Recreating an Early 16th Century French Miniature

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Overview

For this entry I aimed to replicate one of the full-page miniatures found in an early 16th century manuscript originally commissioned for a Dominican cloister in Poissy, France. My main interest in completing this project was to practice using more historical materials and techniques in my scribal work. Although I have done some charter painting and a few one-off original calligraphy and illumination projects, I had previously used modern gouache and had not undertaken a painting of this complexity. Additionally, the miniature I was attempting to copy has been damaged; one reason I chose that particular painting is I was interested in "restoring" the complete image.

I had an opportunity to closely examine the extant manuscript. As it had been little studied at the time of my examination, in my documentation I will present the details of the various types of decoration found in this work and I will advance some hypotheses about the techniques used in painting these decorations. I was interested in testing what I had observed in the manuscript miniatures by trying to replicate the same style in my own painting. I supplemented my direct observations by studying modern scholarly works on book production (particularly illumination) during this period and *Il Libro dell' Arte* (aka "The Craftsman's Handbook," the well-known early 15th century Florentine artists' manual by Cennino Cennini).

I also prepared some of my own painting supplies; I made ink and paints and have documented the processes I used for each. I also attempted to make some of my own tools (specifically quills for doing the initial inking of the artwork). The finished painting was painted on parchment using paints I made from period pigments or modern chemically similar substitutes.

Background on the Reed Poissy Processional

The manuscript this entry is based on is a Processional produced in Paris around 1510 for the Dominican sisters of St. Louis in Poissy, France (Christie's catalogue). Presumably this book belonged to one nun in particular, judging by the arms on the first page of text. The nun who commissioned it probably determined how she wanted her book laid out, such as specifying which prayers and songs she wanted included (in addition to the standard ones), how many miniatures, how many and what types of capitals, and whether she wanted borders. From this information the workshop that produced the text and the miniatures could have either added all the elements and presented the finished book to the nun, or could have left some areas (like borders and capitals) blank, so that the nun herself or someone else in the cloister could have completed the manuscript.

Images from the Poissy Processional

Example of a typical page with decorative border, initial, music, and text.

Full page miniature: Presentation at the Temple (fol. 10v)

Full page miniature: the Arrest of Christ (26v)

Full page miniature: the Last Supper (88v)

Full page miniature: Martyrdom of Saints Agnes and Catherine (118v)

Three quarter page miniature with decorated border

Reverse (recto) side of Last Supper miniature, showing oxidation pattern and ruling lines.

Parisian Book Production and Painting Techniques

By the 15th century Paris had a highly developed community of book producers, and professional illuminators practiced their trade largely separate from other aspects of manuscript production and from other types of painting. The basic productive unit for illumination was a workshop; some may have been hierarchical, organized around a single master and his apprentices, while others may have been more collaborative and made up of equals. Multiple strands of evidence (such as unfinished manuscripts and payment records/contracts) suggest that within a workshop different artists had different specializations. For example, a separate painter might have been responsible for painting drapery from the one painting faces.

Evidence from unfinished manuscripts suggests that the typical process for completing a miniature (without text) was as follows: ruling of margin / border; drawing of figures with graphite or hard point (graphite may have predominated after the 12th century); inking the drawing; gilding (if using leaf gold); applying washes; layering stronger and lighter tones for highlights and shadows; finishing fine details (especially faces), cleaning up errors, and doing final outlines in ink (Alexander 1992). If gold paint (shell gold) was used, that would have been the final step (de Hamel). Again, there is evidence that each of these steps may have been completed independently by different artists; the colorist in particular (responsible for laying down the washes) may have not had much other painting or drafting skill (Watson 2003), suggesting that this was a task for apprentices or other lower-skilled workers.

Below are some images of several finished and unfinished manuscripts from approximately this same time period as the Poissy Processional that give evidence for the process of painting.

From a Rouen book of hours dating to the late 15th century (Watson). Note the compositional similarities to the Poissy Processional; note also that this appears to have been executed by a much more skilled painter.

9–12. This is a Dutch translation of the *Cité des Dames* of Christine de Pisan, dated 1475. The text was written first, carefully leaving 14 rules lines blank above each chapter opening for the insertion of miniatures (plate 9, f.78r). Designs for miniatures were quickly sketched out in ink, and large blocks of colour were applied rapidly with a brush (plate 10, f.109r). Gradations of colour and outlines were added, leaving the faces to the end (plate 11, f.101r). Pictures were finished with a pen, using black, white and liquid gold, supplying highlights, faces and details of the room and its furnishings (plate 12, f.11r).
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Scan of a page from De Hamel showing several images from one manuscript, a Dutch copy of *The City of Ladies* from ca. 1475

Scan of a page by Watson showing various unfinished images from the Harreteau Hours (France, end of the 15th century).

Ibid. A finished image from the same manuscript.

Analysis of Illuminations in the Poissy Processional

The decoration in this Processional takes several forms: full-page miniatures, a three-quarter-page miniature, multiple vine borders, a heraldic charge with a wreath, decorated initials (of which there are several types), and in-text decorations.

There are four full-page miniatures, all apparently painted in a typical style for miniatures produced in Paris in the early 16th century (Christie's catalogue). The full-page miniatures are, in order: the Presentation at the Temple (10v), the Arrest of Christ (26v), the Last Supper (88v), and three scenes of the martyrdom of saints Agnes and Catherine (118v). All are painted on the hair side of the vellum. Excepting the St. Catherine series, the folios are blank on the recto side. The first two miniatures are on distinctively thick vellum.

Taken together these observations suggest that the miniatures may have been tipped in. This was a common practice during this time period, and provides further evidence for commercial production of miniatures. It generally appears that miniaturists had little knowledge of the text of a particular book, rather they produced paintings which were intended to stand alone; this is a sharp contrast to earlier manuscripts produced almost exclusively in religious communities and in which did not show images were produced in conjunction with text.

Both sides of the folios that the miniatures are on have the same pink frame rulings as seen on the text pages (although they lack the text lines that are otherwise on every page) suggesting that the miniatures were produced in the same workshop that put together the manuscript. Each miniature has a frame of decorated columns executed in liquid gold with details of fine lines of in red paint. Leaf gold is not used in the miniatures.

Colors used are a standard array of green, blue, red, black, white, and flesh tones, with more limited limited use of yellow, purple, and orange. As of this writing, there has not been a formal chemical analysis of the pigments used in this manuscript. Silver was used in a few miniatures (the Last Supper and the St. Catherine series most notably), and where it has been used it has, predictably, left a noticeable oxidation pattern on the reverse side of the folio. This effect is notable in the wall hanging behind Christ's head in the Last Supper: a pattern that is not obvious in the miniature itself can clearly be seen through the vellum. This pattern looks as though it has worn off on the front.

The four full-page miniatures are painted in the same style. I examined each miniature with a magnifying glass to determine how the paint was layered to create the final effect. Based on my examination of the scratched out area in the Last Supper miniature (88v), it appears that the elements of each image were first outlined in ink. The ink appears brown (matching the calligraphy on other pages of the book) and penetrated the parchment well enough to withstand the scratching. The background of each scene may have been painted next. Both interior and exterior scenes are included.

