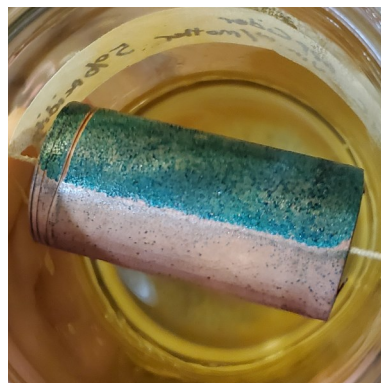
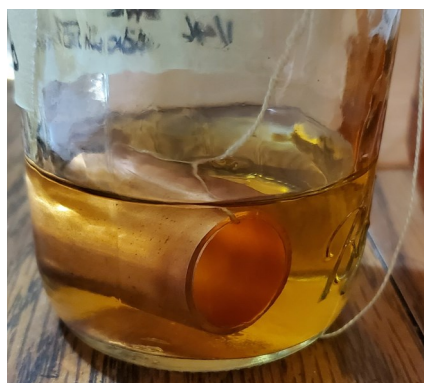


Making Verdigris Pigment for Coloring Medieval Period Sealing Wax

Verdigris is created by the oxidation “rusting” of copper. It is the greenish blue patina on copper statues and ornaments.



Aerugo rasilis (copper acetate) or verdigris is a deliberate corrosion of copper using organic materials, such as the lees of wine, stale vinegar, curdled milk, urine, salt, and honey.



Project Goals:

- ◆ Research period recipes for making verdigris pigment
- ◆ Test different types of vinegar and other ingredients to make verdigris
- ◆ Grow and harvest verdigris pigment to mix with beeswax and resin to make sealing wax
- ◆ Display those methods at SCA events and classes
- ◆ Discuss ideas for future experiments

THL Katrin Grimsdottir

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Making Verdigris with Household Ingredients

Purpose: to determine which vinegar type will yield the best/most verdigris

Many medieval verdigris recipes do not specify what type of vinegar was used so I wanted to try some popular household vinegars and one 30% concentrated vinegar that is used for weed killing...for science!

This experiment does not involve heating the vinegar, hunting down exotic ingredients, or horse dung. This is more of a hey, can I make verdigris from the contents of my kitchen?

Unlike making pigment for paints, I am not concerned with achieving any particular "ideal" color. There does not seem to be a set color for making green wax seals. I couldn't find verdigris for sale, so I decided to make my own using Medieval methods.



Ingredients Used

Heinz distilled white vinegar 5% acidity

Harris concentrated white vinegar 30% acidity

Meijer filtered apple cider vinegar 5% acidity

Bragg Organic unfiltered apple cider vinegar with the Mother 5% acidity

Redmond Real Salt - mineral rich sea salt

Wild Harvest organic wildflower honey

Ace Hardware 3/4 inch copper pipe

Cotton embroidery floss

Ball smooth half pint jars

Start Date 01-05-25

Contents of Each Jar

Jar 1: Distilled White Vinegar - 5% Acidity

Jar 2: Distilled White Vinegar - 5% Ac + 1/4 tsp salt

Jar 3: Distilled White Vinegar - 5% Ac + 1 tsp honey

Jar 4: Distilled White Vinegar - 30% Acidity

Jar 5: Distilled White Vinegar - 30% Ac + 1/4 tsp salt

Jar 6: Distilled White Vinegar - 30% Ac + 1 tsp honey

Jar 7: Apple Cider Vin w/Mother - 5% Acidity

Jar 8: Apple Cider Vin w/Mother - 5% Ac + 1/4 tsp salt

Jar 9: Apple Cider Vin w/Mother - 5% Ac = 1 tsp honey

Jar 10: Filtered Apple Cider Vin - 5% Acidity

Jar 11: Filtered Apple Cider Vin - 5% Ac + 1/4 tsp salt

Jar 12: Filtered Apple Cider Vin - 5% Ac + 1 tsp honey

Fun Facts

- ◆ Salt changes the color of the verdigris from copper carbonate, $(\text{Cu}_2\text{CO}_3(\text{OH}))$ to copper chloride $(\text{Cu}_2(\text{OH})_3\text{Cl})$



Making Verdigris ~ Setting up the Jars



Day One

Day One

- Step 1:** Fill jar with vinegar approximately 1/4 cup
For jars with salt - mix in 1/4 tsp salt until it dissolves
For jars with honey - mix in 1 tsp honey until it dissolves
- Step 2:** Cut clean copper tubes into 2 inch lengths and pull a long piece of thread/twine/floss through the tube
- Step 3:** Place tube in the jar - keep the excess string outside of the jar. The tube should be mostly submerged in the solution
- Step 4:** Replace the lid tightly onto the jar keeping the excess string outside the jar - store at room temperature (aprox 67-69 degrees) in the dark.

