

Note from the Making and Knowing Project:

This essay was written for “The Art Technological Source,” an 8-week graduate course at the University of Amsterdam offered by Dr. Marjolijn Bol in 2015 and 2016 to students enrolled in an MA program in either Technical Art History or Conservation and Restoration. Students worked on various recipes from BnF Ms. Fr. 640 on the following five topics: 1) tracing and painting on glass, 2) yellow dyes and their applications, 3) dragon’s blood, 4) painters’ varnishes, and 5) sieves.

This is an un-edited student paper that relies on an earlier state of the Making and Knowing Project’s transcription and translation of Ms. Fr. 640. For an updated version of the text, see:

Making and Knowing Project, Pamela H. Smith, Naomi Rosenkranz, Tianna Helena Uchacz, Tillmann Taape, Clément Godborge, Sophie Pitman, Jenny Boulboulle, Joel Klein, Donna Bilak, Marc Smith, and Terry Catapano, eds., *Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640* (New York: Making and Knowing Project, 2020), <https://edition640.makingandknowing.org>. DOI: <https://doi.org/10.7916/78yt-2v41>.

BnF Ms. Fr. 640, fol. 41v: “Colors and gilt on glass”

Annotation by Rosa Hoogenboom

Transcription: Couleurs et doreure sur le verre

<id>p041v_3</id>

<head>Couleurs et <m>doreure</m> sur le <m>verre</m></head>

<ab>Il ne fault pas donner l'<m>eau gommée</m> si forte sur le</ab>

<m>verre</m> pour la couche de l'<m>argent</m> que de l'<m>or</m>, pource q{ue}</ab>

une foeille d'<m>argent</m> est deulx foys plus forte qu'une foeille</ab>

d'<m>or</m>. L'<m>argent</m> aussy est plus dur, et par ainsy ne s'esgratigne</ab>

pas si aysem{ent}. Et si la <m>gomme</m> n'estoit pour l'<m>argent</m> un peu</ab>

forte, il ne se refendrait pas si nettem{ent}. Quand tu travailles</ab>

l'exalation de ton <m>halene</m> humecte la foeille couchée</ab>

sur le <m>verre</m> & par ainsy il sera bon en travaillant de</ab>

le chaufer quelque foys. Il te fault bien estre curieux</ab>

de nettoyer ce que tu veulx estre vuide & servir de champ</ab>

painct de couleurs, car s'il n'estoit bien net de la <m>graisse</m></ab>

& viscosité de la <m>gomme</m> & aultres choses, les couleurs</ab>

n'i seroient pas si nettes. Pour avancer besoignes, tu</ab>

peulx <m>poncer</m>, ou pour mieulx coucher de <m>gomme</m> & de foeille</ab>

sur un <m>papier</m> couppé. En ceste sorte il ne te fauldra</ab>

que bien peu reparer. Si tu y veulx faire couleur d'<m>or</m></ab>

sans <m>or</m>, mesle du <m>safran</m> sec destrempé avecq un peu de</ab>

<m>massicot</m>.

Translation: Colors and gilt on glass

<div>

<id>p041v_3</id>

<head>Colors and <m>gilt</m> on <m>glass</m></head>

<ab>You should not put as strong <m>gummed water</m> on <m>glass</m> for the

<m>silver</m> layer as for the <m>gold</m> layer because a <m>silver</m> leaf is twice as

strong as <m>gold</m> leaf. Also, <m>silver</m> is harder and therefore does not scratch as

easily. And if <m>gum</m> was not a little [too] strong for <m>silver</m>, it would not crack

so clearly. When you work, the exhalation of your <m>breath</m> humidifies the leaf lying on

the <m>glass</m>, and therefore it would be good, when working, to heat it up a few times. You

have to very thoroughly wash what you want to be empty and used as a surface painted with

colors, because if it is not really clean of the <m>gum</m>'s <m>grease</m> and viscosity, and

of other things, the colors will not be so clear on it. To advance your work you can smooth with a

<m>pumice stone</m>, or [you can do this] to better lay down <m>gum</m> and leaf on a cut

<m>paper</m>. This way, you will have to do very little repairs. If you want a <m>gold</m>

color there without <m>gold</m>, mix soaked dried <m>saffron</m> with a little bit of

<m>massicot</m>.

</ab>

</div>

Introduction

The recipe ‘colors and gilt on glass’ on fol. 41v, hereafter referred to as ‘recipe 41v’, can be seen as a detailed manual of the different ways of gilding and silvering glass in a manner that makes it possible to engrave the gilt layer and color the engraved spaces afterwards. It is one of the many recipes in manuscript BnF Ms. Fr. 640 that describes the handling and applying of gold and silver leaf.¹ These techniques of engraving are used in the art called *reverse glass painting*. Thus, this recipe can be used in combination with the recipe ‘tracing a story on glass’ on fol. 39v.² In this art form, a thin sheet of glass is painted, gilded, and/or engraved on the reverse side. Because the image will be viewed from the other side, the buildup of paint layers is also done in reverse. Glass was commonly painted in reverse north of the Alps, hence the commonly used German term *hinterglasmalerei*. In Southern Europe, however, it was more common to gild the glass and then engrave it, a technique that is now referred to as *verre églomisé*.³



Fig. 1: devotional pendant, late 16th century, Lombardy. Metropolitan Museum of Art, New York.

