mahlstick* can leave traces that could possibly indicate whether a painter was left- or righthanded.

[9] The lead white, madder lake and verdigris were made by the author, based on historical processes. (See chapter 2 for details.) Ultramarine I was made by Arie Wallert following a recipe from Siena, Biblioteca Comunale, MS L.II.19, fol. 99v. Lead-tin yellow type II (10120), yellow lake (Farblack aus Reseda luteola leicht grünlich, 36262), carmin naccarat (42100), azurite (10200), ultramarine (II) (42100) and vine black (47000) were obtained from Kremer pigmente. Bone black, red and yellow ochres came from *De Kat*. Dry process vermilion (II) (Rublev) was obtained from Natural pigments, while another slightly more orange vermilion (I) was used of an unknown brand (labeled 'zinnober').
[10] Filedt Kok 2016: 6.
[11] *Ibid.* for some information on historical brushes.
[12] The earliest proof I know for the use of this tool is a picture of Saint Luke painting the Virgin (1478), by Gabriel Mälesskircher at Museum Thyssen-Bornemisza, Madrid, Inv. 237 (1928.19).

| Linseed oil/ additive | Preparation details | Characteristics, based on previous research (strongly dependent on pigment) |
|---|---|---|
| Raw linseed oil | Pressed from organically produced non-GMO 'Sofie' seeds on windmill *Het Pink* in 2014, clarified by settlement. See chapter 3.[13] This oil was the basis for the oils listed below. | Yellow, low viscosity, yields soft, buttery paints that are easy to handle, keep their texture, show imprint brush, dry medium fast, appear matte and unsaturated. |
| Sun-thickened linseed oil | Sofie raw linseed oil, exposed to sunlight and air in an open glass vial for 369 days. See chapter 4. | Initially pale, medium to high viscosity, yields paints that are runny, a bit viscous, level, and have saturated colors, paints tend to wrinkle and dry slowly. |
| Heat-treated linseed oil<br>1. Copper<br>2. 4h-270 | Heated Sofie linseed oil<br>1. in a copper pan over a fire for 6,5 hours, average temperature of 270°C (15/5/2017).<br>2. in a glass beaker on a hotplate for 4 hours at an average temperature of 273°C (27/7/2017). See chapter 5. | Brownish, highly viscous. Yields runny paints that are difficult to handle. Drops added to paint with raw linseed still makes it level, giving smooth, glossy and saturated surfaces, that do not dry faster, but with lead white the paint may yellow less. |
| Powdered high potassium glass<br>1.particles <43µ<br>2.particles <<43µ | Shards of colorless glass with a high potassium content, from a cesspit that was used between 1595-97, ground on glass, hand crushed in a mortar with water and passed through a sieve with an aperture of 43µ. The <<43µ particles were ground 15 min extra. See chapter 6. | White powder that speeds up the drying rate somewhat. It takes the place of pigment without changing the body of the paint, has little effect on color. It may be used to counteract loss of texture with a leveling binder, but the paint may become more matte. |
| Colophony varnish | 1 part colophony (De Kat) dissolved in three parts Sofie linseed oil. Total heating time 2h and 53 min at an average temperature of 135°C, (25/7/2017). See chapter 7. | Yellow, high viscosity, used as additive it increases the viscosity of a paint yet also making it runnier, and leveling. Paints are difficult to handle, tend to become brittle and dry slower, but surfaces appear smooth, glossy and saturated. |
| Zinc sulfate (Vitriolum Goslariensis, mixture after Hickel) | In chapter 8 I argue that the trace elements in historical zinc sulfate are essential for the drying effect of this material. To imitate such an impure zinc sulfate, I used a mixture that was prepared according to an analysis of the composition of natural zinc sulfate from Goslar.[14] See chapter 8. | Off white powder that increases the drying rate of paints. |

**Table 9.1** Overview of the preparation details and characteristics of the materials that were tested in the reconstruction of *The Three Marys.*

Being righthanded, I held the stick with my left hand, causing it to lean predominantly on the upper right edge of the panel, where it removed more paint than on the left. Although painted edges are easily damaged by other factors, or may have been covered by frames, such traces might still exist.

Before starting on my description of the actual reconstruction process I want to stress that re-creating an artwork is not the same as making an original. I was constantly checking the analytical data and zooming in on macro images, to trace individual brushstrokes, trying to understand what the original artist did. This, and the fact that neither my talent nor training even comes close that of Jan, Hubert or their colleagues, obviously slowed down my working pace, compared to theirs.[15] Copying the individual leaves and sprigs of grass for example cost me many hours, while originally, they were clearly painted in sessions of a couple of minutes. In total, my section of the painting took me roughly three and a half months, four days a week. Even when we consider the larger size of the original panel, the lack of electric lighting in the historical workshop, and the possibility of simultaneous work on several artworks, that is probably quite slow. Such a retardation in the working process inevitably affects one's perception of it. Drying issues, for example,

[13] See also: Geldof *et al*. 2018: 3-6 of 20.

[14] Because pre-industrial zinc sulfate is rare, I used a 'Vitriolum Goslariensis' that was mixed of $ZnSO_4 . 7H_2O$ (48%), $Al_2(SO_4)_3 . 18\ H_2O$ (28%), $Fe_2(SO_4)_3 . 18H_2O$ (7%), $MnSO_4 . 5\ H_2O$ (15%), MnO2 (2%), at the Dutch Cultural Heritage Agency in 2013. This composition was based on an analysis by Gerda Hickel of 16th century samples of zinc vitriol, kept at the University of Braunschweig. Hickel 1963: 135.

[15] Billinge *et al*. describe that Van Eyck paints really fast and less precise than Rogier van der Weyden, based on a comparison of the way the two paint beads. Billinge *et al*. 1997 (3): 82.

become less of an issue if the whole process is stretched.

Finally, one should keep in mind that there are often many ways to achieve a similar effect in oil painting, and that I could only work from what the painting looks like today, nearly six hundred years after it was finished. So, success or failure of any of the sections in this reconstruction should not be considered prove that the original artist(s) applied the exact same materials or techniques.[16]

**Reconstruction process**

In the following paragraphs I describe the reconstruction process of the *Three Marys*, from the panel up to the final paint layers, as well as the most important results of this experiment. I'll explain the choices I made, and the argumentation behind them, while pointing out what I learned. The painting process is described per color section, rather than strictly chronologically, so that it becomes clearer how the various paint compositions interact in the layer structure.

***Panel, ground and isolation layers***

A panel, measuring 50 x 72 x 1,1 cm, was made from two well-seasoned radially cut oak boards, that were butt-joined with a mixture of hide- and bone-sizes.[17] The surface was machine planed, and small holes were filled.[18] Both sides of the panel were isolated with one layer of 5% size, and two layers of 10% size.[19]

As a ground, eight layers of Champagne chalk[20] in 10% size were applied, wetting the back each time, to avoid warping. After starting with a yoghurt like consistency, I realized that a more fluid ground creates less pronounced brushstrokes. Once dry, it was polished with a variety of sand papers,[21] as a practical alternative for the abrasive materials that were used in the past.[22] During that process, the surface was repeatedly rubbed with vine black to indicate any remaining unevenness. A last polishing with a metal scraper made the surface appear smooth and glossy. The whole was given a final isolation layer with 10% size. I later regretted adding this layer because it made the surface so smooth that it was impossible to draw on it with silverpoint, while the lines I traced to apply the underdrawing did not catch. To remedy this, I slightly roughened the surface with fine grained sand paper. In the end, I still decided against the use of silverpoint as a first drawing medium.