Exterior scenes (see the St. Catherine series, for example) are characterized by light green vegetation executed in a looser style than the figures, with less use of over-painting and outlines to bring out details. Perspective is not as apparent in the exterior scenes as in the more highly illusionistic manuscripts of the period. Instead, there is a grassy foreground and some small trees and shrubs in the background. Interior scenes (see the presentation at the temple, for example) do make use of perspective, most pronounced in the receding lines of the checkered floors. In the Last Supper miniature, the background is both interior and exterior, and the contrast is made

apparent; the interior parts of the scene show good use of perspective, while the exterior portions are tiny and lack detail.

The foreground elements, particularly the figures, seem to have been painted in a very specific style. Washes of middle tones were applied over large areas (as for clothing) and a pinkish flesh tone put down in the areas of faces and hands. Layers of darker or lighter paints were then built up on top of this foundation. Medieval pigments did not allow for much blending once applied to the surface, and so effects of highlights and shadows were usually created by putting gradients of color next to one another and by adding shadows and highlights in the form of hatching. In keeping with this, shadows were done with lines of deep pigments, and highlights were added in very fine lines of white or a contrasting light color.

On faces, shadows under and around the eyes, chins, and noses emphasize these features. These shadows are in a light grey; a small amount of black paint was probably added to the flesh tone, which would mean that faces got different treatment from drapery (possibly suggesting separate artists). Lips are uniformly a light red, giving many of the male figures a somewhat feminine appearance to modern eyes. Eyes are also uniformly done with a large black iris/pupil over white. Sometimes hair is done in a large area of pigment with highlights and shadows over it, as done with drapery, and sometimes it looks as though it was painted one strand at a time with a very small brush. The final step in creating the look of the faces was to add fine black outlines to further emphasize the expressions (hands were similarly outlined).

Fine lines of liquid gold were used to add halos around the faces and highlights on the clothing of some figures (notably the holy ones). My examination suggests that this was the final step, as I did not find any examples of other figural elements overlapping the gold (large areas of

gold were accented with red ink, as in the framing columns). As previously mentioned, no leaf gold is used in the miniatures. Leaf gold works best on a large area, therefore there would have been no limitation on using it for the framing columns. However, it is possible that the artist first chose to use fine gold lines to accent parts of the painting, which would have required him to use liquid gold. Since leaf gold is much shinier and visually very different from liquid gold, the artist may have chosen to use exclusively liquid gold to maintain a uniform look in the miniatures, and to ensure that the halos and highlights did not lose brilliance by comparison. (This hypothesis does lose some support by the fact that leaf gold was used in the borders of the text pages, and these borders appear alongside miniatures).

For a discussion of the other painted elements present in this manuscript, see appendix 1.

For the particular image that I was recreating, one part was particularly fascinating to me: the scratchout. After carefully examining the damaged area with a magnifying glass and the reverse side of the vellum, I am confident that this area originally had an image of a dog. I base this primarily on the remains of brown ink lines left behind in the parchment. It was in a half-crouching position, with its forelegs crossed and possibly with something it its mouth. It had the sleek, lean lines of a greyhound. A few tantalizing flecks of paint remain on the surface of the vellum, all in a very pale grey. Interestingly, *domini canes*, dogs of the Lord, was used as a visual pun on Dominicans during the Middle Ages, which may explain the inclusion of a dog in a miniature of the Last Supper intended for Dominican nuns.

There is no clear answer as to why this image has been scratched out. The scratched out area is very close in shape to a dog, which would mean that the scratching was a deliberate removal of the dog itself. My best hypothesis is that a later owner of the manuscript viewed the

inclusion of a dog at the Lord's table as extremely vulgar and sacrilegious. I do not have a way of testing this hypothesis, but in one of the practice versions that I completed of this painting I altered the dog to look like my pet corgi as if he were licking crumbs off the floor; in this way I hope to give a modern viewer a sense of how jarring a dog on the floor in front of Christ might have appeared to a post-medieval viewer of this particular image.

Recreation Process and Justification

Overview:

Knowing that this project would stretch my skills, I chose to tackle doing this painting in phases. First, I did a practice version using mostly modern materials such as watercolor paper and gouache (since I was most familiar with these) but following the same overall steps of painting as described above. Next, after making myself ink and paints, I used these to do a practice version on modern watercolor paper to get a feel for how the period materials handled (and because I was still not confident in my painting skills). Finally, I completed the final version on parchment using my homemade ink and paints. I have brought all of these paintings with me today as part of my display.

First Practice Painting:

One aspect of this project that continually challenged me was the simple act of drawing the figures and getting the composition correct. I am not used to trying to copy artwork so exactly, and I think my desire to do a slavish reproduction caused me to get hung up on what should have been simple steps. After trying and failing to copy the composition by eye, I ended up using tracing paper to copy the painting from a printout of the original, cleaning up this tracing to account for the curvature of the book in the scan, and then using a stylus to imprint the outlines of this tracing onto the watercolor paper. Fortunately for me, we do have plenty of evidence that period painters copied from exemplars when composing images, and Cennini talks extensively about tracing and copying as critical to developing the artist's skill; I am hopeful that if I practice as Cennini suggests that I can gain a better eye for drawing.

Once I had the outline traced, I finished the sketch with graphite pencil. In my first practice version, I did not add a lot of detail during the drawing phase; I decided this was a mistake, and in both later versions of the painting I did much more detailed drawings before starting to paint. (In the unfinished manuscripts shown previously you can see that the ink drawings were fairly detailed before the paint was laid down). To sketch the dog, I estimated its shape as best as I could from the scratchout and simply pencilled it in. I then went over my sketch using Micron brand archival black pens. Next I prepared my paints, in this case meaning mixing modern gouache to approximate the colors found in the original manuscript. I then layed down my washes, added the layers of shadows and highlights, painted the faces and details, did the gold work, painted in the silver design using a modern aluminum-based gouache, and then retraced some of the ink outlines (again using the Micron pens).

Paints:

While I was finishing the modern materials version, I was simultaneously working on making paints, ink, and quills. To learn how to make these items, I consulted scholarly modern sources, a period text (*Il Libro dell' Arte*), and a websites and guides written for reenactors and conservators; full citations for each of these sources are given in the bibliography.

Pigments available to the renaissance illuminator included mineral and organic ones. The typical palette consisted of:

- Black: from lamp soot, charred bone, other carbon sources (e.g. vine black, made from charred grape vines)

- White: lead white; Cennini specifically mentions that other sources of white, such as chalk, have limited value to the artist
- Browns: typically from various earth sources such as umber
- Yellows: orpiment (arsenic sulphide), various ochres/earths, tin, saffron
- Greens: verdigris (copper acetate produced via various chemical reactions), some earths, malachite (a mineral that also derives its color from copper)
- Blues: lazurite (lapis lazuli, which yielded the expensive and desirable ultramarine blue), azurite, some copper compounds (including some forms of verdigris), indigo
- Purple: turnsole
- Reds: madder, minium (lead oxide), vermilion (cinnabar / mercuric sulphide), possibly kermes and cochineal

These pigments would have been suspended in a binder, typically clarified egg white or animal or vegetable gums mixed with water.