The two techniques appear to have been combined in the 1500s, becoming very popular in the making of jewelry. The technique was used for medallions and amulets, and Lombardy was one of the leading locations for this trade.⁴ An example of a reverse glass painted jewel can be seen in figure 1. The relation between reverse glass painting and jewels can be connected to former

¹ See for instance fol. 08r, 10v, 29v, 32r, 66r, 75v, 97r, 100v.

² An annotation on fol. 39v is written by: Wenrui Zhao & Ana Estrades (AnnotationFall2015_ZhaoEstrades_39v_reverse painting on glass.docx)

³ Rudy Eswarin ed, *Reverse Paintings on Glass: The Ryser Collection* (Corning: Corning Museum of Glass, 1992), 13. *Verre églomisé*, the now frequently used term for reverse gilding on glass, resulted from the name of an eighteenth century French picture restorer, Glomy, who brought new life into the techniques of reverse gilding on glass, in the use of picture frames. In this annotation, the more comprehensive term of *reverse glass painting* will be used to describe all examples chosen.

⁴ For more information about the history, techniques and conservation of reverse glass paintings, it is necessary to mention the career of Simone Bretz, who is a conservator-restorer specializing in this subject since 1985. He has published numerous articles on the subject:

www.bretz-hinterglass.com/publikationen.html.

research on the manuscript, in which it has been suggested that the author-practitioner could have been a jeweler.⁵

The methods the author-practitioner explains in recipe 41v may not seem obvious when reading the recipe, and it was found during the research for this annotation that no other recipe is comparable in its detail for this specific type of gilding. A reconstruction of the recipe was in this case very valuable, of which the results will be presented in the next section.⁶ In addition, manuals for gilding from a variety of time periods can be used to help understanding the meaning of recipe 41v, since the methods for gilding have hardly changed from the earliest descriptions to the time BnF. Ms. Fr. 640 was written.⁷ There are, however, only a few art technological sources that discuss the gilding on glass, and even fewer that discuss reverse glass gilding techniques.⁸ The aim of this research is to gain insight into how the author-practitioner's details on applying a gilt layer differ from other comparable recipes on reverse glass gilding, and to what extent these details affect the results. This may also provide more information about whether the author-practitioner was in fact the practitioner of recipe 41v.

Reconstruction

The first part of recipe 41v describes the way that gold leaf should be adhered to glass in a different way than silver leaf. It mentions that strong gummed water should be used for gold. Less strong gummed water is required for silver, because it is twice as strong as gold.⁹ When a test was done on a sheet of clean and colored glass, it immediately became clear why.¹⁰ If strong gummed water was used in combination with gold leaf, the gold would become fixed in place, it

⁵ See 'clues on the author', 'professional identity of the author', accessed March 14, 2016. <https://docs.google.com/document/d/1S6qSg2nyUFFS8JRtNB2sk7J3U6eR7cBLWrDag65LwXY/edit>; The author-practitioner seems to be very experienced, for instance, in imitating gems and casting in gold. He never, however, refers to the *trade* of jewelry, which he does when discussing other trades where he is not involved in. For this reason, it has been suggested that he was a part of this trade himself.

⁶ The experiments were executed during the course *The Art Technological Source*, taught by dr. M.A.H. Bol, which is part of the curriculum of the University of Amsterdam's program for *Conservation and restoration of cultural Heritage* (February-March 2016).

⁷ Lara Broecke, *Cennino Cennini's il libro dell'arte: a new English translation and commentary, with Italian transcription* (London: Archetype Publications, 2015), 168, chapter 134, 'the way to gild on panel'. For instance, the tools for gilding that Cennino Cennini describes in his famous treatises on paintings, are the same tools that are still used in the present day.

⁸ See Appendix 2: a list that contains the sources that do have chapters on glass gilding techniques, but are not as detailed in their descriptions as recipe 41v.

⁹ 'Il ne fault pas donner l'eau gommée si forte sur le verre pour la couche de l'argent que de l'or, pource q{ue} une foeille d'argent est deulx foys plus forte qu'une foeille d'or.'

¹⁰ For photographs of all the experiments done, the exact proportions of Arabic gum and water, and the type of gold and silver leaf used, please see appendix 1, field notes.

could be flattened by a gold duster (special brush of squirrel hair), and it would extend over the gum a bit because of its thinness. When using strong gummed water in combination with silver, however, the silver would be fixed in place but could not be flattened with a gold duster and did not extend, either. Therefore, the silver stayed in the form in which the gummed water was brought onto the glass, and this had a very bad effect on the sight from the reverse side of the glass. The less strong gummed water had the effect to expand itself more over the surface. Because of this expansion, the applied gold leaf would stretch out too much and crack undesirably. The silver leaf would also stretch out, but because it was indeed stronger than gold, it would not crack.¹¹ What remains unclear after the experiments is what the author-practitioner meant with ‘and if gum wasn’t a little [too] strong for silver, it would not crack so clearly’.¹² However, during the experiments it turned out that if the strong or less strong gummed water were used in combination with silver, the silver would show different results in the reflection when looked at through the reversed side of the glass. It would therefore be very interesting if the term ‘se refendroit’, which is translated as ‘crack’, could be examined again in the original manuscript, to see if this word can also be read as a tense of the verb ‘se refléter’ or ‘se refléchir’, which can be translated as ‘to reflect’.

