

Ms Fr 640 Experiments

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Craft & Science: Object Making in Early Modern Europe

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Experiment 1: Egg Whites, Eau Magistra, and other binders for sand casting

The process of transforming the dry sand to the a proper molding material for sand casting involves the addition of a wet binding agent. In our manuscript, we have encountered several different binders that can be mixed in with dry sand: sal ammoniac, egg whites, salt water, and wine boiled with elm root, to name a few. Egg whites are praised for the strength they give to the sand; it seems to our author that sand molds made with egg whites might be strong enough to be used more than once. We propose to test these binders with the sand available and make observations about their properties.

One limitation that we have superimposed on this experiment is to use only one sand to test the different binders, even though some recipes (like 68-69r) mention several different types of sand. Testing these different sands with a host of different binders would be an excellent follow-up project; we hope that students in the Spring 2015 might take this up and continue the work. Our aim is to research and attempt to re-create the different binders that are mentioned in Ms Fr 640, rather than the matrix of varying binders and varying sands.

The following recipes from Ms Fr 640 will be key to our investigation:

- 85v "Sand Experiments"
- 84v "Eau Magistra"
- 68r-69r "Casting"

We will also reference other related recipes in the manuscript to aid our research and understanding of binders:

- 49r "Sand for Lead Casting"
- 82r "Egg White"
- 82r "Other Sand"
- 85v "Casters"
- 86v "Excellent sand for lead, tin and copper"
- 87v "Sand of Toulouse"

We are also doing external research in other manuscripts and written sources, including Piemontese, Hugh Plat, Cellini, and Biringuccio.

Experiment Protocol

We will begin with the lead free version of recipe 85v "Sand Experiments" and then compare it with our other principle recipes in 84v and 68r (in terms of the binding materials).

One way to do this might be to simply replace the elm root infusion used as a binder in 85v with other binding agents mentioned in our other key recipes: egg whites, wine infused with burnt oysters, and salt water.

Initial Guiding Questions

1. In what ways does the experience of working with different binders vary?
2. Describe the performance/functional differences of the resulting molds/casts.
3. How do these recipes/instructions compare to contemporary recipes in other sources?
4. What is the earliest reference to egg white as binder that we can find?
5. What other properties might egg white, elm root, wine, sal ammoniac, tripoli convey (in any of the following modes: symbolic/allegorical/metallurgical/mystical/literary/artistic) as a reason for its inclusion?
6. Perhaps investigation into the chemical properties of the binders could be fruitful . . .

Ingredient List

- Wine
 - We discussed briefly what kind of wine would be best for our purposes. For now, we've decided to err on the economic side of wine selection (Trader Joe's).
- Elm root
 - As per Joel's notes, we could also use elm inner bark (which is essentially the same as elm root). This is available via Amazon in powder forms.
- Eggs
- Salt water
- Burnt oysters
 - Donna has obtained oyster shells as well as access to a kiln in which we can calcinate them.
- Tammy cloth (wool?); double sieve
 - According to a couple online sources, tammy cloths were in fact made of wool. These days, they are quite difficult to source, so we may need to use a replacement.
 - The manuscript mentions "double sieve," which we think pertains to a double layer of tammy cloths. It seemed that a double cheesecloth sieve was perhaps too fine for straining the tallow, as the strained tallow was "too pure" (see field notes), so perhaps we will have to experiment with one-layer and two-layer sieves. Though it seems in the case of straining sand, the finer the particles are the better the mold will be.
 - <http://www.thefreedictionary.com/tammy>
 - <http://www.wisegeek.com/what-is-a-tammy-cloth.htm>
 - http://www.collinsdictionary.com/dictionary/english/tammy#tammy_3
- Sand of Toulouse
 - We are planning to use a local New Jersey "sand," perhaps sourced from Home Depot. The manuscript does indeed say that the sand near you should work fine...granted, the author probably didn't have New Jersey in mind.
- Several box molds
 - At least 3-4? It would be great to be able to mold our different sand mixtures at once so we can compare them side-by-side. We need to check if we might need to make more in a woodshop or if there will be enough for us in the lab. (Also, can we take some of these box frames to NJ?)
- Pattern for molding
 - We will find an object for molding, possibly a coin, medal, or small toy of some kind
- Media for casting
 - We have not yet decided how we will cast our objects. Will they be cast in wax or sulfur? Should we attempt melting tin in Julianna's backyard in New Jersey? Stay tuned.
 - <http://www.hotrod.com/how-to/additional-how-to/1306-simple-aluminum-casting/>
 - http://www.youtube.com/watch?v=8uIF_NIJN5g

'Modern' Transcription of Ms Fr 640 Recipes

Experiment 85v "Sand Experiments"

1. Cook Sand of Toulouse two times in a skillet.
 - We assume that "cooking two times" means drying out the sand as much as possible.
2. Pass cooked sand through a fine tammy cloth like the double sieve the apothecaries use (opportunity for historical research).

- See note on tammy cloths above.
- 3. Do not grind on the porphyry.
- 4. Moisten sand in infusion with elm root
 - This infusion will be prepared ahead of time, as directed in 84v “Eau Magistra” -- we will boil the wine and elm root.
- 5. Mold object (Large piece of portrait of Jesus used in manuscript) for ideal thickness of coin of forty sols.
- 6. Cast this

Related tips from BnF Manuscript

- according to manuscript additional notes (do not use sand when it is too hot, etc.
- make sure cast is higher than molded thing bc of sand swelling
- be sure to reheat cast and mol
- cast all at once with no wind
- if mold is thin add a card
- cast in the place where your medal is least thick & where the relief is lowest.