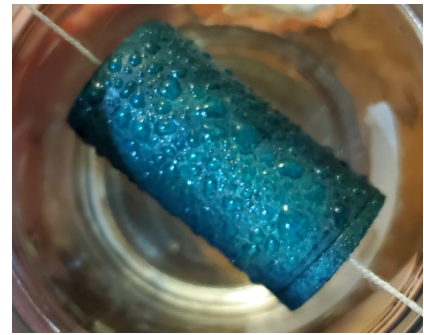
Day Two

- Step 5:** after 24 hours - open the lid - keep strings on the outside
- Step 6:** Pull the strings tight across the lid opening - secure the strings either by holding them in one hand or taping the strings to the sides of the jar.
- Step 7:** Carefully replace the lid - you want to have the tube suspended over the vinegar without touching the vinegar or the sides of the glass.



Day Two: (left) 24 hours after closing up the jars to soak the copper tubes. All parts of the tubes that were above the vinegar line showed early stages of patina. (right) Copper tubes suspended over vinegar

Making Verdigris ~ 17 Days



Close up of jar #1: Vinegar condensation over patina with small crystals



Close up of jar #2: Smoother patina with crusted salt?



Close up of jar #7: Growing crystals on tube
All of the other tubes looked like this one.



Close up of jar #12: Growing crystals on tube

Making Verdigris ~ 28 days

Day 27

Step 1: Open lid and remove the tube from the jar

Step 2: Hang tubes to dry for 24 hours in the sunlight to dry



Day 28

Step 5: After 24 hours - remove string from tubes

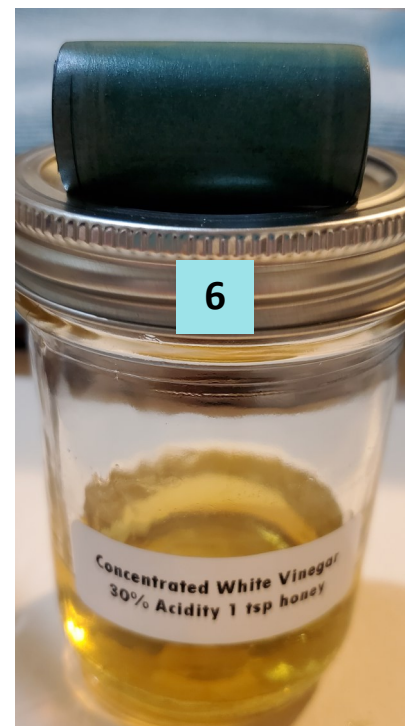
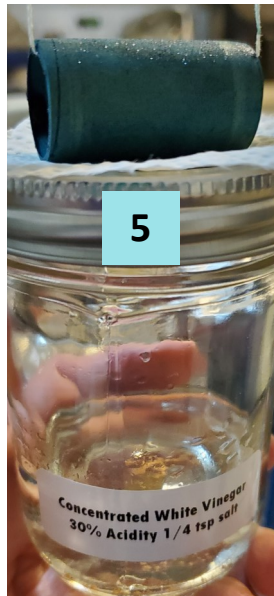
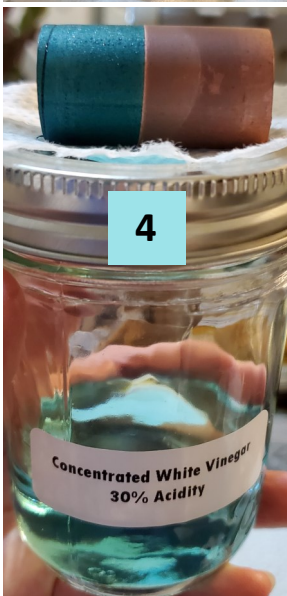
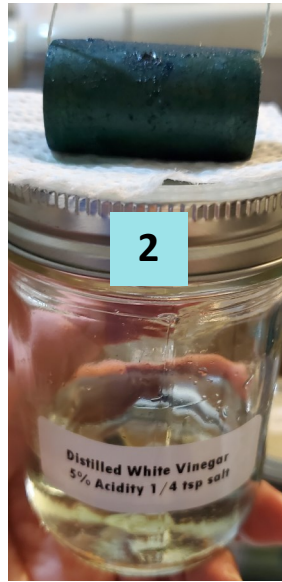
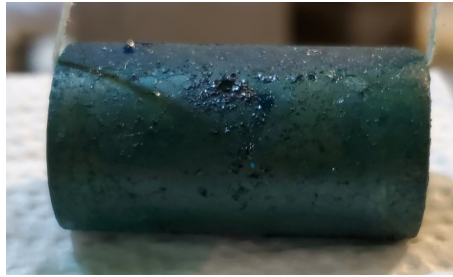
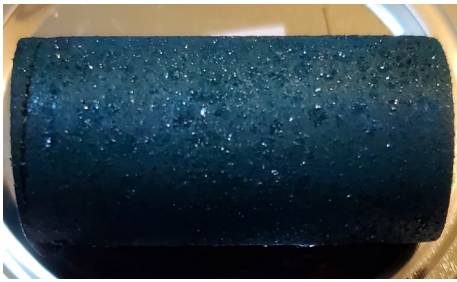
Step 6: With a sharp knife/razor scrape of patina into a mortar