***Underdrawing and imprimatura***

The IR images show a combination of sketchy lines in a seemingly dry medium. Little 'puddles' that sometimes occur at the end of thicker lines suggest that these were applied with a liquid medium, such as ink. The drawing mainly indicates contours and folds. Roughly parallel or fanning hatchings mark the shadows of the draperies, in a way that also occurs on the Ghent altar piece, but is very different from the neat

[16] See also: Roy 2000: 98; White 2000: 101.

[17] The size mixture came from Sheppy adhesives, and was applied in an unknown concentration. The original panel from the Museum Boijmans van Beuningen consists of four boards of which three were joint with dowels.

[18] Filler: Modostuc (mixture of polyvinylacetate, calcium carbonate, kaolin and an acrylester). In the X-rays of the original panel there is at least one large knot that seem to have been filled with a highly absorbing material, probably lead white.

[19] *Hasenleim Würfel aus Hasenfellen*, Kremer 63025 dissolved in demineralized water.

[20] De Kat, P.w. 18. According to Van Asperen de Boer and Giltaij the panel is grounded with chalk in a proteinaceous binder, like size. Van Asperen de Boer and Giltaij 1987: 266.

[21] 80, 120, 180 and 240 grains per $cm^2$.

[22] Wallert, describes the use of sharkskin, cuttlebone, scouring rush or 'horse tail' for this purpose. Wallert *et al.* forthcoming.

**Figure 9.2** Detail of the infrared reflectogram showing dry (?) hatchings and thicker lines in a wet medium. Photo: KIK-IRPA, Brussels.

parallel hatchings that can be found for example on the *Washington Annunciation*.[23] **Figure 9.2.** I found no cross hatching, but in some places, washings seem to be present. Apart from a few surprisingly thick lines, the drawing is quite refined, though not of the level of the Antwerp St. Barbara.[24] In some cases thicker lines are now visible through the final paint layers, particularly in the white dress of the angel, which, according to Van Asperen de Boer and Giltaij, consists of a single layer of lead white.[25]

To reconstruct the dry underdrawing, I rubbed the back of a 1:1 print of the IR reflectogram with ivory black, and traced it with a blind stylus. The result approached the delicate 'dry' lines from the IRR quite well, although practice taught that similar lines can also be achieved with pencil and ink. I reinforced the dry lines with an ink of vine black in a 10% solution of gum Arabic,[26] and a fine round pencil. Being right-handed, I worked upwards from the lower right, to avoid smearing the loose dry underdrawing. I made the wet underdrawing quite dark and pronounced, knowing that the *imprimatura* layer would tone it down, and fearing it would become invisible too early in the painting process.

There is some evidence for the presence of an *imprimatura* based on lead white.[27] First of all, lead was found in nearly every point analysis.[28] More importantly, there is a thin fluorescent, whitish layer with some black particles in several cross-sections, right above the ground.[29] I interpreted this as a layer of medium rich paint with lead white and some dispersed particles from the underdrawing.

[23] See <closertovaneyck.kikirpa.be> Compare for example the dresses of Mary in the *Ghent altarpiece*, St Bavo's Cathedral, Ghent and the *Washington Annunciation,* National Gallery of Art, Washington, Andrew W. Mellon Collection, 1937.1.39. Gifford, Metzger and Delaney 2013: 133.

[24] Koninklijk Museum voor Schone Kunsten, Antwerpen, Inv. 410. For more details on the use of metal points and other media in this art work see: Postec and Sanyova 2016: 22-29.

[25] Van Asperen de Boer and Giltaij 1987: 267.

[26] Kremer 63330, dissolved in demineralized water.

[27] Billinge *et al.* 1997: 22-24, describe the use of white oil based priming layers in many early Netherlandish paintings from the National Gallery.

[28] Rousselière and de Viguerie 2013: 13.

[29] See the unpublished restoration reports by Boersma and Van Zuien, 2012. Van Asperen de Boer and Giltaij interpret this layer as an unpigmented isolation layer that was applied over the underdrawing. Van Asperen de Boer and Giltaij 1987: 266.

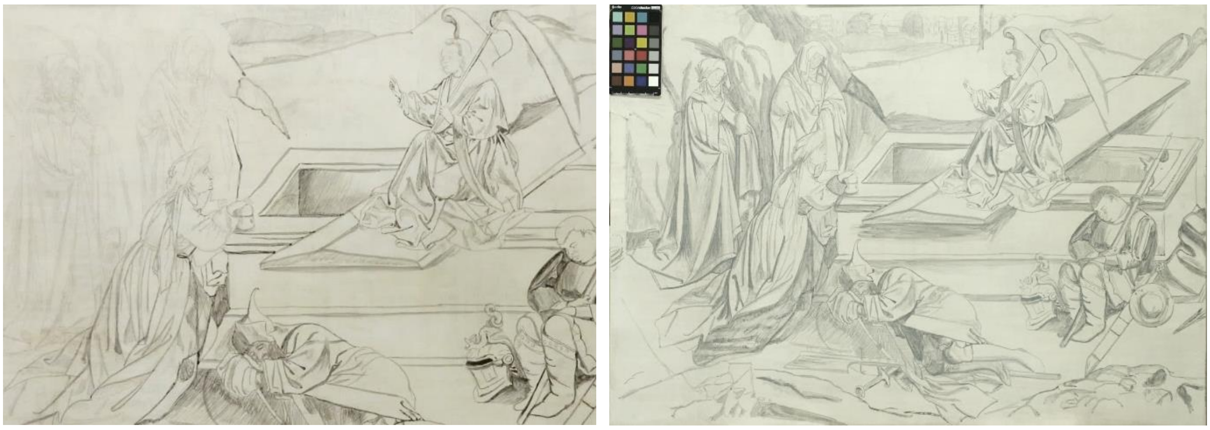

**Figure 9.3** Underdrawing (detail) and *imprimatura* of the *Three Marys* reconstruction. Left: picture taken during application of the wet underdrawing. The vague lines on the upper left are the traced dry underdrawing, the darker lines on the right were already fixed with ink. To the right: finished underdrawing, toned down with an *imprimatura* of lead white in raw linseed oil.

However, it is also possible that this layer was slightly tinted and/ or applied before the underdrawing.[30] To apply a thin *imprimatura* layer of lead white in raw linseed oil I used a linen rag. This layer unified the underdrawing nicely, but it took over five days to dry, and it appeared slightly streaky, perhaps due to the application method I used. On hind sight, addition of a little heat-treated oil for smoothness and perhaps a drier might have helped.[31] **Figure 9.3.**

Eventually, the underdrawing worked out well, except in a few places where it shines through the paint layers. This happened especially in the occasional spot where the painter didn't follow the underdrawing, like in the yellow drapery. This effect could be due to an over-pronounced underdrawing, use of pigments with less hiding power, or application of a thinner *imprimatura*. In other sections, such as the blue and red draperies, the underdrawing was apparently not dark enough, and I struggled to keep it visible until the modeling was completed. It is conceivable that similar experiences would have led painters to vary the thickness of their underdrawing, anticipating on the thickness and opacity of subsequent paint layers.