Experiment 84v “Sand, for the most excellent lead of all, for large and small reliefs”

NOTE: We will not be working with crushed white led, but we are interested in experimenting with egg white as a binding agent.

1. Crush white lead and let it dry on porphyry.
2. Moisten it with a **very well beaten egg white to create a paste that sticks together perfectly** with the flat of a knife.
3. Let it rest
 - How long should we let it rest?
4. Mix it well with the knife.
5. Place on flat clean table and let it dry out and reduce.
6. Grind it into small pieces with fingers and sharp side of knife and mold it with sand.
7. Oil medal (to clean it without damaging it)
8. Dry medal with cloth (material?) and ribbons of pork skin
9. Oil medal again with clear walnut oil
10. Swipe medal with cloth
 - {so that [the medal] would not be too oiled; having already considered that in this way [the medal] should come out easily, because the white lead, **wet with egg white water**, which would not damage the oil. }
11. mold medal
12. re-cooked it in the mold so that mold became hard like marble.
 - { And then I knew that sands used to mold big relief must be very moist with some kind of water, which gives body and firmness, **like egg white**, gummed water, [or] one [water] boiled with elm root. And lightly oil your medal. It can take as many firings as you want because it is as hard as glass. But soft lead and sour tin must be cast at a very hot temperature}

Additional manuscript observations

- “Since that moment, I have realized that even though this sand is excellent, can be cast often and molds very neatly, it is fat and it makes bubbles. In this way, the soft lead does not suit the mold well. But I have tried to mix it with lean sand, such as pumice, metal scrapings, and similar things,

in order to give it body, and to help it come off easily, because lean sand [alone] does not come off easily; and yet it takes metal well.”

- Try to mix white lead or minium with other sands.
- Oil and smear with aspic oil, which will disappear when reheated, because the oil causes bubbling.
- **It is necessary to mold with egg white, and then mix it well.** And once it is in the box mold, beat it well on the top with a pestle, or something else clean. This helps to make molding better and come out more easily
- It is best to fill the box mold in one go, because the mixture made of several sands, and the one from mines, that you use to fill the box mold, damages it.

Experiment 68r-69r “Casting”

NOTE: This recipe contains the different types of sand which were mentioned in the introduction. In the current iteration of our project plan, we are not planning on experimenting with these different sand materials; our interest in this recipe stems from the fact that it mentions egg white as a binder. Though the experimentation with different sands is out of the scope of this particular project, we highly encourage further work on this recipe.

1. Four types of sand a. **chalk** b. crushed **glass** c. **tripoli** and d. burnt **linen**,
2. re: **chalk**, it needs to be of the softest kind available, like the Champagne chalk used by *painters*. It releases very cleanly, needs not be dampened with **magistry** or with anything else, but is used in its natural dry state and finely pulverized. The first cast is always cleaner, however it will sustain two or three castings. Should you only cast once, keep in mind, while remaking your box mold, to take powdered **chalk** that has not yet been used, since the one previously used in the box has dried out and will not bind and hold together as well as fresh **chalk**.
3. Crushed **glass** can be made from ordinary **glass sand**, however **crystallo glass** is more excellent, because **common glass** contains **saltwort** only, while **crystallo glass** contains both **salt of tartar** and **saltwort**. Both of them help the fusion, during which the glass is calcinated and reduced to its prime matter. In order to calcinate it perfectly, throw your pieces of **glass**, of whichever sort, among the largest possible glowing **coals**, unless some other violent heat source is available. And once the glass is red hot, throw it into **water**.
4. Sand from bulls’ feet twice-burned and finely ground melts more neatly with copper, & without a coating, than sand that I’ve seen. I cast a medal with quite high relief in it, and slender, with the thickness of a knife blade or a card. And there being a hollow on one side, the obverse, with the relief being on the other side.

Manuscript tips

- Putty is considered excellent for these two metals.
- The sand near my area is very excellent. But in order to make an excellent work, take it fresh, hardly having been used. Because it dries out after having done a casting several times & is arid & has no body at all. If you cast some fine work which has hardly any thickness, your copper matter must be very hot so that it penetrates and runs. Some people mix lead within this molten metal, but this is for large works & not for small ones
- Lean sand needs to be more moistened than others, that’s to say with *magistra* or good pure wine or wine boiled with elm tree roots or something similar. But very fine sands, like burned linen which is fat and soft of its own accord, want to be applied dry.
- All moistened sand needs to be very beaten and tumbled in order to make it fine & flattened of the little globules that it makes in itself when it is drenched.
- The olive oil that some people mix in with beaten egg white makes it puff out.

- Sand of calcined glass lasts for many fusions. But there are only the first ones. It also puffs out.
- Latten works well on its own, but it charges. It is good to mix it with some copper, about a quarter part, with frying pan material.
- Founders cast box frames well up to about 30 or 40 pounds. But no more.
- It is good for big work. But for small it is troublesome to take away. This is because it crumbles. It would be good for it to be a little glued together with something fatty that binds, like molded tripoli or burned felt or salt ammoniac or tripoli & similar things.