The differences in applying the gilt layers were very noticeable, but even more evident was the way the gilt layers could be scratched into when they had dried up. The author-practitioner states that the silver layer is not easy to scratch because it is harder than gold, and this could also be a reason to use a less strong gummed water.¹³ When a test panel of gilt layers was scratched into, it turned out that the gold layer in combination with both strong and less strong gummed water could be engraved with a steel awl without a lot of effort. The same was applicable for the silver layer that was adhered to the glass with the less strong gummed water. For the silver in combination with the strong gummed water, however, quite the opposite was the case. Scratching away the silver as well as the gum was very difficult, and it took a lot more strength to push the steel awl and get the glass totally clean of the gum. It can be imagined that one slips easily when pushing an awl very hard over a smooth surface like glass. The use of a pumice stone to advance the work, as the author-practitioner suggested, did not work either.¹⁴ Because it was rougher than the awl, it could be used for large surfaces, but it was not suitable for fine work. It was just as easy to slip with the pumice stone as it was with the steel awl. This makes the instruction for using a different form of adhesion for gold or silver leaf a very important one, especially because it is impossible to correct mistakes in these kind of engravings.

¹¹ Of course, the techniques of gilding should be practiced for years to become good at it. However, the differences in the use of strong or less strong gummed water were easily noticeable.

¹² ‘Et si la gomme n’estoit pour l’argent un peu forte, il ne se refendroit pas si nettem{ent}’.

¹³ ‘L’argent aussy est plus dur, et par ainsy ne s’esgratigne pas si aysem{ent}’.

¹⁴ ‘Pour avancer besoignes, tu peulx poncer’.

The last advice the author-practitioner gives is not very straightforward to a present-day reader: ‘to advance your work you can [...] better lay down gum and leaf on a cut paper’.¹⁵ He is not very specific on what he means with this method. In the rest of his manuscript, only one other clue can be found on the use of a cut paper in a gilding or painting technique. In the margin of fol. 65r, it is written that one cannot lay down oil on cut paper or make a stencil as you can do with tempera, because the oil will expand and the colors will run out.¹⁶ This indicates that the cut paper is in this case used as a stencil. To find out if this is indeed the most logical interpretation, several alternatives of the use of a cut paper have been tried out in a reconstruction.

First, the gum and gold leaf were laid down on a cut paper in the most literal way it is mentioned. The shape of the figure that had to be brought on to the glass was cut out, strong gummed water was applied on this paper, and a gold leaf was laid on top of it. Then, the paper was adhered to the glass with the same strong gummed water. This was not successful; the drying of the gum caused the paper to curl and snap off the glass, with the gold still attached to it. The second method was to cut the paper in the right shape, spread strong gummed water on the paper, push the paper onto the glass and take it off again, so that a sort of stamp of strong gummed water stayed on the glass. Then gold leaf was laid on top of this. The remaining gold was wiped off when the adhesive had dried. This method seemed to work when adhering the gold, but when the excess gold was wiped off, some gold also got removed from the gum, especially at the edges. The last method tried was to cut out a shape from a piece of paper and use it as a stencil. The shape was laid over the glass, strong gummed water was applied on the stencil, and glass and the gold leaf was laid on top of it. The gold cracked at the edges of the stencil by itself and the paper stencil could be taken off. This method worked the way one can imagine the author-practitioner would have wanted it to work: the shape was transferred to the glass, and there were no remains of the gum’s grease on the glass. The only unfortunate thing was that there was more loss of gold leaf because it also stuck to the gummed paper and could not be used again.

Glass gilding techniques in other treatises

During the research for this annotation, several sources from a time range of ca. 1000-1850 have been studied in order to find recipes that are comparable with recipe 41v. These can be found in Appendix 2, Art technological Sources. Remarkable is that only one major treatise is found on

¹⁵ ‘Pour avancer besoignes, tu peulx [poncer, ou pour] mieulx coucher de gomme & de foeille sur un papier couppé.’

¹⁶ Fol 65r, margin left-middle: ‘On ne peult point coucher à huile sur un papier coupé & patronner co{mm}e à destrempe, car la couleur couleroit. Ainsy pour dorer d’or mat il faut poncer & puy coucher les couleurs avecq le pinceau.’

the topic of reverse glass gilding, which is Cennino Cennini's *Il libro dell'arte* (the craftsman's handbook).¹⁷

In Cennini's *Il libro dell'arte*, which is the most frequently used source on Italian painting techniques, the instructions for gilding on glass are quite extensive. The adhesive he uses is a thoroughly beaten fresh egg white, which is applied to the glass and followed by the laying of gold on top of it. After the glass has dried out of the sun for a few days, the gilt layer is ready for engraving. Cennini focuses very much on the setting for this work: the artist should not be disturbed in any way and must work patiently and with joy, for mistakes can never be repaired.¹⁸ He also mentions scraping the gold of the glass neatly with a leaden style, and filling the empty spaces with colors ground in oil.¹⁹ He does not refer to the use of stencils in combination with glass gilding, nor does he speak of silvering glass.

The second source that can be discussed in relation to BnF. Ms. Fr. 640 is the *Liber diversarum arcium* (book of various arts), also known as the Montpellier manuscript, a very important manuscript that includes the most comprehensive manuals for medieval painting techniques. The purpose for gilding glass is different in this manuscript; it is a way of making goblets or dishes. These are gilded, and then another layer of glass is melted on top so that the gilt layer is enclosed in the glass. There is, however, one technique used that is comparable with a technique in recipe 41v, namely, the use of stencils in gilding: "make in a page a cut work, and put the page over the vessel or panel, and over the page gold or silver is applied, and it will be like the cuts."²⁰ In the commentary by Marc Clarke, translator of the manuscript, it is assumed that this technique is involved in a section on panel painting, debating whether the stencil could damage a 'tacky' paint surface. He does not link this technique to the gilding of glass, which is remarkable, since the manuscript speaks of 'a panel or vessel' as a surface for this stencil technique.²¹ Not only is a vessel an illogical object to find in a section on panel painting, but in the chapter of gilding on glass the terms 'panels and vessels of glass' are also used.²² In the manuscript, like in Cennini, there is no mention of silvering of glass. The only thing that is said about silvering is that the techniques used for gold can also be used for silver.²³

¹⁷ All the sources mentioned in Appendix 2 have a chapter on glass gilding, however, reverse glass gilding and engraving is not described.