***Red drapery and dark red glaze***

Although Van Asperen de Boer and Giltaij describe a pink underlayer for the red drapery, [32] the MA-XRF scans show a predominant presence of mercury, with some lead concentrated in the highlights. Therefore, it seems likely that this area was underpainted in vermilion, later to be highlighted with lead white. Initially, I assumed the painters had applied a homogenous thin layer throughout, leaving modeling for later. However, while grappling to keep the underdrawing visible through the opaque vermilion, I noticed that the MA-XRF scan indicated variation in the concentration of mercury; there was more of it in

[30] If this layer was applied directly on the ground, as an isolation layer or a slightly tinted a base tone, it would come in place of an isolating size layer. I chose to apply the layer over the underdrawing, because experience has shown that particles from the underdrawing sometimes get loose when paint is applied, with a potentially negative effect on light colors. Also, I aimed for the unifying effect such an *imprimatura* has on the underdrawing.

[31] It is uncommon for lead white to dry this slowly. Earlier batches from this same coil of lead dried faster. Perhaps it has something to do with the washing of the lead white.

[32] Although Van Asperen de Boer and Giltaij describe a pink underlayer the XRF scans and the color that is visible at the abraded edges of the craquelures strongly suggest a vermilion red underpaint layer. Van Asperen de Boer and Giltaij 1987: 266.

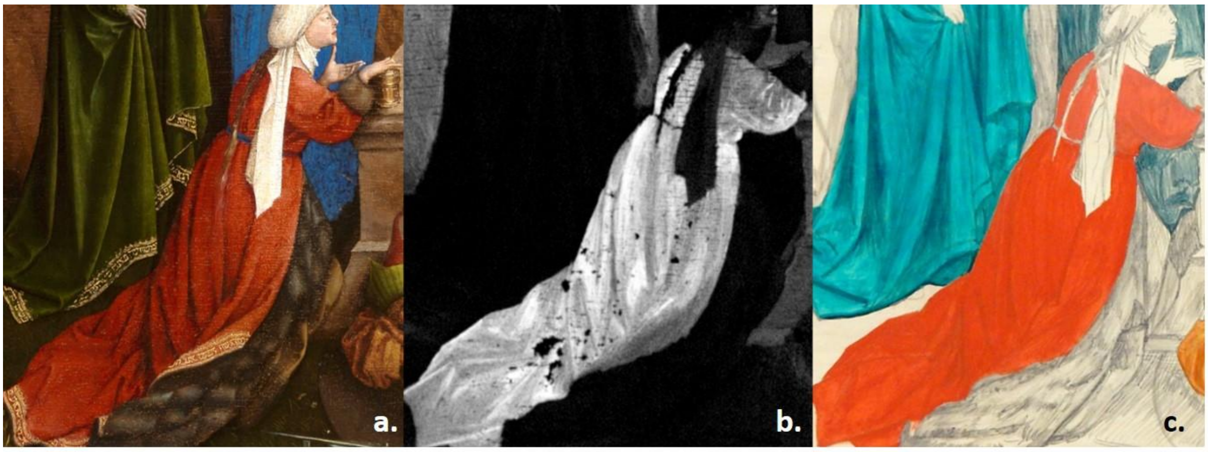


**Figure 9.4a-c** Red drapery from *The Three Marys*. a. Original painting; b. MA-XRF Mercury scan, made by Geert van der Snickt, Joris Dik, Annetje Boersma and Evan van Zuien (Note how the concentration of mercury is higher on the highlights); c. Reconstruction of the vermilion underpaint layer of this fragment. (Note how the paint above the waist, that was prepared with only raw linseed oil appears paler than below the waist where some heat-treated oil was added.)

the highlights. It occurred to me that the artist may also have experienced problems with the visibility of the underdrawing, and perhaps removed some of the opaque paint to make sure the dark lines remained visible for later modeling with red lake. **Figure 9.4.**

In this context it is relevant to note that the hiding power of vermilion was clearly influenced by the choice of medium. Above the belt, where I used raw linseed oil, the paint had a lower hiding power and came out a bit matte, almost pinkish. Below the belt, I added some heat-treated oil (1) to the paint, which increased its viscosity. As a result, the paint layer turned out thicker, less opaque, more saturated and glossier. In thin applications it also appeared a bit streaky. Remarkable as these effects were, they did not influence the final appearance once the red lake layers were applied on top.

In the underpaint stage of the reconstruction, drying was never an issue; even when a section took a while to dry, there were always others that still needed to be painted. The upper red glazes however, needed to be applied in several layers to achieve variation in the depth of the shadows. Here it became annoying to have to wait days for every layer to dry.[33] The original painters, seem to have used a number of tricks to bypass such issues. The MA-XRF scan indicates that the darkest shadows of all draperies and parts of the tomb are accentuated with a purplish mixture that contains potassium as well as some iron and calcium. I interpreted this mixture as a red lake, darkened with some bone black and perhaps some earth pigment. Using such a dark mixture, the deepest shades could be achieved in fewer layers.[34]

The scans also suggest that this mixture contains zinc. Given the presence of zinc sulfate in other Eyckian paintings, and its recurrent mentioning in historical sources, such a material may well have been added as a drier.[35] In the previous chapter we have studied the *Strasburg Manuscript* (ca. 1400), which refers to the use of zinc sulfate as a drier.[36]

[33] Red lakes are notorious for slow drying. Billinge *et al.* 1997: 42. In my case studies I've had medium thick samples that took up to three weeks to dry.
[34] Billinge *et al.* 1997: 38, describe such a use of red lake with additives as common in fifteenth-century painting.
[35] Spring 2017: 47. The use of zinc sulfate as a drier is discussed more extensively in chapter 8.
[36] Neven 2016: 120-122, No. 66-68.

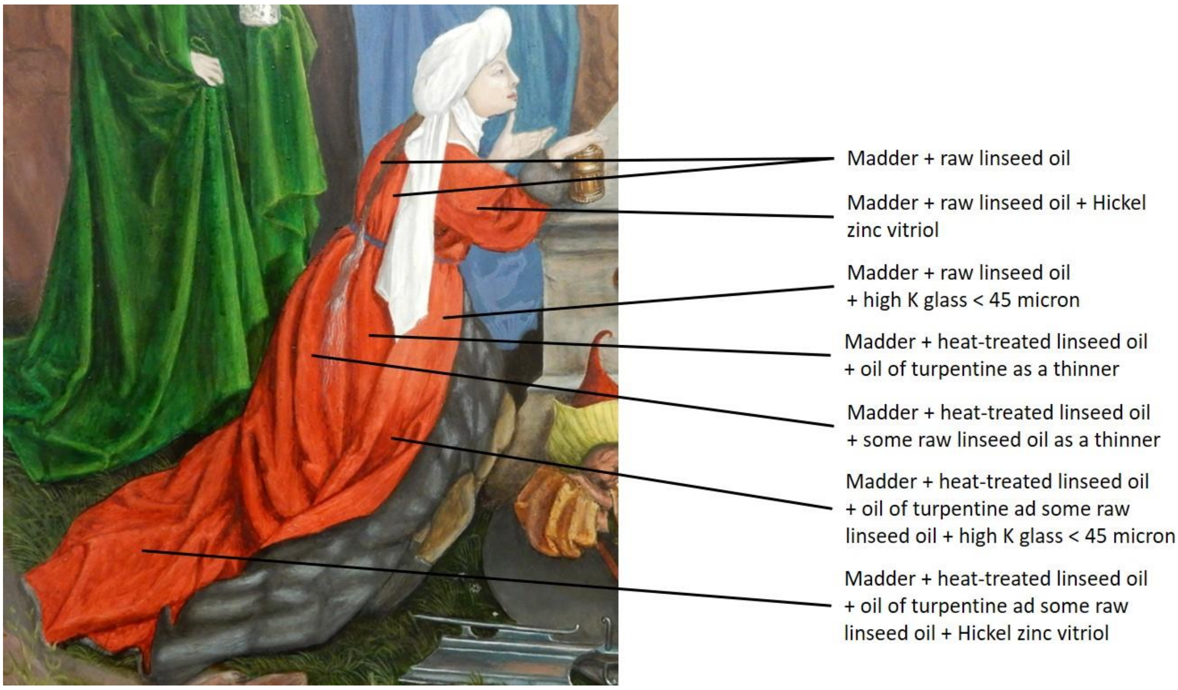


**Figure 9.5** Reconstructed red drapery, comparing various oils and additives. Note how the sections that include heat-treated oil appear more saturated, and the patchiness in the tail of the dress, due to premature evaporation of the oil of turpentine. Overall, the appearance of the dress does not seem influenced by the binding medium that was used in the underpaint layer, or the added driers.