Key Recipes from Ms Fr 640

BnF Ms. Fr. 640 fol. 85v "Sand Experiments"

<titled id="p085v_a4">Sand Experiments</title>

<ab id="p085v_b4a">X I have tested **sand** of Th{oulous}e, and after seeing it well recooked two times in a skillet, I passed it through a fine **tammy cloth**, like the double [sieve] which *apothecaries* use, without grinding it further on the **porphyry**, as I have done other times. I moistened it [the **sand**] in infusion with **elm root**, and in it, I molded a big piece of a portrait of Jesus. I found it unmolded very well without having to tire myself out by hitting it from behind and it molded cleanly on one side of the relief and on the other concave. And [it was] of the thickness of a coin of forty sols. I cast [this] very hot</ab>

<note id="p085v_c4">**Sand** from a mine, well chosen and well reheated, is the most excellent of all without trying to find all other mixtures because it receives all **metal**. It does not like to be used hot because it bubbles the more finely. For large works, it is not the best because it does not have enough body to sustain [it],</note>

<ab id="p085v_b4d">[or **metal**] fills with bubbles. Most of all, make sure that the cast is always higher than the molded thing, since the **sand** swells very often when reheating, even in the middle, and therefore with the molded thing remaining higher than the cast, the **metal** cannot run easily or at all nor enter at all. Also make sure that the mold & the cast are indeed reheated. Also cast in one go & outside of the wind. And if your medal is really thin, when you want to mold it, put a **card**, or two or three thicknesses of **paper**, so that the mold will be lower than the cast. Also cast in the place where your medal is least thick & where the relief is lowest.</ab>

BnF Ms. Fr. 640 fol. 84v "Eau Magistra"

<ab id="p084v_b2a">Some people think that salt water is not good, because the salt releases gas when heated and as a result causes bubbles. [In this case], there is only wine boiled with elm root.</ab>

<ab id="p084v_b2b">Sanding charcoal makes [things] come off well. But one finds that willow charcoal creates bubbles, but oak or beech charcoal does the job without making bubbles.</ab>

<note id="p084v_c2">Try burnt oysters.</note>

<title id="p068r_a3">Casting</title>

<ab id="p068r_b3a">I have tried four kinds of **sand** for **lead** and **tin**: **chalk**, crushed **glass**, **tripoli** and burnt **linen**, all four are excellent. As to the **chalk**, it needs to be of the softest kind available, like the **Champagne chalk** used by *painters*. It releases very cleanly, needs not be dampened with **magistry** or with anything else, but is used in its natural dry state and finely pulverized. The first cast is always cleaner,

however it will sustain two or three castings. Should you only cast once, keep in mind, while remaking your box mold, to take powdered **chalk** that has not yet been used, since the one previously used in the box has dried out and will not bind and hold together as well as fresh **chalk**. Crushed **glass** can be made from ordinary **glass sand**, however **cristallo glass** is more excellent, because **common glass** contains **saltwort** only, while **cristallo glass** contains both **salt of tartar** and **saltwort**. Both of them help the fusion, during which the glass is calcinated and reduced to its prime matter. In order to calcinate it perfectly, throw your pieces of **glass**, of whichever sort, among the largest possible glowing **coals**, unless some other violent heat source is available. And once the glass is red hot, throw it into **water**.

<note id="p068r_c3">**Putty** is considered excellent for these two **metals**.</note>

<ab id="p069r_b2b">The sand near my area is very excellent. But in order to make an excellent work, take it fresh, hardly having been used. Because it dries out after having done a casting several times & is arid & has no body at all. If you cast some fine work which has hardly any thickness, your copper matter must be very hot so that it penetrates and runs. Some people mix lead within this molten metal, but this is for large works & not for small ones.</ab>

<ab id="p069r_b2c">Sand from bulls' feet twice-burned and finely ground melts more neatly with copper, & without a coating, than sand that I've seen. I cast a medal with quite high relief in it, and slender, with the thickness of a knife blade or a card. And there being a hollow on one side, the obverse, with the relief being on the other side.</ab>

<ab id="p069r_b2d">Lean sand needs to be more moistened than others, that's to say with magistra or good pure wine or wine boiled with elm tree roots or something similar. But very fine sands, like burned linen which is fat and soft of its own accord, want to be applied dry.</ ab>

<ab id="p069r_b2e">All moistened sand needs to be very beaten and tumbled in order to make it fine & flattened of the little globules that it makes in itself when it is drenched.</ab>

<ab id="p069r_b2f">The olive oil that some people mix in with beaten egg white makes it puff out.</ab>

<ab id="p069r_b2g">Sand of calcined glass lasts for many fusions. But there are only the first ones. It also puffs out.</ab>

<ab id="p069r_b2h">Latten works well on its own, but it charges. It is good to mix it with some copper, about a quarter part, with frying pan material.</ab>

<ab id="p069r_b2i">Founders cast box frames well up to about 30 or 40 pounds. But no more.</ab>

<note id="p069r_c2c">It is good for big work. But for small it is troublesome to take away. This is because it crumbles. It would be good for it to be a little glued together with something fatty that binds, like molded tripoli or burned felt or salt ammoniac or tripoli & similar things.</ note>

Related Recipes from Ms Fr 640

<title id="p082r_a3">Egg white</title>

<ab id="p082r_b3">Egg white gives strength to sand so that many casts [can be] made from it</ab>

BnF Ms. Fr. 640 fol. 83r "other sand"

<ab id="p083r_b3">[Take] charcoal made from vine shoots and clay earth, both well searced, and mix them with well-beaten egg white. Next calcinate it [the resulting paste] in the oven and to use it, dillute it in vinegar.</ab>

<title id="p084v_a4"> Sand, for the most excellent lead of all, for large and small reliefs</title>

<ab id="p084v_b4a"> I took white lead and crushed it dry on porphyry, to make it very fine. Then I moistened it a lot with **very well beaten egg white**, so that it became like a paste, by making it stick together perfectly with the flat of a knife. I let it rest for a while. </ab>