¹⁸ Lara Broecke, *Il libro dell'arte*, 227, 228.

¹⁹ *Ibid.*, 229.

²⁰ Mark Clarke, *Mediaeval painters' materials and techniques: the Montpellier Liber Diversarum Arcium* (London: Archetype, 2011), 141.

²¹ *Ibid.*, 213.

²² *Ibid.*, 153.

²³ Mark Clarke, *the Montpellier Liber Diversarum Arcium*, 131. Note: this remark of the author is next to the chapter on applying silver and gold on another support than glass, namely 'pages'.

The differences between Cennini, the Montpellier manuscript, and BnF. Ms. Fr. 640 are quite clear: Cennini uses a different adhesive, the Montpellier manuscript states that the techniques for gilding and silvering are similar. Neither Cennini nor the Montpellier manuscript speak specifically about the use of silver leaf on glass. Like the author-practitioner, Cennini focuses on removing the gilt layer neatly with a leaden stylus. The author-practitioner speaks about *thoroughly* washing the removed parts—if they are not totally freed of the gum’s grease, the colors will not appear *bright*. These are warnings that Cennini does not include in his chapter.

Conclusion

At first sight, the recipe ‘colors and gilt on glass’ may not seem very understandable to a present-day reader. Yet, after carrying out simple experiments and researching other sources from a wide time range, it turns out that the instructions in the recipe are very specific. It is interesting that no other major treatise could be found that is comparable in detail for the technique of reverse glass gilding and silvering. The use of different types of gummed water in recipe 41v is remarkable, since no other treatise focuses on this type of adhesion.

However, from the reconstruction, we have learned that the use of strong or less strong gummed water affects the condition of the gilt layer significantly, in both aesthetic appearance and suitability for engraving. From the fact that experiment’s results show such accuracy in the recipe, it can be concluded that it is likely that the author-practitioner had personal experience with the techniques of reverse glass gilding.

This conclusion can be connected to the research that has already been done to determine the profession of the author-practitioner. In this research, several clues have been found that he may have been a jeweler. The art of reverse glass painting was very frequently used in the manufacturing of jewelry at the time BnF. Ms. Fr. 640 was written. The personal experience of the author-practitioner in this technique could thus be a meaningful clue that reinforces the previously completed research.

The comparison of recipe 41v with other manuals shows that it is very specific for the author-practitioner to use gum water for an adhesive. It could therefore be interesting to look into technical examination (condition or conservation reports) of jewels that have been made around this time with this technique, and see if it appears that gummed water was indeed an adhesive used in the production of reverse glass gilded jewels.

The author does however not specify if he is speaking about a certain support for gold or silver leaf when he makes this statement.

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Appendix 1: Field notes

Made during the reconstruction of recipe ‘Colors and gilt on glass’ (fol. 41v)

Introduction:

After a close reading of recipe 41v, it is clear that the author-practitioner’s aim is to describe a gilding method on glass that is suitable for subsequent engraving. Whereas most gilding methods focus on the problem of adhering the metal foil as strongly as possible, recipe 41v provides information on how to adhere the foil in such a way that makes it possible to completely remove it again and make the glass very clean, making the colors applied afterwards look very clear.

I have experimented with every detail from recipe 41v for my reconstruction. Because the annotation is focused on the author-practitioner’s detailed description for applying the gilt layers, and to keep this annotation understandable, I have chosen to only add the notes for the topics that

are relevant for the annotation. However, every other experiment is photographed and documented, and if someone wants to discuss the results, they can contact me any time.

Preparation and materials:

The recipe on fol. 41v can be seen as an addition to the recipe on fol. 39v, ‘tracing a story on glass.’ This is why some of the materials used in this reconstruction of fol. 41v are chosen based on recipe fol. 39v. Below is a list of the materials that are used. The words emphasized in **bold** are the terms that are used in the rest of the field notes.

Glass:

The **glass** of simple cheap photo frames was used for this reconstruction. This was not a historically accurate choice, but the reconstruction needed the properties of the transparency of the glass and the way gold and silver can be attached to it. Also, it was evident that there was no sixteenth century transparent glass available to do the reconstruction. For these reasons, the photo frame glass was deemed sufficient. We cut the glass into plates of 10 x 15 cm, and the thickness of the glass was 2 mm. Then, we cleaned it the way it is described in recipe 039v: ‘having cleaned the glass well with lye and ashes so that it is not greasy.’ We ‘test cleaned’ different glass plates with various materials (ammonia, ethanol, potassium hydroxide dissolved in demineralized water, sodium hydroxide in demineralized water, and ashes from oak and alder tree). Then, we executed a *surface tension test* by letting one drop of water fall down on the surface of the glass plates and observing how the drops flowed on the surface. The glass plate on which the drop flowed best was the one that had been cleaned with sodium hydroxide dissolved in demineralized water mixed with ashes, so all glass plates were cleaned with this mixture.