In *Il Libro dell'Arte*, Cennini describes mixing some pigments to create secondary shades, so the range of colors available to painters was broader than this; however other sources advise that many mineral pigments were incompatible with each other, so the range was not infinite. Cennini also describes the process of grinding minerals using a slab of a hard mineral and a hand-held rock, then mixing with egg white or gum to produce paints for use on parchment. These prepared paints would have been stored in shells and either could have been used immediately or allowed to dry before being rehydrated as needed.

In appendix 2, I have provided a full list of the various pigments I used to make paints and what colors they yielded (I have also prepared color swatches for my display); not all of these paints were used in the final painting. Because this was my first attempt at making my own paints, I started from pre-ground pigments (with the exception of the verdigris). I also only worked with small amounts of pigment at a time, and I used both modern (artificial) pigments and more historical ones. Again, see appendix 2. To make my paints, I used gum arabic with a little honey as my binder and distilled water as the extender. I ground the paints with a ceramic pestle on a glass plate, used a palette knife as a mixing and transferring tool, and stored the finished paints in natural sea shells. While painting, I used a larger shell as my palette.

I followed the same process for making each paint color:

1. Place a small amount (usually about half a teaspoon) of pigment on the plate.
2. Add dry gum arabic. Mix somewhat using the palette knife.
    a. In my early experiments, I was afraid to add too much gum and only used about an eighth of the amount of gum arabic as there was pigment. These paints cracked upon drying.
    b. In reading modern guides to making paints for doing illumination, I found references to using anywhere from 1 part dry gum arabic to 2 parts pigment all the way up to 2 parts dry gum arabic to 1 part pigment. Still wary of adding too much, I settled on using half as much gum as pigment.
3. Grind gum and pigment together (still dry) with the pestle until they are equally blended.

4. Add a drop of honey and grind slightly to mix. The honey was recommended by several of the modern guides I consulted. Honey is hygroscopic and I found that the paints in which I used more honey maintained a moist, shiny appearance in the shell.
5. Add distilled water, one drop at a time, and grind/mix continuously using small circular (or figure 8) motions until it reaches an even, smooth consistency. How long this takes will vary by the pigment.

6. Scrape the finished paint into the shell. It can either be used immediately or allowed to dry and then rehydrated, like pan watercolors. I found it easier to work with the rehydrated paints for most pigments, but needed to use the azurite freshly mixed.

Although glair made from processed egg whites was also a binder used historically, I was not able to find much information on how to actually use it. When I first got my pigments, I played around a little with mixing them with egg whites, but I found the process a lot harder to control than using gum. This is something I would like to experiment with more as I thankfully have a ready supply of fresh eggs.

I chose to use distilled water for mixing (and later rehydrating) my paints as it is less chemically reactive than tap water. Since many historical ink recipes seem to call for rain water, I think medieval artists had some concern for the purity of their water when creating materials (although I have not been able to verify this for paints). With the higher amount of gum arabic, I did find that some of the finished paints seemed too gummy, and were difficult to rehydrate, but most performed well with 2 parts pigment to 1 part gum.

I followed slightly different procedures for making the shell gold. I first ground gold leaf in a mortar with some coarse salt until it was fairly fine and uniform. I then added distilled water and ground again, then transferred the liquid to a test tube (this just happened to be what I had handy, any relatively narrow container would work), let the gold settle overnight, and poured off as much of the water as I could. I repeated this several times to wash out the salt, then transferred the liquid back to the mortar and added a very small amount of gum arabic. I let the resulting mixture dry in the mortar, then used it by rehydrating it with a little water.

I have brought my paints and some test swatches to display.

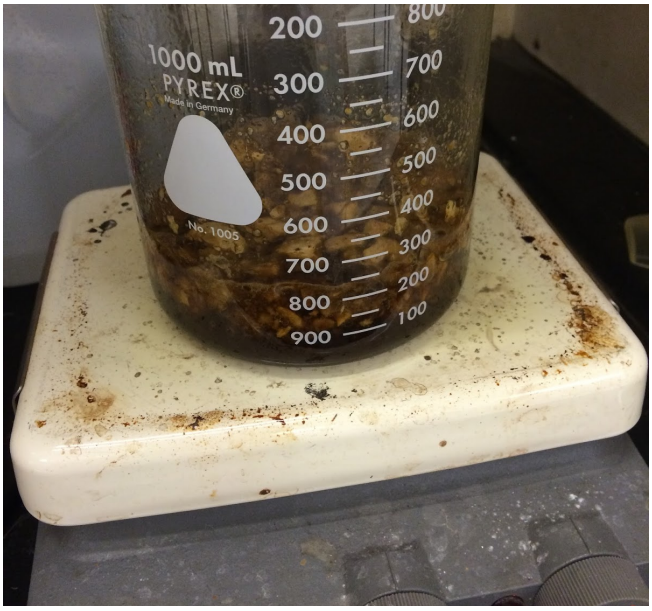
Ink:

Tannin-iron ink was the standard used in manuscript making. Although remarkably stable under certain conditions, it can corrode or degrade over time (this is a source of ongoing research in the international conservation community, according to The Iron Gall Ink Website). There are numerous historical recipes for this type of ink, most based on a chemical reaction between oak galls (formed by wasp larvae) as a tannic acid source and ferrous sulfate (called "vitriol" or "copperas" in period). This ink usually does not appear deep black until it dries on the parchment (or paper) and it needs to be thickened with a gum source. Some historical recipes involve fermenting the ink ingredients, some have different iron sources, some call for other additives (like wine). I chose to use a modernized recipe from "The Iron Gall Ink Website" (see sources) that involved boiling the galls and that did not require me to wait for it to age or ferment.

I made my ink using oak galls that I gathered last summer; once the wasp larvae pupate, the galls fall naturally in August and September. This is the best time to gather the galls as they rot pretty quickly on the ground in our climate. I crushed the galls roughly then boiled them in distilled water; after filtering out the galls, I added ferrous sulfate and gum arabic to the liquid. A full write-up of my procedures is in appendix 3. My ink turned out a pale gray color, deepening to black once applied to paper or parchment. The ink in the Poissy Processional is brown; either a different ink-making method was used or the ink has changed color over time.

I have brought along both the ink itself and some examples of writing and doodles done with it.

Filtrate from the cooked galls combined with ferrous sulfate, before adding gum arabic. Note the black staining on my gloves.



Galls during cooking.

The weighed ferrous sulfate.

The Poissy Processional has accents over the gold paint done in red ink, and red ink was also used to rule the marginal lines. The information I was able to find on red ink suggested that it would have been made with Brazilwood. As I was trying to source materials to make red ink, I found ready-made Brazilwood and alum ink in an Etsy shop (see section in bibliography on suppliers for link) and decided to purchase this ink rather than making my own.