Step 7: Use a pestle to grind the verdigris into a fine powder

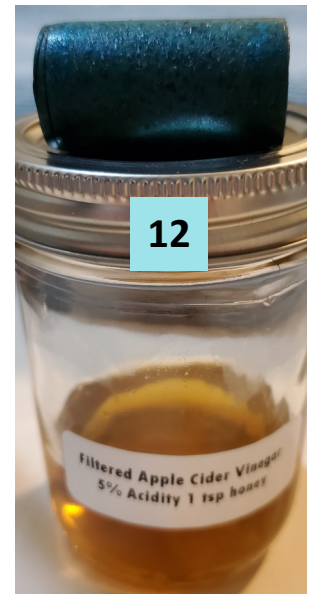
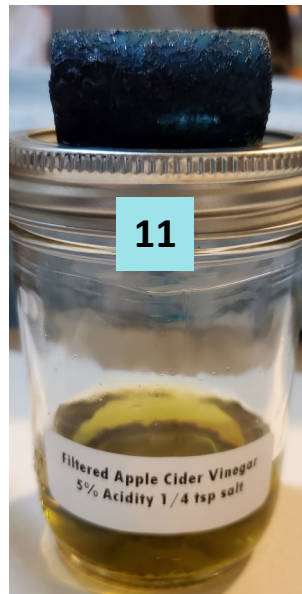
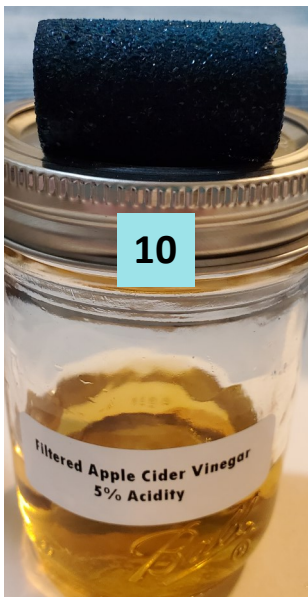
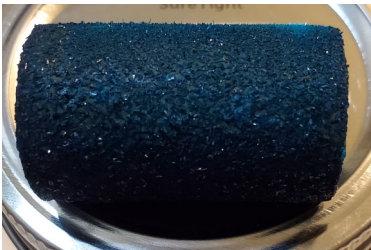
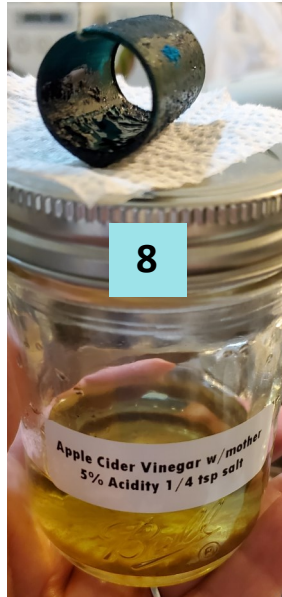
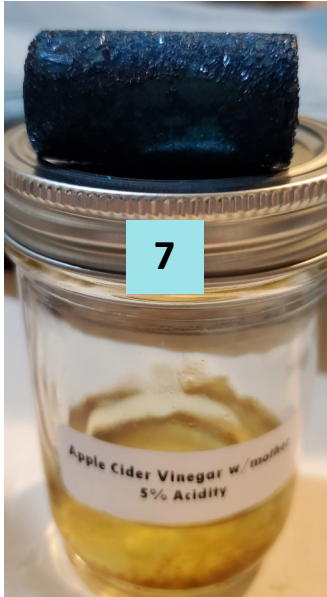
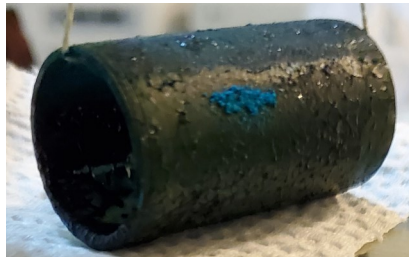
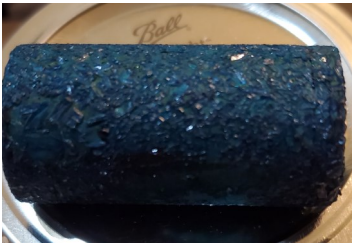
Step 8: Bottle powdered verdigris for future use as paint or pigment for seal wax.