Gummed water:

I prepared two different types of gummed water: for the **strong gummed water**, I dissolved 13,6 gr of unpurified Arabic gum mixed with 13,6 ml/gr of demineralized water (so 50% each). For the **less strong gummed water**, I took 5ml of the strong gummed water and added another 5 ml demineralized water (so 25% gum, 75% water).

Gold leaf and silver leaf:

The **gold leaf** I used consisted of f ‘Rosenobel dubbeltorengoud’ loose leafs, 23¾ karat, 18 grams quality, bought at A. Bok & Zonen B.V. in Amsterdam. I used a thicker quality that is normally used for outside, because in Cennini’s chapter on ‘how to gild glass for reliquary

objects', he speaks that a heavy, or dull gold is needed for gilding glass. Since the modern gold leaf is much thinner already than the gold in Cennini's time, and probably the author-practitioners time, it seemed more logical to use the thickest quality one can get. The **silver leaf** I used were loose leafs of 'blattsilber,' normal, 95x95mm, bought at firma Van Beek at Amsterdam. No specifics about the thickness are mentioned on the package of silver leaf.

The reconstruction:

Experiment 1: *'You should not put as strong gummed water on glass for the silver layer as for the gold layer because a silver leaf is twice as strong as gold leaf.'*

Step one: A thin layer of strong gummed water was applied to the glass, and within one minute after that, the gold leaf was applied using a gilders tip. It stretched out over the gum a bit and did not crack much (the cracks that are visible occurred because of a lack of experience in gilding techniques. figure 1 is the gold layer after a one or two minutes, figure 2 is the gold layer after one month.²⁴



Figure 1



Figure 2

Step two: A thin layer of less strong gummed water was applied to the glass and within one minute after that the gold leaf was applied using a gilders tip. It stretched out over the gum immediately. After one or two minutes this looked very good (figure 3); after ten minutes cracks already started to show (figure 4), and in the photo after one month (figure 5) it was evident that less strong gummed water was not applicable when using gold leaf.

²⁴ On all the photos in these steps, a green background color can be seen. This is a layer of verdigris (homemade) ground in turpentine oil. The oil was totally dry when the gum and leaf were applied. The colored layer will be ignored because it is irrelevant for the annotation.

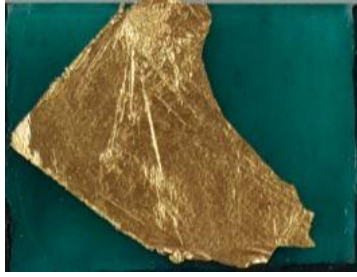


Figure 3

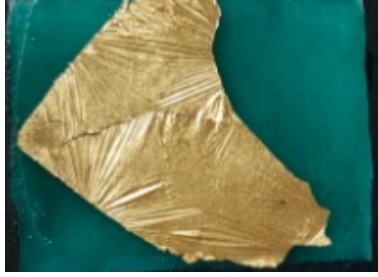


Figure 4

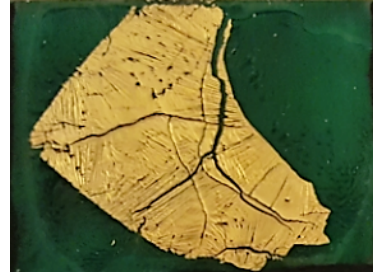


Figure 5

Step three: A thin layer of strong gummed water was applied to the glass, and within one minute after that, the silver leaf was applied using a gilders tip. It would not stretch out over the gum at all and stayed in the shape of the gum layer. Figure 6 is the silver layer after one or two minutes; figure 7 is the silver layer after one month. You can see clearly that there is still a lot of relief in the silver layer after a month.

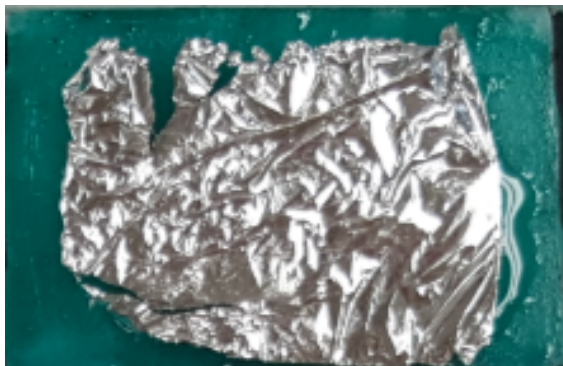


Figure 6

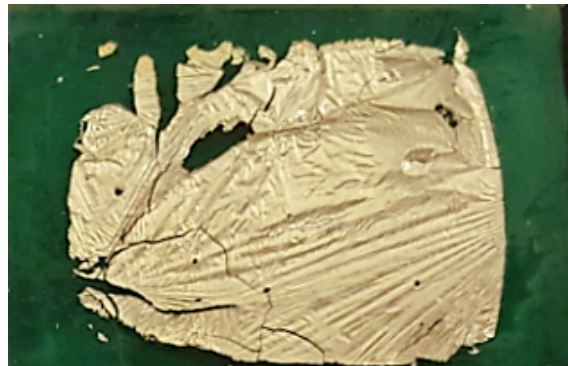


Figure 7

Step four: A thin layer of less strong gummed water was applied to the glass, and within one minute after that, the silver leaf was applied using a gilders tip. It stretched out over the gum immediately, but it did not crack. You could really notice the difference between the gold and silver. Figure 8 is after one or two minutes, figure 9 is after ten minutes and figure 10 is after a month. It still looks quite nice, so it is evident that less strong gummed water is much better to use for silver leaf than strong gummed water.