Quills:

Iron-gall ink does not work well in modern pens; it is not as smooth flowing as modern ink, and it quickly corrodes metal nibs. I thought it would be interesting to cut my own quills for drawing. I had some goose feathers and a crow feather available, and I followed the same basic process for both types: I stripped off the barbs and scraped the shaft, cured the feathers using heated sand, and cut them using a utility knife. As with the paints, I consulted both *Il Libro dell'Arte* and modern guides in trying to learn the proper quill making methods.

Unfortunately, what should have been a simple task was possibly the single least successful part of this project. I had an incredibly difficult time getting any of my quills to write at all, and was utterly unable to produce a quill with a fine enough point to be able to use it to outline my sketch. Had this been a calligraphy project, I would have persisted, but since the outlining should not be the most visible part of the finished painting I ended up using modern nibs to finish inking my sketches.

I have brought my quills, the modern nibs, and some feathers for display.

These are the feathers before any processing or cutting.

Second Practice Painting:

Once my materials were finished, I was able to start on the second practice painting, also on hot-press watercolor paper but using the historical inks and paints. I followed the same tracing procedure described previously, but this time I did a lot more clean-up during the pencilling stage. For this practice painting, I did use my quill pens (one made of goose and one of crow) and homemade ink to outline the figures. The quills left thicker lines than I would have liked. On the frame elements, I used the red ink and a very fine modern nib for the ink outlining.

On this second practice painting, I deliberately chose to do a significant deviation from the original artwork. I wanted the viewer to have a sense of why the dog was scratched out by one of this manuscript's later owners so I replaced the lean greyhound suggested by the scratchout with a drawing of my corgi licking crumbs off the floor.

Once the drawing was complete, I followed the same general procedures to paint the image, but this time using the pigments I had mixed myself. As much as possible I tried to

get the color effects by using pure pigments rather than trying to mix paints. For example, for the mid-tone green I used finely ground malachite, and for the darker shadows on it I used verdigris[1] and viridian. Similarly I used azurite for some of the mid-tone blues and ultramarine for the shadows. However I was not able to match all the colors in this way, and did do some blending. Additionally, I did not think I would have enough shell gold for both this practice version and the final, so I used modern gold gouache (Holbein brand "pearl gold"). I found that this performed extremely well: I could burnish it to improve the luster, even. However, the red ink did not write well on top of it.

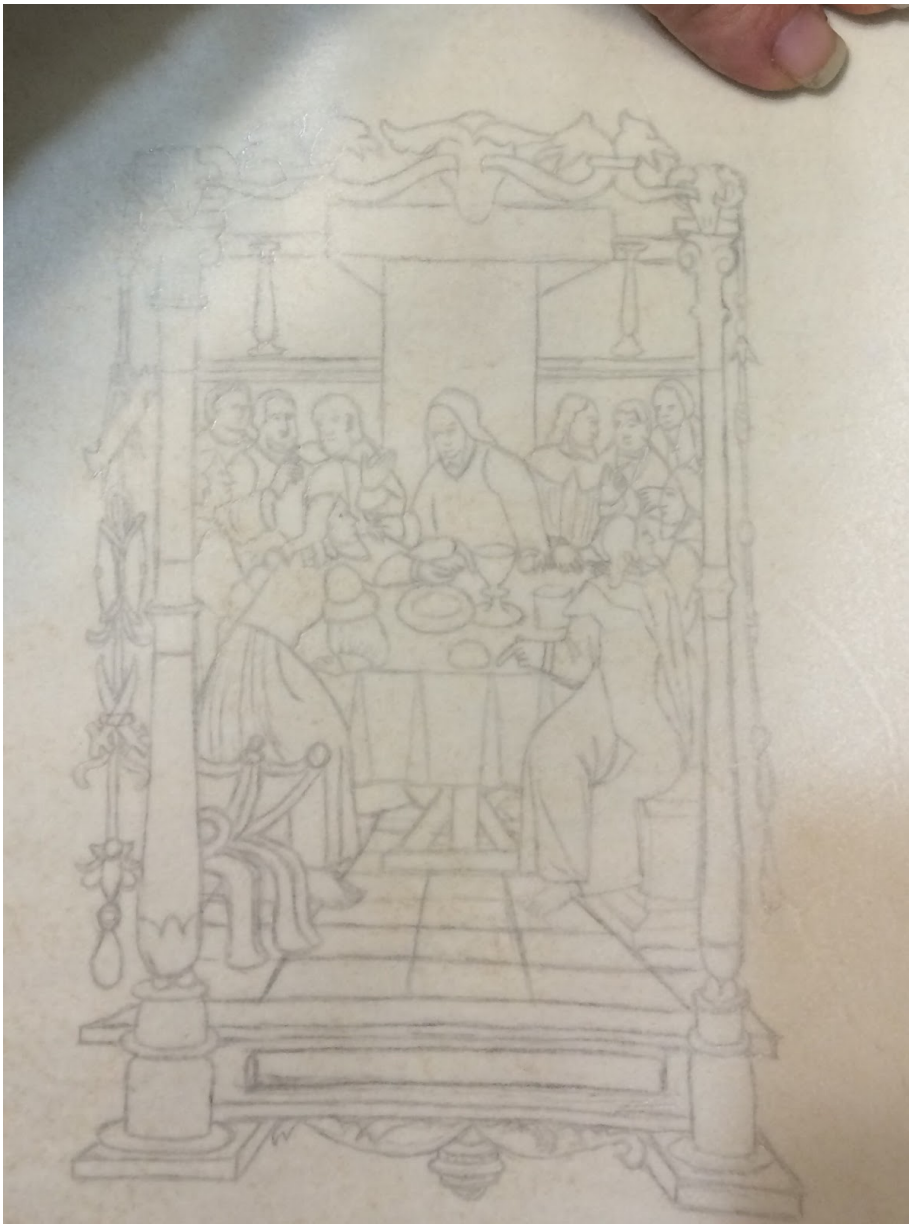
Final Painting on Parchment:

The final painting was completed on calfskin parchment. I used the hair side (as per the original), which also happened to have been smoothed by the manufacturer. To do the pencil draft, I used a window in my house as a lightbox to do a faint preliminary tracing directly onto the parchment.

[1] By testing this combination of period paints, I discovered that they were not close to the manuscript's colors. The malachite was not blue enough and the verdigris paints were too pale.

This worked much better than any of my previous methods, although I am not certain that I did enough to correct for the curvature of the scan. The tracing I did was very incomplete; I had learned by this point that I had better luck by combining tracing (to get the rough locations of the different elements) and copying by eye to get the detail and nuance.

Here is the completed pencil drawing:



At this point I had to add the dog. I used a piece of tracing paper to trace around the scratchout, then sketched a dog that fit within it. I then checked my sketch to see if it fit within the scratchout:

After tracing this dog into my pencil sketch, I inked the central portion of the drawing using a modern dip pen with a super fine nib and my iron gall ink. I was wary of using the gall ink on the outline of the gold elements as I knew my gold was very transparent. After testing alternatives on the paper copy, I outlined the frame elements using the same fine nib and the Brazilwood ink. A picture of the finished ink drawing follows.