Much later, authors such as Pacheco and de Mayerne mention both zinc sulfate and powdered glass as options to increase the drying rate of paints with pigments such as carmine lake, that tend to take a long time to dry.[37]

Because powdered glass and zinc sulfate seem to be a common ingredient in Eyckian, and other fifteenth-century paintings,[38] I wanted to compare the effects these two additives, in relation to the medium. Therefore, I prepared two paints with madder lake; one with raw linseed oil and one with a mixture of raw and heat-treated oil (1). After testing each paint pure, I added zinc vitriol[39] to part of it and powdered glass (1) to another. **Figure 9.5,** indicates how I used these paints side by side in different parts of the red drapery. In the reconstructed painting both powders shortened the drying time considerably (compared to no additive), while neither had a significant effect on the color or handling properties of the paints. On a separate test panel however, the paint with zinc vitriol dried slightly faster, while both powders made the paints with heat-treated oil appear less glossy. If gloss was the main reason to use heat-treated oil, it makes no sense to combine it with driers that (partially) cancel this effect. Yet, one could also imagine that the typical long-lasting tackiness of paints with heat-treated oil would have been a reason to add a drier.

The difficulties in grinding and applying paints with highly viscous heat-treated oils was already pointed out in the previous chapters. In this reconstruction madder lake bound in heat-treated oil again proved difficult to work with, even after adding quite some raw linseed oil. This confirms the notion that it makes more sense to prepare a paint with rawlinseed oil, and then add some heat-treated oil on the palette, to adapt the paint for a specific application.

It is also an option that paints with lots of heat-treated oil were thinned with oil of

[37] De Mayerne 1620-1646: 12r, 18r, 85v; Pacheco 1649: 388, 390.
[38] See chapter 8 and: Spring 2017: 45-49; Spring 2012: 22-23; Gifford, Metzger and Delaney 2013: 141.
[39] Hickel model mixture, prepared at the ICN (Now RCE).

turpentine or another volatile solvent.[40] In the madder lakes of the red drapery I compared the effects of turpentine oil and extra linseed oil as a thinner.[41] In small areas they worked similarly well. However, I noticed the formation of drips on several accounts, and began to suspect that this was related to the combination of heat-treated and raw linseed oil. Therefore, I decided to use turpentine oil in the larger sections of the red drapery. This did not work out well; the turpentine oil evaporated while I was blending the many folds at the lower edge of the drapery, leaving me with an extremely viscous, unmanageable paint. The end result was patchy, while ironically, drips formed anyway. As with so many mistakes in oil painting these could still be corrected, so they are not visible in **figure 9.5.**

***Blue drapery and outer wings***

In comparison with the other robes in the painting, the lack of modeling and saturation in the blue drapery is striking. A quick browse for blues on the website 'Closer to van Eyck' teaches us that the relatively poor state of blue sections is a common issue in the Van Eyck oeuvre. A similar effect appears in the blues on paintings such as the Dresden *Tryptich of the Virgin and Child*, the Sibiu *Portrait of a man*, the *Van der Pale altarpiece*, and the *Washington Annunciation*.[42] Although staining tests on a sample from the blue robe in the *Washington Annunciation* once suggested that Van Eyck may occasionally have used glue or another protein-based binder for his ultramarine glazes, later analyses have only found evidence for oil.[43] Whichever medium van Eyck and his fellow workers chose to bind their ultramarines, they probably chose it with great care, given the extreme preciousness of this pigment. It is therefore ironic that it is precisely this paint that has stood the test of time so badly. Luckily, we can still obtain an impression of the original modeling of the blue drapery in *The Three Marys* by studying the MA-XRF copper, zinc and lead scans. **For the zinc scan, see figure 8.2.**

As described in the previous chapter, a cross-section from this area shows a build-up of two layers of azurite, followed by one or two layers of ultramarine.[44] Although the MOLAB report suggests there is a black underpaint layer,[45] the IRR does not indicate the presence of carbon black, other than the underdrawing. The presence of zinc, that is stronger in the shadows of this section, was also discussed in the previous chapter. Although it is possible that some zinc sulfate was added to the ultramarine glaze as a drier, most of the zinc is probably related to the azurite.

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[40] As I pointed out before, the application of volatile solvents is only documented from the sixteenth century onwards, but there is some circumstantial evidence that suggests prior use. Dunkerton 2000: 288, 291. Mills and White 1999: 95-97; Billinge *et al.* 1997: 41-42.

[41] Turpentine balsam oil, Kremer 70010.

[42] See <www.closertovaneyck.kikirpa.be> Accessed February 18th 2019.

[43] Gifford, Metzger and Delaney 2013: 139-140. White also reports the presence of protein coated ultramarine particles in paint samples from the oeuvre of van Eyck. White 2000: 101-102 and 104.

[44] Keune and Van Loon, unpublished report on SEM_EDX A161_11 and A161_12. Boersma and van Zuien identified two layers of azurite and a single thick layer of ultramarine with a lot of calcite. Boersma and van Zuien 2012. Van Asperen de Boer and Giltaij however describe a built up of a grey modeled layer, followed by a layer with fine azurite, a layer with ultramarine (Lapiz lazuli) and azurite and one layer with ultramarine and lead white. Van Asperen de Boer and Giltaij 1987: 266.

[45] Rousselière and de Viguerie 2013: 13.


**Figure 9.6** Reconstruction of the blue drapery and tests with ultramarine and various (mixtures of) oil and water-based binding media.

For the reconstruction of this drapery I applied two layers of azurite, before adding highlights in lead white and a glaze of ultramarine. I tested a first layer of azurite with pure raw linseed oil on the proper right wing and undergarments of the soldiers. Because it appeared patchy, I added some heat-treated oil (1) and applied it on the left wing of the angel. As expected, this paint appeared much more saturated while the application automatically became thicker, hiding the ground in one coat. Because I wanted to keep the underdrawing visible in the blue drapery, I chose to bind the azurite mainly in raw linseed oil with only a bit of heat-treated oil (1). Nevertheless, it was hard to apply the gritty, opaque paint in a way that would not completely obliterate the underdrawing. Eventually, I decided to model the drapery in this first layer, using more azurite to indicate the deepest folds. Whether the original painter modeled the azurite from the start or only in the second layer is unclear, but as the copper and lead scans complement each other, he must have used azurite and lead white to indicate the darks and lights at some point. In my reconstruction, I used the second layer of azurite, bound in raw and heat-treated oil (2), to close the surface, before adding highlights with lead white in raw linseed oil.