<note id="p084v_c4"> Mix it well with the knife.</note>

<ab id=p084v_b4b">and place it on a flat well-clean table, and since it has a desiccative quality, I knew it would dry out. I left it to dry for a while to reduce it to a powder and mold it with sand, it having been ground into small pieces with my fingers and the sharp side of a knife. I oiled my medal because oil cleans it without damaging it. And after cleaning and drying the medal with a cloth and ribbons of pork skin, I lightly oiled it once more with clear walnut oil, and gently swiped it with a cloth so that [the medal] would not be too oiled; having already considered that in this way [the medal] should come out easily, because the white lead, **wet with egg white water**, which would not damage the oil. This worked very well. I molded a medal very cleanly in high relief, without it having any lumps, which a lot of good sands such as felt, burnt bone, and scoria failed to do on the first attempt. I re-cooked it and my mold became hard like marble. And then I knew that sands used to mold big relief must be very moist with some kind of water, which gives body and firmness, **like egg white**, gummed water, [or] one [water] boiled with elm root. And lightly oil your medal. It can take as many firings as you want because it is as hard as glass. But soft lead and sour tin must be cast at a very hot temperature.</ab>

<ab id=p084v_b4c">Since that moment, I have realized that even though this sand is excellent, can be cast often and molds very neatly, it is fat and it makes bubbles. In this way, the soft lead does not suit the mold well. But I have tried to mix it with lean sand, such as pumice, metal scrapings, and similar things, in order to give it body, and to help it come off easily, because lean sand [alone] does not come off easily; and yet it takes metal well.</ab>

<note id=p084v_c4b">Try to mix white lead or minium with other sands.</note>

<note id=p084v_c4c">Oil and smear with aspic oil, which will disappear when reheated, because the oil causes bubbling.</note>

<note id=p084v_c4d">**It is necessary to mold with egg white, and then mix it well.** And once it is in the box mold, beat it well on the top with a pestle, or something else clean. This helps to make molding better and come out more easily.</note>

<note id=p084v_c4e">It is best to fill the box mold in one go, because the mixture made of several sands, and the one from mines, that you use to fill the box mold, damages it.</note>

BnF Ms. Fr. 640 fol. 85v "Casters"

<ab id="p085v_b1a">**They mix beaten egg white** with earth of which they make the first layer of the crown [of a bell] in pieces. [They also make] bells and all other said pieces which the said [egg] white. This makes [it] come clean and sets and stabilizes the material. For the core of a small piece, egg white is also good.</ab>

<ab id="p085v_b1b">Red copper, in order to make it come clean, wants the mold to be a little hot and lead which is mixed with the red copper [is] therefore chiefly for small pieces.</ab>

<title id="p049r_a2">Sand for lead casting</title>

<ab id="p049r_b2">Rye straw ashes well boiled, dried and then well sieved. [alloy it with egg white](#). One can add copper, latten and others.</ab>

<title id="p049r_a3">Other</title>

<ab id="p049r_b3">Burnt and calcinated pumice stone, burnt and calcined cuttlefish bones, in the same quantity; and ashes of walnut tree or vine, [boiled, dried and finely sieved alloy with egg white](#).</ab>

BnF Ms. Fr. 640 fol. 86v "Excellent sand for lead, tin and copper"

<ab id="p086v_b1a">D</ab>

<ab id="p086v_b1b">Since, I molded with **burned bone**, **mache de fer** & burned **felt**, really crushed and ground on **marble** and mixed together. I got them very wet with beaten **egg white**. And, as in the other [casts], having covered the medal and filled the box frame with **sable de mine**, I gave it a little tap. I found it really stripped & molded quite neatly. I let it sit for a night. The morning after next I reheated it little by little for over the course of seven or eight hours (because if possible there must not remain any humidity at all in the box frame). Two times, I cast **copper** alloyed with ζ there, as old **K**. The material came out really lustrous & resonant & without a coating. And my **sand** was not corrupted at all. Since, I have cast in there many casts of **sweet lead** and **tin**, which came out the best and neatest of any others I have yet found.

<ab id="p086v_b1c">When you mold make some grooves around your mold in the box frame, so that you draw in this manner the matter from all sides.</ab>

[image]

<ab id="p086v_b1d">**Potin** from **sernique** & other works runs yet better than fine **latten**. But I believe that half **copper** and half **latten** is better, which has served & been in very thin works, like frying pans & similar ones. I've seen come out quite well this mixture of half...</ab>

<ab id="p086v_b1e">In order to mold well, you should cast several medals together in a large box mold, because when there is a lot of material and the crucible is almost full, it becomes hotter. Then, if you do not succeed with one of the medals, another will be good.</ab>

<ab id="p086v_b1f">It is better to melt with a bellows furnace than with a wind furnace, because it heats more vigorously. It is true that **latten** melts better in the wind furnace, because it is more sour than **copper**.</ab>

<ab id="p086v_b1g">Some *founders* superstitiously believe that there are only three days in a week that are good for melting, that is, Tuesdays, Thursdays, and Saturdays. For them, the others are unlucky.</ab>

<ab id="p086v_b1h">When you mold, do not excessively pound on the medal that is in **sand**, because that prevents it from being cleanly stripped, and cracks the mold.</ab>

<ab id="p086v_b1i">See to it that **sand** does not go over the edges of the box mold, because if the molded medal is higher than the cast, **metal** will not easily enter the form. Therefore, always take care that the surface of your cast surpasses the mold in a straight line. To accomplish this, if you wish, put a piece of **cardboard** of whatever thickness you please on top of the mold.</ab>

<ab id="p086v_b1j">To prevent their large casting works from becoming too porous, *founders* are careful to heat their molds very well. And to know if the molds are heated enough, they tap them with their finger, and if they start ringing like a pot, they are heated enough.</ab>

<ab id="p086v_b1k">In order to cast their canons cleanly, they mix with their *founder's earth* some fine casting **sand**, if they can get any.</ab>