The actual painting is not this crooked; that's an artifact of how I took the photo.

I found that the parchment was significantly easier to use than paper. It is translucent enough for tracing and easy to erase stray marks from. Paint mistakes scrape off easily, as well.

While I was working on the final painting, I had an opportunity to re-examine the source manuscript. I observed details which I had not recalled from my previous viewing and which do not show well in the digital facsimile. Most notably, I gained a better sense of how fine lines (rather than blending) were used for shading and highlights, and I noted that gold paint is used liberally for highlights on the figures, clothing, and some of the background elements. This shifted my approach to the final painting; although I do not have the skill set (or fine enough brushes) to exactly replicate the finished appearance, I did use the same technique. I have used fine lines in pale colors (white over red, pale blue or white over dark blue, and yellow over green) for highlights, accented the hair and clothing of each of the figures, and used gold to define the shapes of the wood objects, the bread on the table, and the blue canopy above Christ.

In working on the second practice painting, I grew dissatisfied with my green and blue paints. Even at that point, I was fairly sure that the different blue hues, at least, would have been different sized particles of the same pigment. I did some additional research and found instructions for levigating azurite using Ivory soap instead of lye (Helm-Clark). I experimented with this process with both azurite and malachite and was very satisfied with the results; I was able to get several tones of blue and green through this process:

- Scraped a little soap into a cup
- Added warm water

- Stirred and let stand until soap was dissolved
- Mixed dry pigment with soapy water mixture in a small container
- For the first (most intense) color, I poured off the liquid without letting it settle very long at all so that only the largest particles settled out
- Repeated multiple times, each time letting it sit longer to allow more settling
- Rinsed each pigment to remove the soap, let them dry a while, then mixed into paints with gum arabic and honey and stored in shells as before.

However, none of these blues were a match for the gray-blue used for the background of the figures and some of the clothing. I found a picture of someone's swatches of various historical blue paints (West and Duffy), and noted that a light lapis lazuli pigment yielded an almost identical blue. (As lapis was a valuable pigment, this could explain why it was used on Christ's clothing.) I will be attempting to source this pigment for future paint experiments. In the meantime, I replicated the color by blending dry titanium white, ivory black, ultramarine blue, and ultramarine violet pigments, then mixing these with gum arabic, honey, and water to make paint as before.

The colors used in the final painting are as follows:

- White, black, and brown:
    - Titanium white: opaque white with very poor adherence to parchment; used for the tablecloth, the sky and stonework, and for blending.

- Vine black: pure black that blends and covers well; mixed with titanium white to produce the grays of the stones, the dog, the shadows on the tablecloth, and some of the clothing.
- Raw umber: pure, dark brown; used for the wood and bread, plus see below.

- Blues:
  - Azurite: brilliant mid-tone blue, deep blue; used for clothing, the canopy, the background sky and mountain, and the pillars of the frame.
  - Faux lazurite: grayish blue; used for clothing, the area behind the figures / above the canopy, and some of the blue shadows on stone.
  - Mayan indigo (a substitute for European indigo or woad pigments): a drab but deep blue; used for shadows on the areas painted with the faux lazurite.
- Greens:
  - Malachite: blue-tinted mid- and deep-tone green; used for clothing and some features in the background.
  - Verdigris (salt-processed) mixed with saffron: Used for the darker green tones, i.e. for shadows.
- Reds and Oranges:
  - Vermillion: a very bright red; used on the columns in the background, for clothing, and for the red space in the frame.

- Cadmium red: deep red; used for shadows on the background columns and clothing.
- Ercolano orange: has both red and brown casts; used for the tiles on the floor.

- Yellows:
  - Yellow ochre: darker, somewhat muddy; used for the tiles on the floor.
  - Italian gold: similar to ochre but brighter; used in the wood elements, the bread, and as underpainting for some of the metallic gold areas.
  - Nickel titanate yellow: this is a pale but true yellow; used for highlights on the green clothing.
- Skin and hair tones:
  - Skin: iron oxide mixed with titanium white produced both the darker and the lighter skin colors. English red and ercolano orange were used for the cheek highlights and for the lips.
  - Hair: painted using fine lines of various pigments -- one individual has white hair, otherwise the hair was rendered with umber, iron oxide, and Italian gold.
- Metallics:
  - Shell gold: used for the frame, and the wall hanging. The true shell gold was very transparent unless applied thickly, and required burnishing to shine.

- Pearl gold gouache: The true shell gold was not shiny enough for the highlights within the painting; I ended up using modern gold goauche for the halos and highlights on the individual figures.
- Faux silver: used for a design on the wall hanging.

After completing the ink drawing, I painted in washes of mid-tones, then added shadows, and then highlights. I painted the background elements before doing the figures, and I painted the clothing on the figures before painting their skin and hair. For both the shadows and the highlights I used very fine lines of paint rather than blending. For the faces, I did go back and redraw some facial features in ink (or with black paint if the ink would not stick to the layers of paint) after doing the painting to make them sharper. Once all of the other details had been completed, I added the gold accents, also using very fine lines. I painted the frame and the wall hanging last. Finally, I used red ink to complete the frame and some of the gold areas in the body of the painting, such as the clothing of several figures.

Conclusions

Making and using historical paints has been a transformative learning experience. After years of charter painting and being frustrated by not being able to match the colors of manuscripts, I almost laughed when it turns out the answer really was as simple as chemistry; if you want the same colors, you have to use the same compounds. I am now curious about some of the processes by which the individual pigments on manuscripts are identified, and I might study this more.

Through this process I gained a deeper appreciation for role of paint preparation in the training of an artist, and felt like I was able to step into the shoes of an apprentice painter when I was preparing my materials. Additionally, I will leave this project with a sense of the intersection between beauty, expense and difficulty, and the sacred. It does not seem coincidental to me that books, which were objects of worship, were beautifully decorated with unusually colorful chemical and mineral pigments that often had to purchased at great expense and prepared with some difficulty. Miniature paintings existed within a religious framework that I think we often overlook in the SCA.

When I first looked at this manuscript many years ago, I thought that the artist had mixed white with their pigments to achieve mid-tones, then went back over these with pure pigment. This did not match how I had been taught to do shading, so it confused me. Most SCA scribal classes I had attended advised laying down pure pigments and then blending in white bit by bit for shading. Now I would conclude that, at least for this manuscript, the mid- and shadow tones were different pigments, not the same pigment blended with white. The levigation process that I used separated single pigments into

multiple colors, which was a revelatory discovery for me. I was also fascinated to see highlights done in fine lines rather than with blending; I am interested in looking for other examples of this technique to see if it was limited to manuscripts produced around this same time and place or more broadly practiced.

As you can see, I was very interested in the chemistry of the ink and the pigments. I now see that I could easily turn those into projects all on their own. I definitely want to do more research into and experiments with making ink and making paint. I am particularly interested in comparing several different ink methods since there are so many different ways of making ink (and since I still have a lot of oak galls left). I would also like to continue to make my own paints, and especially to do more formal tests of different pigments, binders, and preparation methods.