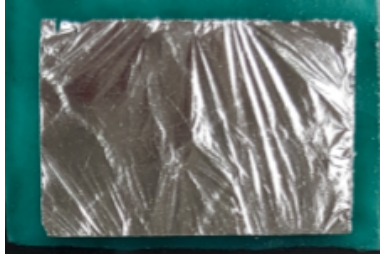


Figure 8

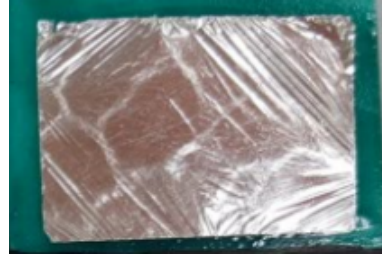


Figure 9

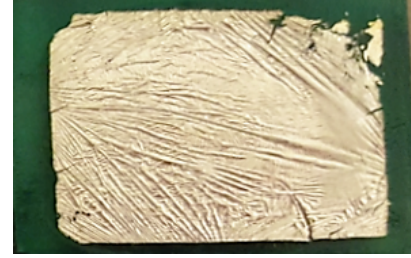


Figure 10

Experiment 2: *Also, silver is harder and therefore does not scratch as easily.*

Step one: the gold and silver leaf was applied on another test panel in the same way as in experiment 1 (see figure 11). After it was applied, it was dried and polished with a fine cotton (old-fashioned) handkerchief so that it could be engraved.

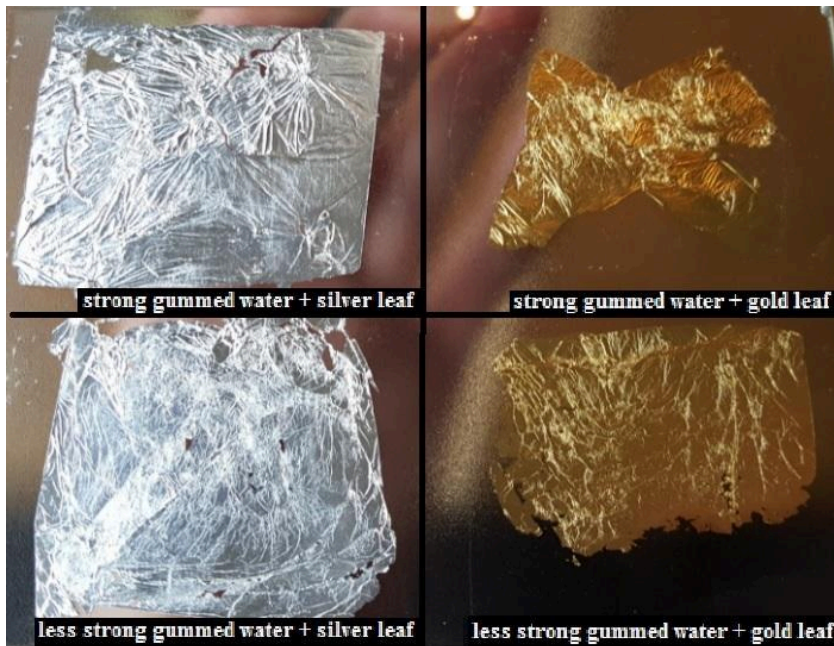


Figure 11

Step two: I started to scratch random shapes into the gilt layers with a steel awl and a safety pin (overview of results: figure 12).