Because of their remarkably bad condition, and the outstanding question whether Van Eyck perhaps used a water-bound medium for his ultramarine glazes, I decided to test this pigment with a variety of oil and water-based binders on a separate test panel.[46] The results were a spectrum from very pale matte colors for the pure water-based media, to saturated, dark and glossy for the heat-treated oil.

Eventually I chose a mixture of egg yolk and some raw linseed oil with ultramarine (I), for the left and lower part of the drapery. The color of this mixture on top of the azurite underpaint layer seemed closest to that of the original blue

[46] According to Dunkerton the addition of oil to egg tempera paints gives the paint more depth and saturation, while the appearance becomes more similar to that of oil paint. Dunkerton 2000: 288.

drapery, while it still had some glaze-like translucency. To my surprise, the watery layer adhered perfectly well on the fatty underlayers. However, once it had dried, the color came out too dark and opaque. The modeling of the lower layers had become completely invisible. Therefore, I tried ultramarine II with egg yolk and an addition of heat-treated linseed oil (2) on the right side of the drapery. This paint had a more convincing color and allowed the undermodeling to shine through due to its translucency. However, in this section the greenish tone of the azurite now dominates the final color a little too much. The difference between the two ultramarine 'glazes' is very apparent in the lower bit of the drapery, where I retouched the first paint with the second. That also shows the difficulty of matching colors in mostly water-based paints: their colors change as they dry. In the end, I reinforced the shadows of the left half of the drapery with some ultramarine II in sun-thickened linseed oil, to give at least some idea of its original modeling. This paint was absorbed a bit by the lower layer, which made me wonder how the whole section would appear after the application of a final varnish. **Figure 9.6.**

Although it's unlikely that the original painter(s) needed this kind of trickery to get their paints right, it teaches us that combining oil- and egg-based media in different parts of the layer structure certainly was an option. It also shows that pre-treated linseed oils could have played a role in all sorts of mixtures, including egg-tempera.

***Green drapery***

The XRF scans of the green drapery indicate copper all over, and highlights containing lead and tin. There is also some calcium on the lower left and some iron and zinc in the darkest part of the middle fold that comes down from the proper right hand. A cross-section from this drapery was not available.

However, in a sample from the meadows above the tomb that was mentioned in the introduction, Van Asperen de Boer and Giltaij reported the presence of some pine resin.[47] Another cross-section from one of the golden rays on the right edge of the original painting, shows distinct cracks in the dark green layer of the grass below.[48] This reminded me of the brittleness I noticed in paint samples with verdigris and colophony varnish from chapter 7. According to the restoration report, the green sections of the painting felt hard and are preserved better than any other.

I chose to prepare the verdigris for the drapery with roughly equal parts of heat-treated linseed oil (2) and colophony varnish. I then thinned the mixture with some raw linseed oil. The paint did not level completely, and remained somewhat patchy, but the result was extremely translucent, smooth, and glossy. Later however, when I tried to apply highlights with lead white and lead tin yellow in raw linseed oil, the paint kept slipping away and wouldn't adhere on the smooth layer below. Perhaps this was a classic case of working lean over fat, that could have been avoided by saving the resin for the final paint layer. This might have prevented other issues as well. On several places the yellow paint for the highlights got trapped in particles that protruded from the surface of the verdigris layer below. As I hadn't noticed any grittiness during application, I wondered if the particles had submerged during shrinkage of the film while drying. No problems occurred during application of the final green layer, that had a composition similar to the first.

The real asset of this mixture of verdigris with heat-treated linseed oil and colophony varnish became evident while I kept reworking the final layer, removing paint from the highlights and deepening the darkest shadows. Due to its tendency to level, the paint blended nicely and disturbing brush imprints disappeared after a few seconds. It appeared beautifully saturated and glossy, while so far it hasn't shown any signs of

[47] Based on these results Van Asperen de Boer and Giltaij identified this paint as a 'ground copperresinate'. Van Asperen de Boer and Giltaij 1987: 266, 272, note 46.
[48] Boersma and Van Zuien 2012.

brittleness. However, the next day several drips had appeared at the lower end of the drapery, and some pigment particles still pierced the surface, even though this time I had made sure the paint was ground to perfection.

Finally, I want to note that it took remarkably long before the natural color change –from turquoise-blue to green – occurred in the first layer of verdigris in heat-treated oil (2) and colophony varnish. Only after six days it had obtained its definite green color. In the first layer of the drapery this slow change caused little trouble, because the paint was used unmixed and the subsequent layers were applied much later. In other sections however, the verdigris paint needed to be mixed or layered to obtain various shades of green, and working with a turquoise paint made it hard to assess the right proportions of various paints. I solved this problem by adding some yellow lake to all further verdigris paints, thus anticipating the color shift that would eventually take place.[49] **Compare figures 9.4a+c and 9.5.**

***Fields***

The MA-XRF scans of the fields, indicate the presence of copper, some lead and tin, iron and a little calcium. How these elements are distributed in the layer structure is clarified by the previously mentioned paint sample with the crack, from the right edge of the painting. It shows an off-white layer with some orange and black particles, followed by a darker and a lighter green layer. In another sample from the grass, possibly including some of the foliage, a darker green layer is placed over a lighter green layer. Such a build-up, of a yellow or yellowish-green layer, followed by two or three layers of increasingly dark green was also described by Van Asperen de Boer and Giltaij.[50]

To underpaint the fields I used red and yellow ochre in raw linseed oil, aiming for a soft paint that could be applied thinly and in a somewhat patchy way. In an attempt to eliminate disturbing brush strokes, I added some drops of raw and heat-treated linseed oil (2). The resulting paint layer was too thick and closed. Dabbing it with a linen rag eventually created the right patchy surface.

For the upper green layers, I used verdigris with heat-treated oil (2), colophony varnish that was thinned with some raw linseed oil and mixed with a little yellow lake in raw linseed oil. Locally I adapted the color by adding some lead tin yellow, red ochre or vine black, all in raw linseed oil. The result showed too much of a brush imprint, but after blotting with some fabric it obtained the right patchiness. In this case the use of a more viscous mixture of media was crucial, because the effect depended on a slight leveling of the textile imprint. Trying different application methods in this way, made me conscious that a particular effect in a finished painting may well be the end result of trying a sequence of materials and technique(s) that together add up to the final result. Distinguishing the individual role of each of them would be nearly impossible.

***Yellow drapery and inner wings***

The yellow coat and the wings of the angel were underpainted with lead tin yellow in raw linseed oil. This paint didn't need any addition to create a thin, smooth and slightly translucent layer. It appeared a bit matte though, and the color was a bit too dark. To create the right contrast, I deepened the shadows wet in wet with some yellow and red ochre in raw linseed oil. Later I adapted the color and added some highlights with lead white and a tiny bit of lead tin yellow, again in raw linseed oil. All this was based on the lead, tin and iron MA-XRF scans, which clearly complemented each other for this section. A dark glaze of madder lake in heat-treated linseed oil (2), bone black, and some yellow lake (both in raw linseed oil), was used to deepen the shadows of the wing and drapery some more. To my surprise this mixture did not adhere well on the lead tin yellow below. Adding some oil of turpentine and retouching the glaze several times

[49] This practice was advised to me by Charlotte Caspers, and is documented in the *Eikelenberg Manuscript* 1700-1732: 399, Jensen 2015-2017: 134, fol. 399 [180nn].