I struggled with the tool-making aspect of this project. I plan to continue to work on making my own quill pens, and hope to connect with people who can provide me with some help and instruction; I tend to learn through doing, but I am completely stumped and can see that I need some expert help before I run through all the feathers I can get my hands on. I would love to do some calligraphy using pens and ink I made myself. Similarly, I would be interested in the future in exploring making my own brushes. Cennini gives instructions for how to do so, and it is my understanding that other period texts do as well.

Painting occupies an interesting niche in the world of SCA arts. On the one hand, period texts such as *Il Libro dell'Arte* suggest that painters really did make all their own tools and materials, as opposed to other crafts, trades, and arts where their practitioners would have only worked at one particular stage in the process. That said, within the world

of Parisian professional bookmakers, the different stages of producing a painting were typically discrete skills. Although a painter had to know each skill, he would not have practiced all of them at once. Workshops most likely practiced specialization and division of labor. The person responsible for doing the final painted gold work in a series of miniatures was not necessarily the same person who had done the washes, while preparing paints, quills, and brushes might have been left to the apprentices.

What this means for me is that my process of painting a complete miniature from start to finish does not fit the type of production approach that became standard in late medieval bookmaking. Instead, I should have ground paints until I perfected that, then graduated to filling in some crude washes. Once I was skilled enough at laying down paint, I could have begun to learn drapery. Eventually I would work my way up to painting faces and fine details. Instead, I found myself translating a cooperative endeavor into a solo one, as I had no fellows to hand my work off to when it was time for the next phase. I would be interested to explore ways of replicating this type of process as an independent miniaturist.

It was enjoyable to be in a learning role while also getting to finish complete paintings, something which someone of my skill level most likely would not have done in a production workshop. I would now like to have the experience of just doing the simpler tasks again and again and again until I feel that I actually master them. I have been proud to see how much my drawing and painting skills have improved even just during the duration of this project. This has been a good reminder for me that practice matters, and I am looking forward to seeing how much better I can get with even more practice.

Works Cited and Bibliography

Primary Source Material:

Prayer book and antiphonary used as a processional at a Dominican nunnery in Poissy, France. 1510, France. MS. Reed College Special Collections.

Digital Facsimile:

"The Illuminated Poissy Processional." *Reed Digital Collections*. Reed College, n.d. Web. 12 Feb. 2015. <http://cdm.reed.edu/cdm4/poissy/>

Other Source Material:

Alexander, Jonathan J. G. *Medieval Illuminators and Their Methods of Work*. New Haven: Yale University Press, 1992.

Asplund, Randy. "Making a 15th C. Style Illuminated Manuscript Book Using Authentic Historical Materials and Techniques." *Home Page of the Artist Randy Asplund*. <http://www.randyasplund.com/pages/article/schiff1.html>

Baker, Amy. "Common Medieval Pigments." *The Cochineal* (December 2004). University of Texas at Austin. Web. <https://pacer.ischool.utexas.edu/handle/2081/1378>

Baranov, Vladimir. "Materials and Techniques of Manuscript Production: Ink." *Medieval Manuscript Manual*. Department of Medieval Studies at Central European University (Budapest). <http://web.ceu.hu/medstud/manual/MMM/ink.html>

Cennini, Cennino D'Andrea. Trans. Daniel V. Thompson, Jr. *Il Libro dell'Arte (The Craftsman's Handbook)*. New York: Yale University Press, 1933. Web. <http://www.noteaccess.com/Texts/Cennini/Contents.htm>

Chowdry, Anita. "Precious Pigments and Gold with Staff from the Bodleian Library." *Journeys with Pattern and Colour*. Anita Chowdry, 02 July 2014. Web. 26 Feb. 2015. <https://anitachowdry.wordpress.com/2014/07/02/precious-pigments-and-gold-with-staff-from-the-bodleian-library/>.

Chowdry, Anita. "How to Paint with 24 Carat Shell Gold." *Journeys with Pattern and Color*. Anita Chowdry, 23 Feb. 2015. Web. 26 Feb. 2015. <https://anitachowdry.wordpress.com/2015/02/23/how-to-paint-with-24-carat-shell-gold/>.

Christie's catalogue, Wednesday, 19 November 2003: "Valuable Printed Books and Manuscripts, including Natural History." London.

De Hamel, Christopher. *The British Library Guide to Manuscript Illumination: History and Techniques*. Toronto: University of Toronto, 2001.

"F." *Glossary for the British Library Catalogue of Illuminated Manuscripts*. The British Library. <http://www.bl.uk/catalogues/illuminatedmanuscripts/GlossF.asp>.

Grimmer, Rachel. "The Medieval Palette: Medieval Pigments and Their Modern Equivalents." *Lochac Virtual Collegium*. 2011. Web. <http://www.sca.org.au/collegium/notes/the%20medieval%20palette.pdf>

Helm-Clark, Catherine. "Azure." *Tharasia's SCA Webpage*. 2001. Web. 16 Feb. 2015. <http://www.rocks4brains.com/~cat/azure.pdf>.

LeMay, Marie-France. *Medieval Manuscripts: Some Ink and Pigment Recipes*. London: Bernard Quaritch, 2010. Special Collections Conservation Unit of the Preservation Department of Yale University Library.

Li, Liralen. "Cutting Quill Pens from Feathers." *How to Cut Quill Pens from Feathers.* <http://www.flick.com/~liralen/quills/quills.html>

Macleod, Christopher. "The Quill Pen." *New Hampshire Historical Society.* <http://www.nhhistory.org/edu/support/nhgrowingup/quillpens.pdf>

MS. Buchanan e.3: Book of Hours, Use of Rouen, in Latin and French, France, Rouen; c. 1500. Available online via the Bodleian Library (University of Oxford) at: <http://www.bodley.ox.ac.uk/dept/scwmss/wmss/medieval/mss/buchanan/e/003.b.htm>

"PROCESSIONAL, for the Use of the Dominican Sisters of St Louis, Poissy, in Latin, ILLUMINATED MANUSCRIPT ON VELLUM, [Paris, Second Quarter 16th-century]." *Books and Manuscripts, Medieval and Renaissance Manuscripts*. Christie's, 16 July 2014. <http://www.christies.com/lotfinder/books-manuscripts/processional-for-the-use-of-the-dominican-5814202-details.aspx>

Raftery, Andrew. "Making a Quill Pen." *Instructables.com.* <http://www.instructables.com/id/Making-a-quill-pen/>

Reissland, Birgit, and Frank Ligterink. *The Iron Gall Ink Website*. Cultural Heritage Agency of the Netherlands, 13 Feb. 2011. <http://irongallink.org/igi_indexd7ce.html>

Rose, John. *Pigments and Their Chemical and Artistic Properties*. <http://www.jcsparks.com/painted/pigment-chem.html>

"The Technique of Shell Gold Painting." *Artists Materials Articles*. Natural Pigments, 9 June 2013. Web. 26 Feb. 2015. <http://www.naturalpigments.com/art-supply-education/technique-shell-gold-painting>.