BnF Ms. Fr. 640 fol. 87v "Sand of Toulouse"

<title id="p087r_a1">**Sand of Toulouse**</title>

<ab id="p087r_b1">The [**sand**] generally considered good is the one found in a vineyard near Pech-David. But the best is the one is from the Touch, a river close to Saint-Michel and Blagnac, in a vineyard at a high altitude. This [**sand**] is thinner, and a bit greasier than the other, and better for small works. It should not be overheated.</ab>

Notes on Related Recipes

49r sand for lead casting

ingredients :

- ½ lb lead
- 1 lb of tin (looking glass tin?)
- stone frame
- rosin candle (to smoke mold)
- copper mold
- resin
- glass
- sand
- calcinated oyster shell
- sand
- rye straw

- egg white (to alloy it)
- copper, latten? , others
- burnt and calcinated pumice stone
- burnt and calcinated cuttlefish bones
- walnut tree/vine ashes
- [specifically for pewterers]
- one lb. of glass tin
- one quintal of fine tin, which makes the tin tinner.
- thick and solid tin molds or, chisel-engraved copper molds, or stone or earth [molds].
- Latten scrapings
- resin candles to perfume their tin molds
- salmons, easy to work with and melts

folio 87

- Sand of Toulouse or
- Sand, slate, and burned earth
- roots of a young elm when it is sappy
- wine, or better yet vinegar. T
- double sieve
- molten
- porphyry to pulverize it
- lead or tin
- a sponge
- strong vinegar. [That way]
- sort pour remplir de chasses with water, salt, or vinegar

84v - “Sand, for the most excellent lead of all, for large and small reliefs”

- crush white lead, moistened with egg white, let it dry on a flat, well-clean table, reduce it to a powder and mold it with sand?
- molded a clean impress
- probably can't do this because of the lead

85v - “Casters”

- ***evidence that egg white can be mixed with “earth” or sand**
- beaten egg white mixed with earth
- make the first layer of the crown of a bell in pieces
- make pieces with the egg white too
- egg white is also good for the core of a small pieces

86v - “Excellent sand for lead, tin and copper”

- ***what is mache de fer? this recipe confuses me; is burned bone, felt, mache de fer mixed in with the “sable de mine”? egg white used as binder here.**
- ***can we mold with copper...?**
- molded with burned bone, mache de fer, burned felt
- ground on marble and mixed together
- very wet w/ beaten egg white
- covered the medal, filled the box frame with “sable de mine”
 - sand from the mines?

- it molded really nicely; let it sit for a night
- reheated it over the course of seven or eight hours
- 2x cast copper and alloyed it with?
- sand held up; cast afterwards sweat lead and tin
- best and neatest of any others
- Potin from sernique? 1/2 copper, 1/2 latten

Additional Research

Hugh Platt, "Casting," from the *Jewell House...*, p. 44-45

Of the aforesaid powders, you must take a reasonable quantity at once, putting the same into a stone porringer, or wooden dish, and put thereunto some cleane water, wherein some dissolve an ounce of Sal Armoniack to every pottle of water, and presently stir it wel together as before, to make a perfect solution and mixture of the matters aforesaid, this pap must not bee made too steffe, when you cast off branches of hearbes or flowers, for then it woulde presse the leaves together. Sometimes temper with warme water, and sometimes with colde, to make the pap drie the faster, for some kine of workes.

...

Some doo mingle Aqua viae, some urine, and some put a small quantity of Sal Armoniack to a great proportion of water, and therewith temper their pap.

Cellini, "Chapter XXXV. How to make aqua fortis for parting."

Aqua fortis for parting [partire] is made thus. You take 8 lbs. of burnt rock alum & an equal quantity of the best saltpetre, and 4 lbs. of Roman vitriol, & put them altogether into the alembic, add to these things a little aquafortis that has already been used, exercising your discretion as to the quantity. And in order to give a good luting portions, and mix them up with the yolk of a hen's egg, then smear the mixture of the alembic as far as the furnace will allow. Then for the rest put it to a moderate fire, as the wont is.

In Biringuccio (p. 185), egg whites are used in the process of distilling aqua fortis, but not mixed in; used to seal instead?

Biringuccio, p. 324

In general in making such powders, all kinds of gravel, tuff, washed river silt, and similar earths whose grain is fine and lean by nature are good for this operation of casting, either by themselves or in mixture because they are disposed to receive the metals well on account of a certain dryness they possess...But first I desire that we return to speak of the natural ones because they are real earths and can always be had wherever one may be, and in the necessary quantity. They please me greatly because they are easy to reduce on account of their disposition.

A loam is made from these and mixed by beating with wool-cloth cuttings, spent wash ashes, and horse dung. This is made into cakes and dried. These are then put to bake in a furnace or in some other way and, in fact, are baked very well. Then it is pounded and sifted with a fine sieve, or it is ground in a potter's color mill, or by hand on a porphyry with water, to the fineness that the craftsman desires, or as fine as he can make it. When it has been ground it is again drained free from water and dried out with fire. Then as much magistery of salt is taken as will moisten it. It is dried and pounded again and passed through a sieve. When it has been made as desired in this way it is moistened again before use with water, urine, or vinegar just enough so that it holds together when it is squeezed in the fist.

Powders are also made of crushed brick, tripoli, vine ashes, tiles and glazed drainpipes, or burned emery, calcined tin, straw, and of burned paper and horse dung as well as of young ram's-horn ashes and many other things. The goodness of all these depends on three things; namely, on receiving the metal well, on being so fine as to be almost impalpable, and on their being made with a magistry that renders them hard and strong when they are dry.