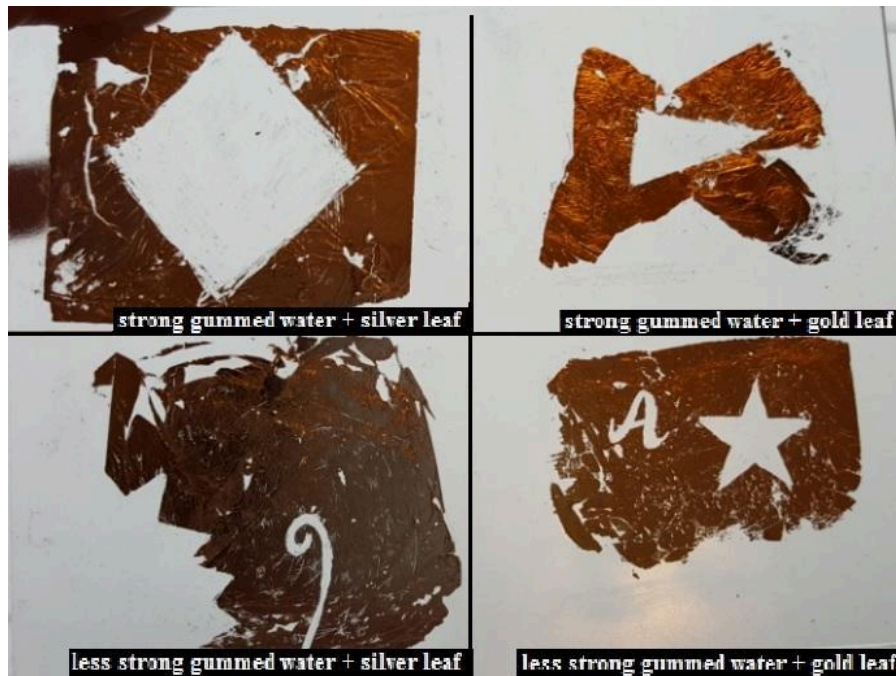


Figure 12

Scratching the gold and the less strong gummy water was very easy; you could make any shape with the awl or pin. The gold and the strong gummy water was still easy to do, but the gum layer under the gold seemed to flake off a little, so the edges of the engraved part were not very neat (figure 13). It would be desirable to try gummy water for gold that contains 35% Arabic gum, instead of either 50% or 25%—perhaps that median ratio will ensure simultaneously that the gold won't crack and that the gum does not flake off when scratching it. The silver in combination with the less strong gummy water could also be engraved very precisely. It was almost impossible to scratch into the layer of silver and strong gummy water by using the awl, as well as pumice stone (figure 14). The surface was very hard and the gum almost did not come off. This gave a very negative effect when looking from the reverse side of the glass; it becomes very clear what the author-practitioner meant with *'if it is not really clean of the gum's grease and viscosity, and of other things, the colors will not be so clear on it'*²⁵ (figure 15).



²⁵ 'car s'il n'estoit bien net de la graisse & viscosité de la gomme & aultres choses, les couleurs n'i seroient pas si nettes'.

Figure 13

Figure 14

Figure 15

Experiment 3: *And if gum was not a little [too] strong for silver, it would not crack so clearly*

Step one: on a glass panel, three types of gummed water were applied from left to right: the strong gummed water, the less strong gummed water and a 'weak' gummed water (amount of the less strong gummed water + equal amount of demineralized water added, so total of 12,5% gum in the solution). Firstly, it is very hard to apply the silver to the weak gummed water because it is such a thin adhesive that if you touch it accidentally afterwards, it will immediately crack. My idea about this is that the silver does not adhere to the water and therefore does not really get stuck and moves around on the glass surface. With a dark background, the open parts show really well (figure 16).



Figure 16

Secondly, the three silver layers show a remarkable difference in reflection. The two leftmost gilt layers have more cracks, but this also makes them capable of scattering the light and reflecting the light in every way. However, the right layer with the weak gum water has a surface almost like a mirror. Under a certain angle, this is obviously the most shimmering one (figure 17), but when you look at a photo with a light upfront by using flashlight, it turns out that the right one is the darkest (figure 18).

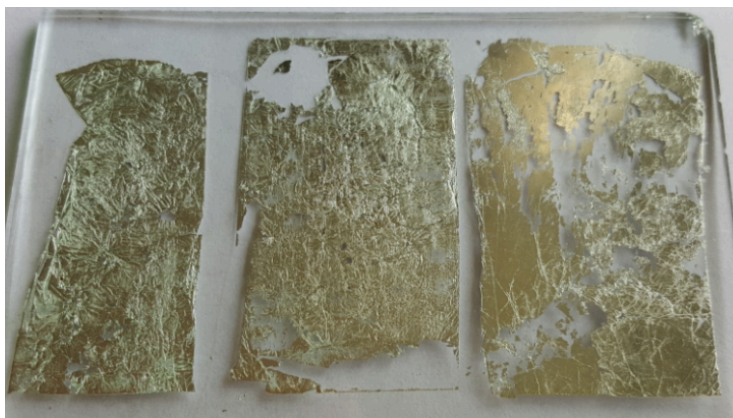


Figure 17

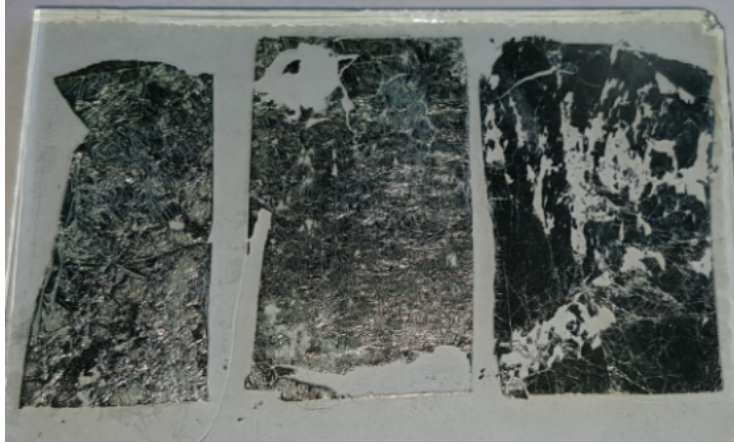


Figure 18

Experiment 4: *To advance your work you [...] better lay down gum and leaf on a cut paper.*²⁶

Step one: The shape of the moon²⁷ was cut out (overview of the shapes, figure 19).



Figure 19

A thin layer of strong gummed water was then applied on it, followed by the application of gold. Another layer of strong gummed water was subsequently applied on top of the gold after the first layer of gummed water had dried. This was then applied to the glass. This procedure seemed to yield a nice result, as there were little repairs to be done (the gum, because it was pressed to the glass, got pushed over the edges of the paper a bit) and the surface of the gold was quite even (figure 20, 21). However, after only two days, the paper curled up and snapped off the paper. The adherence of the gold to the paper was stronger than the adherence to the glass, so the gold fell off with the paper (figure 22).

²⁶ For this experiment, only gold leaf is used, because the author-practitioner only refers to gold, and if you should use the less strong gummed water as an adhesive with the silver leaf, this will expand over the surface, so a 'cut paper' will not be of use.