Tucker, Lucas. "Mulling Paint: A Beginner-ish Guide - Blog." *Blog: Scribal Work Shop*. 15 Aug. 2014. <http://scribalworkshop.com/blog/13532505>

Watson, Rowan. *Illuminated Manuscripts and their Makers: An Account Based on the Collection of the Victoria and Albert Museum*. V&A Publications, Harry N. Abrams, Inc. New York, 2003

Williams, Elizabeth. "Medieval Inks." *Pen and Parchment: Drawing in the Middle Ages*. The Metropolitan Museum of Art. <http://blog.metmuseum.org/penandparchment/2009/07/14/medieval-inks/>

West, Vicky, and Christina Duffy. "Recreating the Medieval Palette." *Collection Care Blog*. British Library, 06 May 2014. Web. 15 Feb. 2015. <http://britishlibrary.typepad.co.uk/collectioncare/2014/05/recreating-the-medieval-palette.html>.

<u>Painting and Chemistry Advice from:</u>

- Countess Inga the Unfettered
- Mistress Morgaine
- HL Renart le Fox de Berwick
- Mistress Annisa Gabrielli
- Jordan Devereaux
- Jennifer Hubbs

<u>Materials Obtained from:</u>

Pigments:

- Atelier500 <http://www.etsy.com/shop/Atelier500>
- Arte of the Booke <http://www.etsy.com/shop/ArteOfTheBooke>
- Natural Pigments <http://www.naturalpigments.com>
- Verdigris provided and made by Maestro Eduardo Francesco Maria Lucrezia
- Azurite and vermillion provided by Conchobhar Ua Muirchertaig; original source unknown.

Brazilwood ink: The Scribal Workshop <http://www.etsy.com/shop/Scribalworkshop>

Parchment: Pergamena <http://www.pergamena.net>

Appendix 1: Other Decoration in the Poissy Processional

The full page miniatures are not the only decorative elements of the Poissy Processional. Many pages feature some kind of decorative border. These borders are made up of swirling vines around the entire margin (on pages of text), or of a single vine on the outer margin (on pages marking the start of a particular piece of music). The single vine borders use only blue, with a leaf done in gold leaf at each terminus. The larger borders have many interlacing vines, terminating in colorful leaves and flowers. Each of these larger borders has two elements, an inner and an outer (the outer portion being the large area of interlacing vines). The inner border is a rectangular frame done in gold leaf, usually with foliage elements within it painted in the same style as the vines. There are at least two exceptions to this, one on 27r and one on 89r. Both of these feature geometric rather than foliate designs on the gold rectangle. Gold leaf is lavishly applied to all these borders, and they utilize only blue, green, red, black, and white.

Stylistically these borders are archaic (as noted in the Christie's catalogue); they look like they would be more at home in a 14th century manuscript. The frames on the miniature pages are typically classical renaissance columns, which are jarringly out of place next to the vines. Other manuscripts from this same period utilize naturalistic depictions of plants and birds in the margins (see, for example, MS. Buchanan e.3). The artist used a layering technique, but fewer layers were used: the pure (dark) pigment, pigment mixed with white, and white highlights and accents, with everything outlined in black. While there has been some attempt to have unified directionality of light in the miniatures, it does not seem that any such effort has been made in the vine borders. The highlights in particular serve only to emphasize the shapes of the vines rather than to make them look more realistic. A separate artist from the miniaturists probably

made these borders. The borders were planned as part of the manuscript (or at least borders of some type were planned) as evidenced by the Mass of St. Gregory miniature.

On 2r, the heraldry of the owner of the book is included within a wreath. The heraldry is very crudely executed, with no layering or depth of color. This does not necessarily indicate that the person who painted it was unskilled, as heraldry can often be highly simplified for the sake of "readability" (think of the level of detail on a flag). The heraldry uses silver, which has oxidized not only to the back of the folio but has marred the subsequent folio as well. It was this observation that confirmed the use of silver in other places in the manuscript. The wreath shares stylistic elements with both the vine borders and with the miniatures. It has four-petaled flowers that are identical to those within the vines. The wreath, however, is in the same light green used for the vegetation of the miniatures, and has a similar kind of paint use. This may suggest a link between artists working on the miniatures and on the borders. Alternatively, yet another person could have done the wreath and used a cruder style than the miniaturist but the same colors, or the miniaturist could have added the wreath but used a crude style on the flowers.

There are several styles of decorated initials in the text. The first style is large and highly decorated, going with the vine borders (see 2v). These use the same kind of archaic style, with an older-looking letter style and the same colors as the vines. The letters enclose foliate designs similar to the vine borders. On top of the letters themselves are some geometric and abstract designs, usually in white or a light version of the capital color. The vine artist probably also did these capitals. The second style of capital is the most prevalent throughout the manuscript; these are done either in gold or in blue, with blue or red penwork decorations (see 13v for some examples). These are also very archaic, bearing a striking resemblance to capitals used in a

mid-14th century Poissy antiphonal[2]. The letterforms are much more rounded than the square, late-gothic calligraphy. Leaf gold was used for the gold capitals. The blue (on gold letters) or red (on blue letters) decorations are intricate patterns of swirls and curlicues. These capitals feature no black outlines. The decorations were probably done with a quill with an extremely fine point, such as can be achieved with a crow's quill. A final style of capitals can be seen on several folios (21v and 22r, for example; these are fairly well dispersed throughout the text and music). These are essentially giant versions of the calligraphy, done in brown ink with light yellow-brown accents, and as such can hardly be counted as part of the decorative program of the manuscript.

As for the division of labor on the capitals, there are several possible scenarios. The same artist who did the borders may have done both types of decorative initials (it is highly probably that the border artist also did the largest initials) and the scribe probably did the plain capitals. Alternatively, a third person could have done the second style of capitals, separate from the border artist and the scribe. It is also possible that the scribe did the gold and blue or blue and red capitals. Of these I think the third is the least likely, if only because the first two types of capitals are so much more archaic in their appearance than the calligraphy.

When text ends before the line it is on has been filled, in-text decorations are used to fill the space. These are in a similar style to the second type of capitals mentioned above -- geometric designs and swirls are done in red, blue, and gold. All of these look a lot like doodles, thus it is somewhat surprising to note that the gold used was leaf gold, which does not lend itself well to idle scribbling. Thus these designs were a part of the manuscript, subject to the same

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[2] "Poissy Antiphonal – made to order for the Dominican Nuns at Poissy, France between 1335 and 1345." Can be viewed online at: http://www.thinkers.org/~mel/gallery/vocalmanuscripts/Poissy_Antiphonal?full=1

amount of planning and care as every other aspect, rather than simply being a way for someone to practice working with a fine-nibbed pen. I am of the opinion that the same person did the in-text decorations and the capitals that look so much like them. This may support the hypothesis that this was a separate person from the border artist, although this is certainly not conclusive.