Biringuccio, p. 325 "The Method of Preparing the Salt for Giving the Magistry to the Casting Powders"
Because it is necessary that the powders made for casting have a magistry of salt water, I wish now to teach you to prepare the salt that must form this magistry, for without it these powders would not have the toughness to hold themselves together when they are dry. In short, you take the quantity (119v) of salt that you need to prepare and put it in a rough pot, either baked or, if it suits you better, raw but well dried. This is completely covered with a lid or is luted with well-made moulding clay. Then it is encircled with brick ends at a distance of three dita, like a drying furnace. This space is filled with good charcoal; fire is applied and it is left to stand until all the charcoal is consumed by itself. Then you take that quantity of this burned or rather melted salt which you wish to use for moistening the clay and which you think can be dissolved in the water so that it will remain very salty. It is boiled in a pot with water and then left to stand. After it has settled, your powder is moistened with it and used for moulding. When you see by testing it that the powder stands up as you wish, it is good.

NOTE: The purpose of this treatment is supposedly to give some sodium silicate by reaction of the fused salt with the clay pot. This would make a most effective binder and at the same time the residual unchanged salt would aid by fluxing the metal in the mould to some extent, giving a fine impression. A similar recipe is given in the Secrets of Alexis, but emphasis is there laid on very strongly heating the mixture, with bellows or otherwise.

Biringuccio, p. 328 - molding with wet sand ("green sand")

By pounding all these [ingredients, sand] are incorporated and mixed together well. Then take urine or wine and moisten it, and mould whatever you wish with the moistened material in frames or wooden boxes...Then cover them with soot as usual, with the smoke of turpentine or a tallow candle.

Experiment 2: Wax as medium

Based on our sources, wax had many uses in the workshop. Taking a cue from the recipes in Ms Fr 640, we will focus on wax as a medium to create patterns and images, especially ways in which the wax can be altered to yield different consistencies. Cellini mentions the importance of the seasons when using wax; the temperature greatly affects its workability, drying time, and consistency. Assuming the lab will be kept at a constant temperature, we will experiment with adding substances to wax as described in the manuscript and observing the effects.

If there is time, we would also like to explore wax as a printing medium for stamping and making impressions. The recipe on 42r "Seal and print wax" details this process.

Key Recipes:

- 109r "Working in rough with wax"
- 120r "Impress medals made from wax"
- 42r "Seal and print wax"

Experiment Protocol

Using the additives described in 109r and 120r, we will experiment with adding substances to wax to change its consistency.

1. Melt beeswax.
2. Stir in a set amount of the additive on hand (TBD, depending on additive)
3. Pour some of the wax into muffin tin or other vessel for cooling.
4. Put the beeswax back on the heat; add another set amount of the additive.
5. Pour out some of the wax into a muffin tin to cool.
6. LABEL each tin.
7. Repeat process until there are enough samples of different ratios of wax mixtures.
8. Carve the beeswax and make observations about its consistency.
9. Additives to try:
 - a. Turpentine
 - b. Resin
 - c. Butter
 - d. Tallow
 - e. Additive to make “black wax”? Hugh Plat mentions “searched charcole” as an additive to wax for making patterns.

Preliminary Questions

- How do we mix wax? What are the correct ratios of wax to a given additive?
 - Turpentine: Biringuccio says to mix “a little”, while Cellini advises to add the correct amount given the season (more in winter, less in summer).
 - Tallow: we already know what a 1:1 mixture looks like from our bread molding experiments, so we will try doing different mixtures: 3:4, 1:10, etc.
- What is the desired consistency of wax for a given task? What do these different consistencies look and feel like?
- What is ‘resin’? There are many different types that we could use. We will need to decide what this resin consists of and what type to use.
 - The manuscript describes purified pine resin; will try to source this.
- What other wax additives can be found in our Early Modern sources?

Ingredient List

- Wax
- Turpentine
- Butter
- Resin
- Tallow (if available)

Notes

- Some recipes specify white lead as a mix-in, but we will be avoiding contact with hazardous materials.
- Many substances can be used to make patterns for casting (either sand or lost-wax or plaster processes). As Biringuccio writes on p. 220, the patterns can consist of tallow, wax, wood, plaster, stone, or metal, to name a few materials.

Key Recipes from Ms Fr 640

p109r Working in rough with wax

When the **wax** is too hard, one mixes in some **turpentine** or a bit of **butter**, which renders the **wax** malleable, and cleaner than **tallow**, which the *Italians* mix in, because oftentimes, it is necessary to put the tools into the mouth, [tools] which are better when made from **box wood** or **antler**.

p120r Impress medals made from wax

You can mold your relief with **wax** mixed with a bit of **resin** to make it harder and firmer, whatever relief that you wish, either an animal or a medal. And then, fashion a hollow out of this relief in **brass** or **copper**. Or mold your [wax] in relief and strike it in a sheet of **tin**. And fill [your final product] with **lead**, and heat it. Try [to use] blades of **stone leaf** to make the hollow for lizards &

p042r Seal and print wax

<ab id="p042r_b2">For large **wax** seals, you should always have tepid water handy, and keep your **wax** in it. Yet previously you should have kneaded it with your hands, so as to make it very smooth and even, for otherwise the water would penetrate the **wax** and prevent it from holding together. Afterwards, you can stamp whatever you want. Cover the **wax** in three or four sheets of **paper**, and, with a round and smooth stick similar to a pestle, roll it out as if to polish it. It will then stick to the **paper**, helping you to take it off from the seal. In this way you will stamp better than if you were dripping molten **wax**. You can carve figures and color them in gold, in silver, or paint them with **couleurs à vernis**, and transfer them onto a **glass** pane painted with **couleurs à tourmentine & mastic**. And if you want to apply these designs by inlaying, use **ammoniacum** mixed with **vinegar**, and it will stick well.</ab>