Making Verdigris ~ 28 Days



Making Verdigris ~ 28 Days



Making Verdigris ~ Medieval Period Recipes

ON THE CHARACTER OF A GREEN CALLED VERDIGRIS. CHAPTER LVI

A color known as verdigris is green. It is very green by itself. And it is manufactured by alchemy, from copper and vinegar. This color is good on panel, tempered with size. Take care never to get it near any white lead, for they are mortal enemies in every respect. Work it up with vinegar, which it retains in accordance with its nature. And if you wish to make a most perfect green for grass . . . ,¹ it is beautiful to the eye, but it does not last. And it is especially good on paper or parchment, tempered with yolk of egg.

Basically do this:

Combine copper and vinegar

Cennino Cennini, *The Craftsman's Handbook, 'Il Libro dell'Arte'*, trans. by Daniel Thompson (New York: Dover, 1960).

RECIPE 21 VERDIGRIS "PIGMENT" FROM THE RICITTE PER FAR OGNI SORTE DI COLORI

"In this recipe from the Ricitte perfar ogni sorte di colori (University of Padua, MS 992, recipe 17), both sides of a piece of copper foil were covered with honey, after which the copper foil was attached to the inside of the lid of a glass jar filled with hot balsamic vinegar. The heat from the vinegar caused a lot of condensation to collect at the top of the jar and on the foil, and this may have dissolved much of the honey. The jar was left in an oven at 40 °C for 1 month. At the end of this time, the surface of the copper was tarnished in some areas and had developed a green patination in others. There was no bulk corrosion. The experiment was repeated as above but without heating the vinegar. This second piece of copper ended up covered lightly with a blue green corrosion of varying texture. A sample from the second experiment was identified as a mixture of two types of copper acetate. This method, however, appeared more likely to create a patina than to be a useful means of producing verdigris pigment."

Basically do this:

Coat a copper sheet in honey, suspend over hot balsamic vinegar, cover with lid, continue to heat for one month.

Scott, David, A., *Copper and Bronze in Art: Corrosion, Colorants, Conservation*, (Los Angeles: Getty Publications, 2002) Index

Original Source: Ricitte perfar ogni sorte di colori (University of Padua, MS 992, recipe 17)

"In his famous work, De materia medica, the first-century Greek physician and pharmacologist Dioscorides records one of the earliest accounts of the preparation of aerugo rasilis (copper acetate) using vinegar and a brazen (copper) vessel from which the product is scraped off and put to use, most likely as a medicinal preparation:

But Aerugo rasilis is thus prepared. Pouring it into an hogshead, or some such vessel, ye sharpest vinegar, turn upon it a brazen vessel : it is good if ye hollow look downward, if not, let it be plane. But let it be made clean and having no breathing space. Then after ten days take off ye cover and scrape off ye Aerugo that is come on it ; or having made a plate of ye brass itself, hang it in the vessel, so as not to touch ye vinegar, and after ye like number of days, scrape it off."