The three-quarter-page miniature, showing the Mass of St. Gregory, was clearly done by a different artist from the full-page miniatures. It follows the same general technique of the full-page miniatures, with the same type of layering. It lacks a border of columns, and instead is on a page with an elaborate vine border. Since the same physical constraints of the paint apply, layering rather than blending is still used, and the artist used similar colors, including liquid gold. The shadows and highlights are more subtle and complex in this miniature. The harsh black outlines on the faces are gone; this artist seems more confident in his ability to use shadows and colors to bring out the features of faces rather than relying on black outlines. The drapery is subtler, mostly because the lines used for shadows and highlights are finer. This makes the lines more difficult to distinguish from a distance and so makes the overall effect more illusionistic. Behind the figure of Christ are the Arma Christi. Judas' head, the hand, and the pitcher and basin demonstrate the artist's skill. Rather than being boldly painted, these are rendered in fine lines (like the highlights and shadows of the other figures) so they appear only as translucent, ghostly impressions.

I also did a cursory study of the calligraphy in this manuscript. Overall it appears that this was the work of a single scribe. I found no evidence of errors having been scratched out and corrected. Some abbreviations were used in text pages, but not in writing down the lyrics to the liturgical music. The alphabet includes all of the standard late-medieval letters, including two

forms each of “s” and “r”. I do not think that there was a separate letter used for “v”, with “u” doing double duty. Also, I found one majascule “K” but have yet to uncover any other uses of this letter. The hand is clear and quite legible, as opposed to some of the more complex hands in use in the late Middle Ages and Renaissance. Generally the musical notation is in a darker color of ink than the writing. Also, there are a few instances where the ink of the music has flaked off while the letters have stayed intact. Together these suggest that a separate person from the scribe might have done the musical notation, but more research would be needed to determine this for sure.

Joan Naughton has suggested that the nuns of Poissy may have done the manuscript decorations themselves (aside from the miniatures) in the books in their collection, at least during an earlier time period[3]. This could explain why the borders, initials, and in-text decorations are so different from the miniatures. Regardless of who actually painted them, it is obvious that there are two major decorative programs at work in this Poissy processional: the miniatures, and everything else. The miniatures are vastly different from the rest of the text, so much that they almost look out of place. The colors used are much more subtle, they use liquid instead of leaf gold, and the classical influences of the Renaissance have a much more prominent role than the stylized artwork of the Middle Ages.

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[3] “Books for a Dominican Nuns' Choir: Illustrated Liturgical Manuscripts at Saint-Louis de Poissy, c.1330-1350” in The Art of the Book: Its Place in Medieval Worship edited by Bernard J. Muir and Margaret M. Manion. Exeter Medieval Texts and Studies, 1998.

Appendix 2: Paint Details

Paints which I prepared:

Pigment	**Color**	**Time Period**	**Notes**
Titanium	White	Modern	sub. for lead
Vine black	Black	Historical	organic - charcoal
Raw Umber	Brown	Historical	earth
Cadmium	Red	Modern	sub. for lead
Vermillion	Red	Historical	mineral
English Red	Red-orange	Historical	earth
Ercolano	Orange	Historical	earth
Iron Oxide	Orange	Historical	earth
Cadmium	Orange	Modern	prepared, did not use
French ochre	Orange-yellow	Historical	earth
Cadmium	Yellow	Modern	sub. for orpiment; did not use
Nickel titanate	Yellow	Modern	sub. for tin yellow; did not use
Italian gold	Yellow (brownish)	Historical	earth
Yellow oxide	Yellow (brownish)	Historical	earth
Salt Verdigris	Green	Historical	chemical compound
Urine Verdigris	Blue-green	Historical	chemical compound
Malachite	Green	Historical	mineral
Nickel titanate	Green	Modern	prepared, did not use
Chrome	Green	Modern	prepared, did not use

Terre Vert	Green	Historical	Earth
Viridian	Green	Modern	sub. for verdigris
Mayan Indigo	Blue	Historical but not European	could be used as a sub. for indigo
Azurite	Blue	Historical	mineral
Cerulean	Blue	Modern	can sub. for some period blues
Ultramarine	Blue	Modern	sub. for ultramarine (lapis) mineral
Ultramarine	Violet	Modern	prepared, did not use
Caput mortuum	Purple-brown	Historical	mineral
Gold	Gold	Historical	metal

Paints which were used in the final recreation which I did not prepare:

Aluminum	Silver	Modern	sub. for silver, which oxidizes
Pearl gold gouache	Gold	Modern	sub. for very shiny gold paint (used mainly for highlights on figures)

Appendix 3: Ink Materials and Procedures

Based on a recipe from The Iron Gall Ink Website[4]:

Materials and Equipment:

- 18 grams oak galls
- 170 mL distilled water
- 8 grams ferrous sulfate dissolved in 15 mL water
- 7 grams gum arabic
- Additional 150 mL distilled water (added over the course of boiling galls)
- Hot plate with magnetic stir function
- Electronic balance
- 100 mL graduated cylinder
- Mortar and pestle
- 500 mL beaker
- 50 mL beaker
- Glass stir rod
- Magnetic stir bar
- Funnel
- Filter paper
- Glass bottle for finished ink

Procedure and notes:

[4] http://irongallink.org/igi_indexc33a.html

1. After weighing the galls, I roughly crushed them in a mortar and placed them in the larger beaker. I then placed the magnetic stir bar at the bottom of the beaker and added 130 mL of water (based on the recipe I was following), but this was insufficient to allow the stir bar to spin so I added an additional 40 mL of water.
2. With the hot plate set to medium-high, I brought the galls and water to a simmer and cooked for 2 hours, stirring continuously (with the stir bar). I added additional water when the level appeared low and I thought the galls were at risk of scorching.
    a. 60 minutes in, added 20 mL water
    b. 90 minutes in, added 40 mL water
    c. 110 minutes in, added 60 mL water
3. As the galls cooked, they softened and the liquid turned brown. The color developed more fully as time went on; at the end of two hours the galls were “mushy” and the liquid was a very deep brown.
4. While the galls were cooking, I ground the ferrous sulfate slightly, then added it to 15 mL water in the small beaker and stirred with a glass rod to dissolve. I found that this was not sufficient water to dissolve this amount of ferrous sulfate.
5. Once the galls had simmered for 2 hours, I removed the beaker from heat and filtered the liquid into a glass bottle using a piece of filter paper and a funnel. I squeezed out the liquid from the cooked galls, and added 20 mL water to rinse more product out of the galls.
    a. The total yield of filtrate was 55 mL of brown, oak-scented liquid.

6. After removing the filter paper from the funnel, I added the iron sulfate solution to the oak gall filtrate, replaced the lid on the bottle, and shook vigorously. At this point I had a thin, grey-to-black liquid that smelled strongly of rust (that is, oxidized iron).
7. Finally, I added 7 grams of powdered gum arabic. I agitated the container for several minutes to dissolve the gum.

The finished ink had an uneven consistency. Although it appeared gray in the bottle and when first applied to paper, it dried to a very deep black.

Caution: Ferrous sulfate (iron (II) sulfate heptahydrate) is an irritant, and harmful if swallowed. This ink will stain clothing and skin.