[50] Van Asperen den Boer and Giltaij 1987: 266.

eventually worked, although in some places beading of the paint remained visible. As the glaze was particularly rich in oil, it is clear that this effect, which also occurs in leg hairs of Adam on the Ghent altarpiece, is not necessarily the result of applying a watery or too lean paint over a fatty underlayer. [51] **Figure 9.7.**

**Figure 9.7** Left: Beaded paint in the hairs of Adam's legs on the *Ghent altarpiece* (1432). Photo: KIK-IRPA, Brussels. Right: the same effect in the reconstruction of the *Three Marys*. Note that the glaze on the right sleeve eventually closed after careful reworking with some oil of turpentine, while in the more subtle applications this was very hard. Eventually it required several overpaints.

***White drapery and tomb***

In the angels' dress I experimented with different media. On the proper left arm, I used lead white in raw linseed oil. Because the XRF-scan indicated the presence of some iron in the shadows, I reinforced them with some red ochre in raw linseed oil. Later I realized that this iron is probably part of the dark glaze with zinc sulfate that was used for shading, later in the process.

In the rest of the dress I used lead white in mainly heat-treated linseed oil (2), because previous tests have indicated such paints might yellow less.[52] To make the consistency of the paint workable I added some raw linseed oil. Although the resulting paint dripped from the brush, it still remained difficult to spread. Like with the red and green paints, several smaller and larger drips had formed when I returned the next day. This is clearly a downside of strongly heat-treated oils that becomes particularly evident when painting in a vertical position.

As a basis for the tomb I used the same lead white paint with a mixture of heat-treated (2) and raw linseed oil, to which I added a little vermilion, vine black, and yellow ochre (all in raw linseed oil). Before I added the blue veins of the marble, I adapted the color of the tomb with a thin wash of azurite all over, some bone black in the darkest areas, and some lead white in the lightest. These paints were also prepared with raw linseed oil. On top of this still wet layer, I painted the veins with a relatively lean paint of finely ground azurite in raw linseed oil. As the lines look very blurred in the macro photographs, I determined their shape based on the copper scan. I then carefully blended them into the background by gently striking the wet paint with a soft round brush. This would definitely not have worked with a heat-treated oil, since it would have been too sticky. **Figure 9.8.**

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[51] Dunkerton also describes this effect and contradicts the popular notion that this effect is due to the repulsion of a water-based paint by an oil-based underlayer. She claims it also occurs when a "light, rapid stroke of oil-bound color is applied over a dry underlayer". Dunkerton 2000: 288. However, in the present case the paint was not applied in light rapid strokes, but in rather brought washings.

[52] See chapters 5 and 7.


**Figure 9.8a-d** Different stages of the white drapery and tomb. Images a and b show how the dripping quality of paints with heat-treated oil (see arrows), on the right soft blending of the veins in both types of stone was only possible with raw linseed oil (the upper image shows the veins in the white marble before they were blended).

***Soldier in armor***

Macro-photographs and MA-XRF scans of the sleeping soldier's chainmail demonstrate that it is built up of little off-white rings that are high in lead, over a greyish blue layer that contains calcium and copper. Because the lower edge of this underpaint appears black, I initially thought that it was made of bone black, partly covered with a thin layer of azurite, before the rings were put on. However, in hindsight, I realized it would have been more efficient to mix the bone black and azurite from the start, creating the right dark grey in one layer, thus providing contrast for the rings.

The slow drying black did however provide a good opportunity for experimentation with driers. As several sources mention powdered glass and verdigris as alternative driers, I decided to compare them.[53] I used bone black with raw linseed oil and a drop of heat-treated oil (1) as a base. In the proper right arm and between the knees I applied a very thin layer of this paint, diluted with some extra raw linseed oil. In the left arm and hanging sleeve, I used the same paint with some verdigris as a drier. In the soldiers back, 'skirt' and scabbard I added some powdered glass (2). All paints were also applied on a small test panel that was taken home. In concordance with Palomino's findings, verdigris clearly came out as the better drier, with an advantage of several days.

The azurite layer on top of the black was ground with mainly heat-treated oil, which was clearly a mistake. Its high viscosity made it impossible to spread the paint thin and evenly. I ended up thinning the layer by removing some of the paint with a piece of cloth. Like in the chainmail of George in the *Madonna with Canon Van der Paele* (Jan van Eyck, 1436),[54] and the knights from the *Knights of Christ*, in the *Ghent altarpiece*, the individual rings in the *Three Marys* are applied with little arches of light blue, white and yellow paint. They measure about one millimeter in the *Three Marys* and the *Knights of Christ*, versus nearly four in St. George, which is probably why only in the latter the rings are painted in both directions.

[53] De Mayerne 1620-1646: 18r; Palomino 1724, Book V, Cap IV: 38, Véliz 1986: 157.
[54] 1436, Groeningemuseum Bruges, Inv. 0000. GRO0161.I.