Related Recipes from Ms Fr 640

Recipes containing 'resin'

<title id="p003r_a1">Imitation coral</title>

<ab id="p003r_b1">One must first make the branches from wood or take a fantastical thorn branch, **then melt a pound of the best possible clear pine resin** and add one ounce of finely ground vermilion together with walnut oil, and if you add a little Venice lake the color will be all the more vivid, and **stir all together into the resin**, molten over a charcoal fire, not over an open flame, lest it catch fire. Then dip in your branches with a swirling motion. And should there remain any filaments, turn the branch over the heat of the charcoal.</ab>

<note id="p003r_c1a">Colophony is nothing other than resin that has been cooked again. To do it well, you take a leaded pot and **melt the resin**, boiling it over the brazier for a good hour until it appears not thick but clear and liquid like water and it easily runs as a thread off the end of a stick, which you use to crush and test it. Then pour it through a coarse canvas or tammy cloth so that it falls into the strongest vinegar you can find, because the vinegar makes it strong and makes it less brittle. Repeat this two or three times and it will be fine and well purified. To imitate your coral, you can mix a fourth part of mastic with your purified resin to make it more solid and finer, and if you should use just one drop of mastic, it would be all the better, but it would take too long.</note>

<note id="p003r_c1b">Sulfur and vermilion have the same effect.</note>

<note id="p003r_c1c">Coral made of red enamel withstands filing and polishing.</note>

<note id="p003r_c1d">It is made like cement, which is stronger when mixed with crushed glass rather than with brick. In the same way, together with the vermilion, one mixes in opaque red enamel, finely ground. It is the same way with all enamel colors.</note>

<title id="p004v_a3">Iron engraver's varnish.</title>

<ab id="p004v_b3a">Take linseed oil or walnut oil and instead of black pitch you will add some pine resin and you must cook it like black varnish on fire. And to apply it, heat your iron and apply just one layer of varnish, and when it no longer smokes, it is dry. Then engrave with a steel point whatever you want. Then take some salt and verdigris and

<title id="p043r_a3">Purpurine</title>

<ab id="p043r_b3">Take half an ounce of soft tin, melt it in a spoon. Once it is melted, throw in an $\frac{3}{4}$ of $\frac{1}{2}$, mix together. Once they are cold, grind on a porphyry slab. Then take an $\frac{3}{4}$ of sal ammoniac and an $\frac{3}{4}$ of the yellowest sulfur that may be found, grind both. And then mix very well all the aforementioned materials. Then put all together into a glass sublimatorium. Hold this over a small fire for an hour, and for an hour over a stronger fire, and for an hour over a very strong fire, and it will be ready. **Then, to use it, apply resin black with the glue used by painters to paint, two or three times, until it is quite black.** Then apply a bit of varnish. Once it is dry, apply the purpurine dry with a finger where you want. The more you apply, the finer it will look. Then, if you like, you can apply varnish on top.</ab>

<title id="p049r_a1">Lead casting</title>

<ab id="p049r_b1">Those who cast these small items, sold in front of the churches, melt half a pound of lead on a pound of tin, and cast in a stone frame. And if they want their work [to be] whiter, they use half of tin and half of lead, but the first mixture is the best, and does not make bubbles. You have to cast it hot enough, otherwise it won't flow. Some [people] smoke their molds with a rosin candle for neat casting. The antimony makes the matter harsh and breakable. The looking-glass tin makes the work whiter, but does not make it flow more than with tin that is correctly made with pure lead. Those who make very precise lead castings use puncheons. Tintiers cast with copper molds. **It is said that one makes lead adhere to glass by using resin.** Some people put a quarter of tin on lead. Glass tin makes the work stronger.</ ab>

<note id="p049r_c1">Poncet. They cast by soldering [using what] the glass-makers use. Lump [of metal] of [...] Calcinated oyster shell.</note>

<title id="p049r_a4">Pewterers</title>

<ab id="p049r_b4a">They add one lb. of glass tin to one quintal of fine tin, which makes the tin ticker. There is two kinds of tin, one which flows better, like lead, while the other one is sour and can be made thicker. They are casted in thick and solid tin molds or, to cast more neatly, in chisel-engraved copper molds, or stone or earth [molds]. Latten scrapings mixed in make the tin more breakable and harder, and more difficult to work with. They cast in the very hot molds some very hot tin. **They perfume their tin molds with resin candles.**</ab>

<title id="p087v_a3">Sand from sand pit from Toulouse</title>

<ab id="p087v_b3a">[In order to use] sand from a sandpit for casting, filter it through a double sieve, then **having mixed it with molten resin it burns and heats**, and becomes all red and hot as iron. Once it has

cooled down it is completely black and can be pulverised on porphyry very well. Having prepared it like this and checked the smoothness of the surface with my nail, I moistened it with egg white and beat it vigorously, until it was not a paste anymore but a powder. I found [this sand] to release the cast very well, and molded very clean in lead and tin [with it], however it needs to be baked long enough and slowly.</ab>

<ab id="p087v_b3b">Others beat it strongly in a mortar, in small amounts at a time, thus it sacache and comes out very fine; then they bake it moderately, just enough to dry it, and then they crush it dry on porphyry. Thus it is made almost impalpable, and yet not too dry, and it retains the consistency and the binding quality of the earth to which it is related, and is better than when it is burnt. When you moisten it with egg white and pass it through a sponge it releases very clean for a low relief, but not a figure in high relief. Considering this, since then I experimented with moistening it only with strong vinegar. [That way] it releases a figure I previously had not been able to release [from the mold]. I think that even when you wet the finest sort with egg white, or in a similar fashion, or the thick sort pour remplir de chasses with water, salt, or vinegar, they do not mix so well. However, given that they are of one and the same nature, and are similarly moistened, they espouse each other, and hold together.</ab>