Basically do this:

Pour strong vinegar into a copper vessel, cover, wait ten days

Scott, David, A., *Copper and Bronze in Art: Corrosion, Colorants, Conservation*, (Los Angeles: Getty Publications, 2002) pg 279

Original source: Dioscorides, De materia medica, translated by Lily Y. Beck (Hildesheim: Olms, 2017)

Making Verdigris ~ Medieval Period Recipes

“How to make the green from brass which is called Greek or common green
If you wish to make the copper-green which is called Greek, take a new jar, or any other concave vase, and put it into the strongest or most acid vinegar, so as not to fill it and put strips of very clean copper or brass over the vinegar, so as that they may not touch the vinegar or each other, being suspended to a stick placed across the vase. Then cover the vase and seal it, and put it into a warm place, or dung, or underground, and leave it so for six months, and then open the vase and shake out what you find in it, and on the strips of metal, into a clean vase, and put it in the sun to dry.”

Basically do this:

Put highly acidic vinegar into a jar, suspend copper strips, cover, bury for six months, take strips out to dry

Merrifield, Mary P., *Original Treatises Dating from the XIIth to XVIIIth Centuries on the Arts of Painting*, 2 vols (London: John Murray, 1849), vol. 1, pg. 124.

95. *To make good green.*—Take honey and strong vinegar of each as much as you like, and incorporate them very well together ; then put the mixture into a well-luted copper vase, place the jar a foot deep in every direction in warm dung, in a place where the sun shines strongly, and let it remain so for a fortnight ; then take it out, and you will find all the matter converted into fine verdigris of a perfect kind.

Basically do this:

Mix honey and strong vinegar and put into copper vessel, bury in heated place for 14 days

Merrifield, Mary P. *Original Treatises, Dating from the XIIth to XVIIIth Centuries on the Arts of Painting, in Oil, Miniature, Mosaic, and on Glass; of Gilding, Dyeing, and the Preparation of Colours and Artificial Gems; Preceded by a General Introduction; with Translations, Prefaces, and Notes.* 2 vols. London: J. Murray, 1849.

“157. Also, How to make verdigris for writing.- Whoever wishes to make a green colour for writing, let him pour into a copper or brass vessel equal quantities by weight of honey well mixed with vinegar, and then bury the vessel in horse-dung, in the hottest part of the heap. After 12 days are passed, he may take the colour out of the vase, scraping it out ; then dry it in the sun, and keep it for use.”

Basically do this:

Mix honey and strong vinegar and put into copper vessel, bury in heated place for 12 days, remove and dry in the sun

Merrifield, Mary P. *Original Treatises, Dating from the XIIth to XVIIIth Centuries on the Arts of Painting, in Oil, Miniature, Mosaic, and on Glass; of Gilding, Dyeing, and the Preparation of Colours and Artificial Gems; Preceded by a General Introduction; with Translations, Prefaces, and Notes.* 2 vols. London: J. Murray, 1849. “*Manuscripts of Jehan Le Bègue*”, p. 126.

Making Verdigris ~ Medieval Period Recipes

“If you want to make verdigris, take a new pot, and put sheets of the purest copper into it; and so fill that pot with very strong’ vinegar; and cover it thus, and seal it. And place that pot in some warm place, or in the ground, and put it away thus for six months; and then open that pot, and put what you find in it on to a wooden panel, and set it in the sun to dry.”

Basically do this:

Put highly acidic vinegar into a jar, insert copper strips, cover, bury in warm spot for six months, take strips out to dry

Thompson, Daniel Varney, George Heard Hamilton. *An Anonymous Fourteenth-Century Treatise: De Arte Illuminandi, the Technique of Manuscript Illumination*; Translated from the Latin of Naples Ms. Xii. E. 27. New Haven, London: Yale University Press; H. Milford, Oxford University Press, 1933. *Endnote 26, p. 29.*

“106. The recipe for verdigris

Take very clean copper leaf and hang it over very sharp vinegar. Leave it undisturbed in the sun for 14 days. Open it up, take away the leaf and collect the efflorescence; and you will make the cleanest verdigris.”