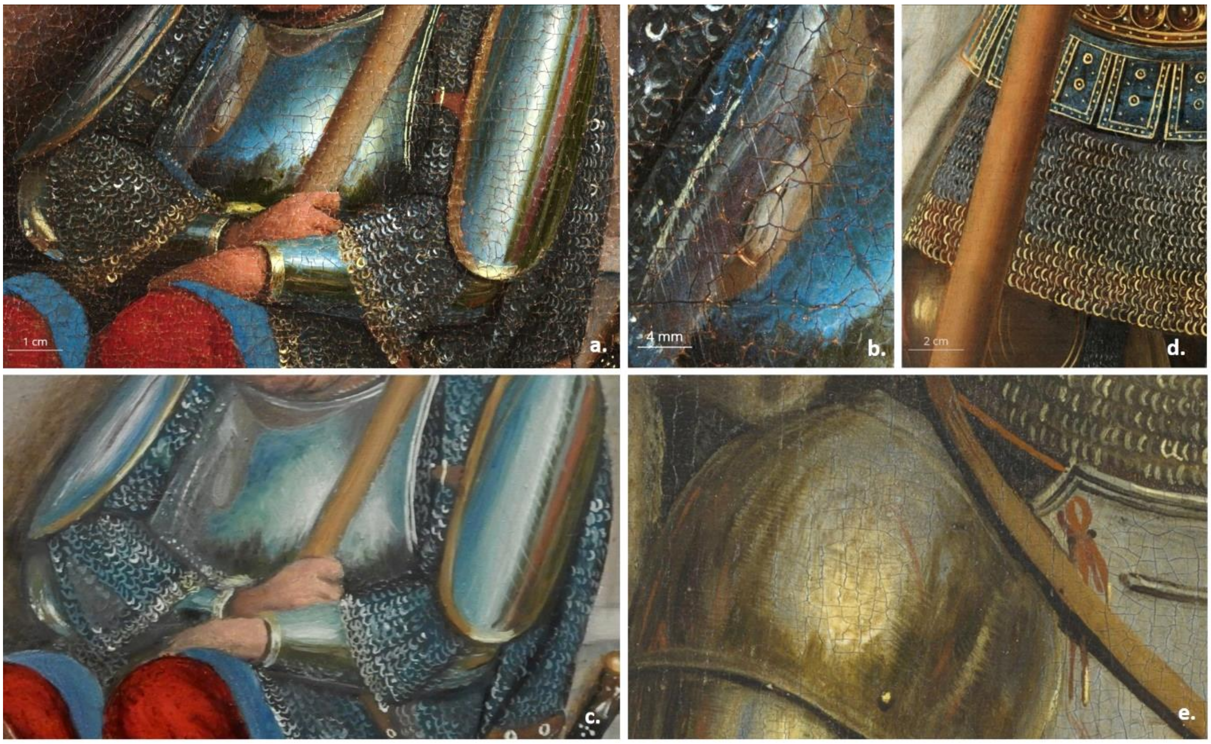


**Figure 9.9a-e a.** Detail of the sleeping knight in armor from the *Three Marys.* **b.** Further detail of the proper right side of the breastplate in the *Three Marys*, showing the minute diagonal lines uniting the highlights of the breastplate with the background. **c.** Reconstruction of the sleeping knight in armor from the *Three Marys.* **d.** Similar treatment of the hauberk of St. George in the *Van der Paele altarpiece.* **e.** Proper right shoulder of the front most knight of Christ from the *Ghent altarpiece* (before restoration), showing a similar treatment of the hauberk and the use of fine diagonal lines to blend in the highlights. Photo's a, b, d and e: KIK-IRPA, Brussels.

The paint must have been soft and buttery, as in some places it is pushed away from the center of the brushstrokes, uncovering the color of the underlayer. This effect also occurs in other details on the painting, like the small flowers in the grass, and is only possible on this scale with a medium that doesn't level: raw oil. **Figure 9.9a-e.**

I also used raw linseed oil to bind the lead white, vine black, ultramarine (Kremer), azurite (Kremer), lead tin yellow, yellow and red ochre, vermilion and verdigris for the breast and arm plates. This medium was crucial for the replication of a special little trick that also occurs in Saint George's helmet (*Madonna van der Paele*) and in the armor in the *Knights of Christ*. In all these paintings very fine diagonal lines are dragged from the wet highlights to unite them with the base tone of the metal, and the colored reflections. To achieve such a refined effect would be impossible with a more viscous paint, because individual lines would broaden as the paint levels. **Figure 9.9a, b and e.**

***Details and texture***

For that same reason I would be inclined to believe that all the little reflections and details that are so characteristic of Eyckian painting, are in fact based on raw linseed oil. With heat-treated or even sun-thickened linseed oil it is simply impossible to create such refined shapes and crispy highlights; again, because they would lose their definition as the paint leveled. This became painfully clear when I tried to paint the little white pearls in the hair of the angel with an only mildly oxidized oil, that had been left in a small container for about a month. **Figure 9.10 a-b.**

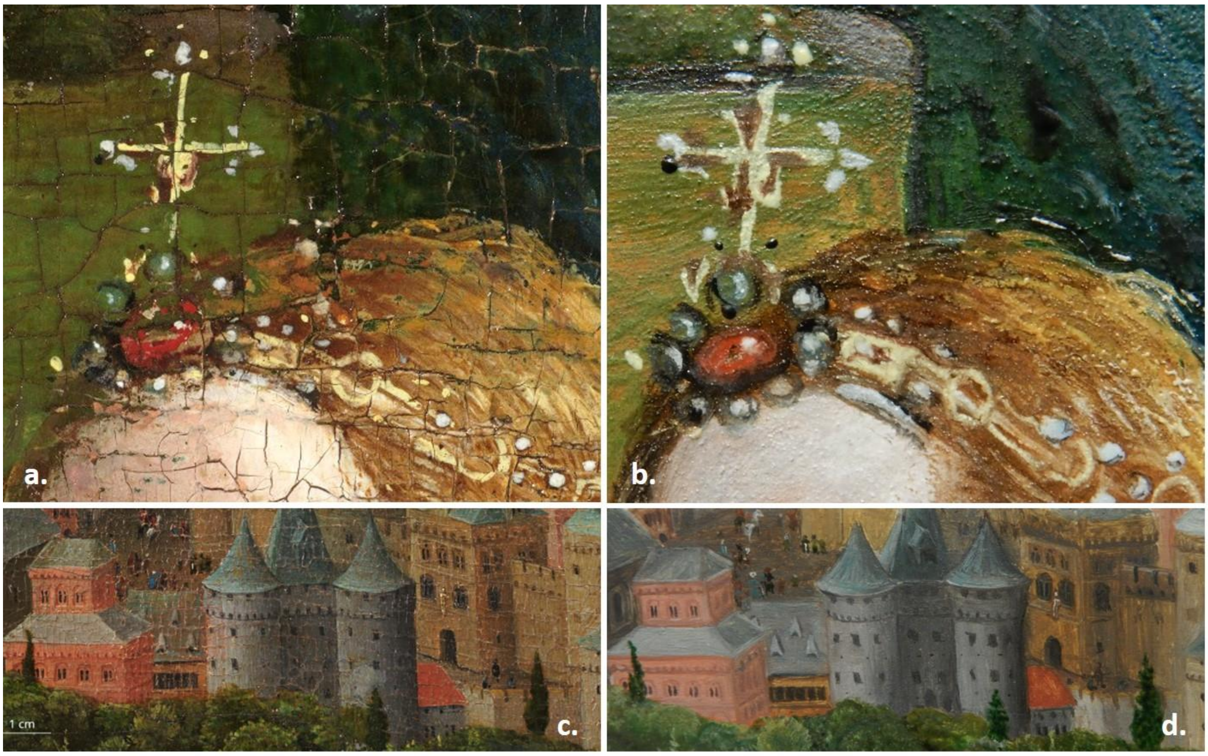


**Figure 9.10a-d** Details from the *Three Marys* **(a. and c.** photos: KIK-IRPA, Brussels**)** and its reconstruction **(b and d.)**. For painting this kind of details, one needs raw linseed oil. Even a slightly more viscous medium, as was used in the white pearls of the tiara **(b.)** levels after the brush is lifted, and may cause details to turn out larger than intended. A slight unevenness in the original painting was especially noticed in sections based on ultramarine, such as the roofs of the round towers **(c.)**, in practice such problems could sometimes be remedied by adding a little heat-treated linseed oil.

Working at such a micro scale, using brushes that hold hardly any paint is only possible with a paint that flows very easily.

I almost exclusively used raw linseed oil for the details in my reconstruction of the *Three Marys*, such as the city scape, faces, flowers, foliage and the veins in the stones. Sometimes however, the paint was still hard to handle and the brush tended to scrape it away, uncovering the ground below. In other cases, the paint had too much hiding power. Both problems could easily be fixed by dipping the brush in a tiny bit of heat-treated oil and mixing it into a paint locally, even directly on the panel. However, sometimes the result remained a bit uneven. Interestingly, such an unevenness appears on several places in the original painting and seems to reveal traces of a similar struggle. **Figure 9.10c-d.**

Although it seems likely that raw linseed oils were the primary binding medium in all those impressive details, that doesn't mean that more viscous oils played a marginal role. Details would certainly have stood out much better on smooth, saturated surfaces that were undisturbed by imprints of the brush. Such a basis could be achieved easily with a viscous medium such as sun-thickened or heat-treated oil. Therefore, the real mastery seems to lie in choosing the right materials for the right paint, anticipating the final effect the combined paint layers will make.