²⁷ The cuts are copied details of *polyptych of the martyrdom of the Holy Theodosia*, unknown artist, ca. 1545, Museum Catharijneconvent Utrecht (Netherlands).



Figure 20



Figure 21



Figure 22

Step two: The shape of the head was cut out, then a thin layer of strong gummed water was applied to the paper. The paper was pressed onto the glass in the wanted place, and the gold leaf was laid on it and pushed a little with the gold duster (figure 23). The remaining gold was wiped off when the adhesive dried. When the remaining gold was swept away, there were some edges where the gold leaf did not rip at the edge of the gum, but were instead taken away together with the loose parts. In this case, the shape was not filled entirely with gold leaf (figure 24).



Figure 23



Figure 24

Step three: We used the paper as a stencil. The shape was laid over the glass and strong gummed water was applied on the stencil and glass using a stencil brush (a round stiff haired brush with a flat top). Then, the gold leaf was laid on top of the stencil and pushed right onto the edges with the gold duster. The gold cracked at the edges of the paper by itself; this can be seen very well in the photo (figure 25). After the gum dried just a little, the paper stencil could be taken off (figure 26 applied side, figure 27 reverse side). This method worked the best for applying the gold in the wanted shape; the only unfortunate result was the loss of more gold leaf in the process because it also stuck to the gummed paper and could not be used again (this can be seen on figure 25).



Figure 25

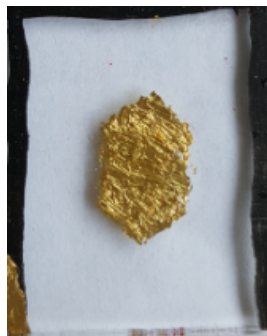


Figure 26



Figure 27

Appendix 2: Art technological sources

Studied to find comparable recipes for recipe 'Colors and gilt on glass' (fol. 41v)

Art technological source	Date ²⁸	Described gilding techniques
Heraclius: <i>De coloribus et artibus romanorum</i> ,	Around 1000-1200	Describes gold decorated roman dishes. A technique that encloses a gold layer between glass by gilding glass first and melting glass on top of this layer. It is mentioned that gold leaf is applied to the glass with <i>gummi</i> , and when dried up, engraved in a desired shape, like a bird or a lion. It is not specified what <i>gummi</i> is. (Heraclius, <i>Von den Farben und Künsten der Römer</i> , 6)
Theophilus Presbyter: <i>Schedula diversarum artium</i>	Twelfth century	Describes the way the Greek decorate drinking cups with gold leaf. Same technique of enclosing as mentioned in Heraclius. They take the gold leaf, form it in the shape they prefer, and then place the leaf on the cup using water. The question on how the gold is formed before applying it on the glass remains open. (Theophilus, <i>De Diversis Artibus</i> , 1847, 133.)
Anonymous: <i>Bologna Manuscript</i>	Around 1450	Also describes the method of enclosing gold layers in glass, for the purpose of making drinking glasses. The adhesive that is mentioned is 'Alexandrian borax, which the goldsmiths use'. (Merrifield, <i>Original Treatises on the Arts of Painting</i> , 1849, 526).
Anonymous: <i>Marciana Manuscript</i>	Around 1525	Mentions a mordant for gilding glass, for the purpose of making vases. Adhesive is made of roasted mastic, varnish, roche alum and linseed oil. Also mentions a mordant for gilding any surface: a mixture of garlic juice and a little gum Arabic. (Merrifield, <i>Original Treatises on the Arts of Painting</i> , 1849, 620-4).

²⁸ There is a discussion about the dating of the five earliest sources, The dates in this table are taken approximately from the book in which they are published. Also, Christophe Zindels *Göldene Kunst-Pforte* of 2010 (an overview of art technological sources) is used.

Anonymous (Venetian): <i>Paduan Manuscript</i>	Around 1575	Mentions a mordant for gilding on glass, not clear if this is a method in which heat is involved. The mordant consists of white lead, terra galla, minium, ground with nut oil, mixed with boiled oil, and then boiled again. (Merrifield, <i>Original Treatises on the Arts of Painting</i> , 1849, 692).
John Bate: <i>The mysteryes of nature and art</i>	1634	Describes a way for laying gold leaf upon glass by a mordant consisting of chalk, red lead and linseed oil. A nice note is that this recipe is in ‘the booke of extravagants’. (Bate, <i>The mysteryes of nature and art</i> , 152).
Pierre le Brun: <i>Brussels Manuscript</i>	1635	Speaks about various gilding methods but not specifically for glass. Does mention that gold can be laid on with well-gummed water alone, which is especially suitable for parchment or skin. (Merrifield, <i>Original Treatises on the Arts of Painting</i> , 1849, 830).
J.B. Pictorius: <i>De geheime illumineer-konst</i>	1747	When translating the gilding method for glass by J.B. Pictorius, it turns out it is an exact translation of the recipe by John Bate in <i>The mysteryes of nature and art</i> . (Pictorius, <i>De geheime illumineer-konst</i> , 1747).
Robert Dossie: <i>Handmaid to the Arts</i>	1764	Mentions to use any size for gilding glass without annealing or burning, however warns to not use a water soluble size to decorate drinking glasses. (Dossie, <i>Handmaid to the Arts</i> , 1764, 399)
<i>The Artist’s assistant, or School of science: forming a practical introduction to the polite arts</i>	1801	Copies the exact text of Dossie mentioned above in the whole section on gilding. (Anonymous, <i>The Artist’s assistant</i> , 1801, 272)