Basically do this:

Put highly acidic vinegar into a jar, suspend copper strips, cover, put it in the sun for 14 days, take strips out to dry

Smith, Cyril Stanley, and John G. Hawthorne. *Mappae Clavicula: a Little Key to the World of Medieval Techniques*, Transactions of the American Philosophical Society. Philadelphia: American Philosophical Society, 1974. *p. 42.*

15 century recipe for green ink:

“To make verdigris green. Take one pound of copper filings or scraps and wash it a little through a linen bag. Take ground egg yolks, quicklime, tartar sediment, common salt, strong vinegar, and boys’ urine, and mix everything in the vinegar and urine and put half of it in a copper vessel and stir four times a day, then put it over heat or in the sun to dry.”

Raymond Clemens, Timothy Graham . “Introduction to Manuscript Studies” Cornell University Press, 2007. p 27
<https://distillatio.wordpress.com/2015/09/26/making-blue-and-green-ink/>

Making Verdigris ~ Recipe for Seal Wax

Original 15th Century Recipe

For to make reed wex. Take a pound of whight wex, and throwe therinne a quartroun of terbentyne, and melte hem two togidere; and if thou wolt asaye it if it be weel gummed, caste a litil in coold watir, and thanne asaye it if it be tendre, and if it be tendre it is weel gummed. Thanne loke thou have redy oz. 1 of vermyloun, smal grounde, al so smal as ony poudre, and whanne thi wex and thi terbentyne is hoot molten, anoon rijt throwe yn thi poudre of thi vermeloun, and sette it adoun of the fier, and styre it weel, and meynge it weel togidere til it be coold, and thanne thou hast good reed wex y-mad.

For to make grene wex. Take lj. 1 of whight wex, and quart 1. of terbentyne, and medle hem togidere, and asaye if it be weel gummed as thou haddist the rede wex right in the same maner, and thanne take an ounce of vertegrece smal broken, and y-grounden upon a marbil stoon, and throwe it in the matere, and styre it til it be coold, and thanne thu hast good grene wex.

My Translation to Modern English:

To make red wax, take a pound of white wax and throw in a quarter of a pound of terebinth resin, and melt them together; and if you would test it if it is well blended, cast a small sample in cold water and then test it if it is tender, and if it is soft it is well blended. Then look you have ready 1 ounce of Vermillion, small ground as small as any powder and when this wax and this terebinth resin is hot molten, soon after throw in the vermilion powder, and set it down on the flame and stir it well, and mix/mingle it well together until it cools, and then you have good red wax made.

To make green wax. Take 1 pound of white wax, and 1 quart of terebinth resin, and mix them together, and test if it is well blended as you did with the red wax the same way, and then take an ounce of verdigris broken into in small pieces, and ground to powder on a marble stone, and throw it in the mix, and stir it until it cools, and then you have good green wax.

By THL Katrin Grimsdottir 2024

Recipe found at: <https://willscommonplacebook.blogspot.com/2013/02/early-15th-c-recipes-for-sealing-wax.html>

Original Cited Source: British Museum MS. Sloane, No. 73 in British Archaeological Association. 1845.

Making Verdigris ~ For Wax Seals

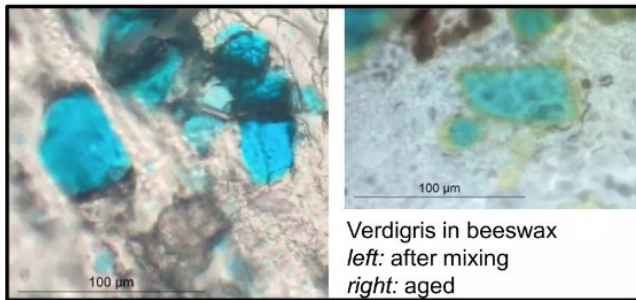


Photo from <https://distillatio.wordpress.com/wp-content/uploads/2013/08/green-sealing-wax-in-the-making.jpg>