## Conclusion

Making a reconstruction of *The Three Marys at the Tomb*, and actually painting with a selection of raw and processed linseed oils as well as a variety of additives, has been an extremely rewarding and insightful experience. Not only has it confirmed and nuanced the results of the mock-ups from the previous chapters, it also taught me a lot about the original painting, and the practice of oil painting in general. The intensive interaction with the materials in combination with a whole range of pigments and techniques has deepened my understanding of their individual assets, their interaction with other materials in a layered structure, and their effect on the work-flow. It has also made me appreciate the kind of choices that need to be made in such a process, and the possible motivations behind them.

In practice, using a variety of oils rather than just one was not particularly difficult, but it did require some thinking. Whilst preparing small batches of paint, it was a matter of choosing a specific oil, to match a pigment for a certain section. Which choice I made was mostly based on whether I needed a soft and flexible paint that kept its shape, for details and highlights, or one that would yield a smooth result, for sections that would be disturbed by brush imprints, like the draperies. In some cases, there were additional motivations. Like the choice for a heat-treated oil in sections that would suffer from the more pronounced yellowing of raw linseed oil. Particularly with coarse azurite I found that a small addition of heat-treated oil helped to close the surface, where with only raw linseed oil the particles kept uncovering the white ground below. While occasionally I forgot which binding medium I had used for a particular paint on my palette, this was usually easy to see, because paints with viscous media also level on the palette. When I really wanted to prevent mistakes, for the sake of the experiment, I made a note next to the paint, or I positioned paints with different media on a distinct part of my palette. Sometimes I used leftover paints with different binding media and additives to adapt the color of a certain mixture. If this is something historical painters also did, one may expect to find a variety of oils and additives in sections with mixed paints.

Where it came to the choice of additives, various considerations were made. For darker paints, like blacks, one could choose any effective drier like for example verdigris, as long as it didn't make the paint turn grey. Yet, for the lighter and more delicate pigments one needs something that doesn't spoil the color. So, although powdered glass and zinc sulfate are not the most effective driers, their lack of color may have been an argument for their use in combination with red lakes, or a precious ultramarine blue.

To what extent the use of such driers affected the work-flow, would not only have depended on the choice of pigment and the relative number of paint layers, but also on the artist's working speed. It may be due to my slow pace that I was only held up twice by a slow drying paint during this reconstruction. This happened with the *imprimatura*, and in the modeling of the red drapery. In all other cases where a paint took relatively long to dry, I had enough work on the rest of the panel to keep myself busy. Especially in the beginning of the process, in the underpaint stage, I saw no need to add a drier, as there was still so much to do. However, in hindsight, I would have applied the first layer of red lake earlier in the process. That way, I would have made sure there was always one layer of lake drying, and I would not have created a retardation by leaving the stack of slow drying layers of lake for the end, when there was no other work left. A faster-working artist, or one under time pressure, might have benefitted more from the addition of a drier in such a layered application of red lakes. Like the creator of the *Three Marys*, he might also decide to add some black to the darkest shadows, so that he could achieve a convincing modeling with fewer layers. In practice, I was not bothered by a loss of gloss due to any of these driers in the upper paint layers, but even if it had occurred, it would probably have been remedied by the application of a final coat of varnish.

Like in the mock-up's, the addition of some colophony varnish to the verdigris paints created relatively smooth and sometimes glossy surfaces. However, occasionally these paints were so viscous that they could only be spread sufficiently thin through blotting. Whether the gloss that an addition of varnish potentially brings really pays off, again depends on whether a final varnish is foreseen. However, adding varnish to the underpaint layers really makes no sense. While its gloss would be covered by later paint layers, the smoothness of a resin-rich layer created problems with the adhesion of subsequent paints. If the painter was only out to create a smooth and saturated layer, for example as a basis for details, the addition of some heat-treated oil would certainly suffice.

In either case, the addition of such a viscous material would make the paint less easy to handle. Whilst both oil of turpentine and raw linseed oil were effective as thinners, their use requires foresight and some extra skill. Paints that were prepared with a mixture of heat-treated and raw linseed oil, repeatedly formed drips overnight, regardless of the pigment they were combined with. This downside of the leveling quality of such paints only became fully evident during the full-scale reconstruction, as it was made and dried in vertical position. Whilst in most cases drips could be corrected easily, they could still be a reason to renounce the use of too much heat-treated oil, or to let a particular section dry in horizontal position.

Paints with a considerable ratio of heat-treated oil that were thinned with oil of turpentine were also found to drip. Yet more challenging was the fact that this solvent tended to evaporate so fast that it allowed little time to model a particular section. Therefore, it requires a very certain hand, or else its use should probably be limited to larger, unmodeled applications.

I also want to spend a few words on the use of yellow lake as an addition to paints with verdigris. Although I've never come across a description of such a practice in modern literature, I found it quite essential for the assessment of color in green mixtures. This becomes all the more pressing if the addition of colophony varnish really slows down the color change of verdigris from turquoise to green. For future research it could be interesting to study how the addition of pine resins and yellow lakes affect the durability of verdigris paints.

What my reconstruction of the *Three Marys* has also shown, is that it is very well possible to apply an egg tempera paint on top of an oil-bound layer. The 'universal rule' that paints were always applied 'fat over lean' should therefore not be taken too rigidly. My experiments have also shown that one cannot simply explain any paint that has contracted into droplets, like in the leg hairs of Adam in the *Ghent altarpiece*, as a violation against this rule. While I experienced severe issues with contracting paint when I tried to apply the fatty glaze over the lean yellow drapery, no such problems occurred with any of the blue temperas over the oil-based azurite of the tests and reconstruction.

Summarizing the affordances of individual materials and the considerations behind their use helps us understand what may have gone on in the mind of fifteenth- and early sixteenth-century artists. It unravels something of the material intelligence they displayed during the production of their master pieces. But to what extent does the use of these materials explain the advancement in the depiction of reality that characterizes fifteenth- and early sixteenth-century oil painting? Could the effect of any material be so spectacular that it would have affected the development of style and technique in this period? Based on my experience with these materials my answer to these questions would be 'no'.

If there is one thing my experiments have shown, it is that we are not speaking of one magic material that made all painting much easier. Instead, we should be thinking of groups of materials that could be adapted and applied for specific purposes, depending on a whole range of factors. The real art was in knowing exactly how to do that. Ironically, my reconstructions have shown that the one material that seems most suitable to create the details and highlights that are so essential for the mimesis of materials, is raw linseed oil. Of the media I tested, it is simply the only one that yields paints that are soft and flexible enough for application on a micro scale, and keep their shape once the brush is lifted. That doesn't mean that all the other oils and additives were of secondary importance. Each of them has its own affordances that, if used wisely, may have contributed to specific sections of a painting, in support of the whole. So, it was really about using the available materials in a clever way, to make sure that all attention could be drawn to the beautiful details.

The outstanding quality of the work of Jan van Eyck and some of his colleagues, even after six hundred years, simply proofs that these artists understood and controlled their materials on the highest level. Their painting bears witness to an incredible dedication combined with a remarkably perceptive mind, that was deeply invested in defining the properties of the materials they tried to imitate as well as those they used to do so. I believe that it is this curiosity, this material intelligence, that inspired fifteenth- and early sixteenth-century painters, and that was the motor behind the technical and stylistic development that we see in their work. As with any profound interest: cause and result are deeply intertwined. Whether the application of certain materials facilitated the imitation of reality, or if the desire to do so, led to an advancement in the use of painting materials, are basically two sides of the same coin.

**Figure 9.11** Indra Kneepkens, *The three Marys at the Tomb*, reconstruction after Jan and Hubert van Eyck, workshop(?), 2019.