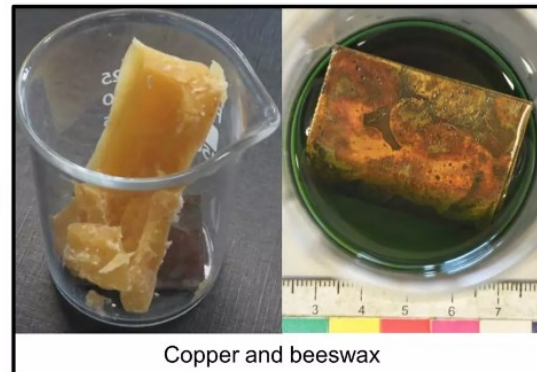


Impression of the seal of Hugh, son of Ailmund.
Photograph: Hoskin & New (see bibliography)

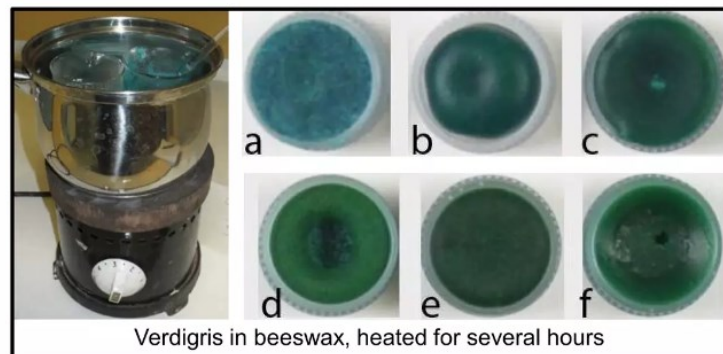
Quality of Sealing Wax – Reproduction



Verdigris in beeswax
left: after mixing
right: aged



Copper and beeswax



Verdigris in beeswax, heated for several hours

Making Verdigris ~ Conclusions

In many of the recipes I found, only one mentions using a particular type of vinegar. Unfortunately, I found the balsamic vinegar recipe after I started the experiment. Another Scadian recommended unfiltered apple cider vinegar with the mother as he considered that to be most like what would have been used in period. So armed only with words like: sharpest, strongest, most acid; I chose the vinegar types I had in my kitchen. I am not a chemist, alchemist, or physicist, so I don't have a background in or have expectations of what was going to happen other than what I have observed in nature.

What I thought was probably going to happen:

- The 30% cleaning vinegar would have the greatest yield since it is a stronger acid.
- Apple cider vinegar with the mother would be next highest yield of verdigris.
- I was skeptical about adding honey as it seemed like it would dilute the acidity.
- I wasn't sure how much salt to use, so I used a 1/4 tsp, but I may need more to change the results.

What I found:

- The strongest or most acid vinegar, the **30% acidity white vinegar yielded the least amount of verdigris.**
- Adding honey did not significantly add to the amount of verdigris produced.
- Adding salt changed the crystal structure but it did not add to the quantity of the verdigris for any of the types of vinegar used.
- The filtered apple cider vinegar yielded the most consistent amount of growth and had a better yield than the unfiltered apple cider vinegar with the mother.

Things that could have affected the experiment:

- The copper tubes used were not pristine. They all had minor tarnish which is why I soaked them for 24 hours to get rid of contaminants.
- Medieval recipes call for copper sheets which have a greater surface area than the tubes.
- I did this experiment in my kitchen which had variable temperature and light.
- I did not heat the vinegar before adding the tubes. This could have slowed down the chemical reaction.
- I shook up the bottle of unfiltered apple cider vinegar with the mother before adding the liquid into the experiment jars. I dropped the copper tubes into the jars before the sediment settled to the bottom. The live bacteria cultures in the sediment may have affected the crystal growth.

If I were to make verdigris for pigment in the future:

- **I would use the filtered apple cider vinegar.**
- It had the best yield of crystals.
- The crystals were easiest to scrape off and grind into powder.
- Filtered apple cider vinegar is less expensive than the Braggs with the mother apple cider vinegar.
- It has fewer variables such as the live bacteria cultures.

Surprises:

- One of the copper tubes in the 30% concentrated group fell into the vinegar in the jar. The vinegar stripped the patina off of the tube where it was submerged. This could be useful for cleaning used tubes for future experiments.

Making Verdigris ~ Bibliography

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