<note id="p087v_b3c"> To mold well, when your sands are prepared, mold in one day. Bake slowly the next day, then cast the other.</ab>

<note id="p087v_c3a">Choose [sand] that comes in clods and lumps, and deep down in the earth, because commonly the one near the surface is too much akin to earth, whereas the deep one is similar to rock.</note>

<note id="p087v_c3b">I have sometimes molded with pure lead cast very hot, and the example as well as the principal were very clean, but since the vinegar gives it little binding, it held only for one cast.</note>

<ab id="p095v_b1a">The end can be bought already made, a dozen costs six sols but the big ones 2 carolii. The end is fixed either with nails which are fixed on the sides of the cutting edge But this only spoils the sword and rot the scabbard for the water goes into it via the juncture of the nail. The best way is to apply it with some resin or glue but the resin is better. **And the best is when the end is strongly hold and set when is so hot that the powdered resin on the end melts**, in that way it doesn't fall and can't be undone unless it is put in fire.</ab>

<title id="p098r_a3">Locksmith</title>

<ab id="p098r_b3a">To tin nails and other work, they file their work neatly, then in order to clean & degrease it well, it is boiled in vinegar. Then they dry it with linen, afterwards they heat it & **pass some resin over it**, which induces a shining skin like varnish. This done, they melt some pure & fine tin in their tinning tool, which is a square little iron box. And when the tin is well melted and moderately warm, they **throw some resin in to consume the scum**, & then they temper the head of a nail or something similar for a bit, and having been left in for seven or eight pauses, they take it out and shake it, hitting it with some iron to make the the superfluous tin fall off, & clean it with a small stick wrapped in tow. And if it is not well tinned, you will hit it until it is hot with a piece of resin and do as before before and leave it to get cold. When the work cools down it becomes yellow, which is a sign that the tin is the right temperature. But it becomes blue if the tin is too hot. Things so tinned are of a duration, & do not come undone at all, like the tinning done by leaves. But at the end of a year they can be clarified & renewed by heating & striking them.</ab>

<ab id="p098r_b3b">Leadsmiths say that making a lizard die in the melted tin makes the tinning become very golden. Or else by adding sal ammoniac.</ab>

<title id="p110v_a3">A cast of lead or tin</title>

<ab id="p110v_b3">Because you want to cast tin very thinly, if your medal, plant or other thing [you want] to mold is thin and fine, make [sure] to include more tin, much more than lead, namely less than the fourth part of lead for three of tin. And moreover, one only puts lead in as an alloy. Contrarily, if you want to mold something strong and thick, put a lot more lead in than tin. And for the one and the other you can put in a little lookingglass tin, but only a very little, **with a little resin**, when you want to cast. Since then, when molding with pure new lead, I put in two ounces of pure tin for every pound [of lead]. And when molding with pure tin, I put in two ounces of pure lead for every pound [of tin]. I made some plants and snakes as if they were real.</ab>

<title id="p166v_a2">Scented candle from Le Mans</title>

<ab id="p166v_b2"> They melt in wax and candle **of some rosin which is called in France of Burgundy**, which is white and not as non burnished and dried as the other rosin. They also put scent on the candle-end and snuff of a candle[1]. </ab>

Related recipes containing wax

<title id="p160v_a1">Moulding a foot or a hand</title>

<ab id="p160v_b1">**Mix resin to the wax.** Once well blended, soften the mixture into hot water or urine. Then press [the foot or the hand] in the mixture in order to get and impress, then pour plaster; the cast will which will be clean and come off easily.</ab>

<title id="p044v_a4"> Stucco </title>

<ab id="p044v_b4"> Some don't use for sticking stones some gemme **pitch black rosin** because it is too greasy but they use some **rosin and sulphur in the same quantity and as much wax as both**, and then the strongest mingled some crushed brick, the others some crushed and powdered and sieved white chalk or white stone. </ab>

<title id="p050r_a2">Molding</title>

<ab id="p050r_b2">If you want to quickly mold in demi-relief anything you come upon, fold some paper five or six times over, and place it on the medal and make sure the paper is folded around the edges of the medal so it is very secure. Next take a stick, broad at one end and with a well-dulled point at the other, and rub firmly on the paper, and retrace the lines with the point of the stick until you reckon that your impression is well done. Then, at your convenience, rub oil onto the paper lightly with a brush, and cast some tallow or wax or sulphur into it. And the paper, without burning, will give you a neat design that you can then mold in plaster or tripoli and then in lead and other metals.</ab>

<title id="p104v_a2">For casting</title>

<ab id="p104v_b2">If you've got a big piece which does not allow an easy stripping of casting, mold it with some wax, either on the hollow side or in relief, because it is soft and hollow and so can easily be separated from the piece without leaving anything. But be sure that the melted wax is neither too hot nor too cold. Some people use for molding some wax warmed in boiled water, but while pressing the mold it bends and becomes unusable. Once you have made your wax cavity, you can cast in some very soft and clear clay, and let it dry. Then, upon it you will make a lead or tin cavity, in which what you will make will easily be stripped.</ab>

<title id="p109r_a3">Molding wax</title>

<ab id="p109r_b3">So that your mold takes hold without repelling any surface on a form or figure in wax, it is necessary to rub the wax with oil and soak your sand in lukewarm water, because cold water repels oil even more and will not make a good layer on the wax.

<note id="p109r_c3"> Rub the oil on very very lightly, [use] so little that it hardly appears at all. Then rub with some spirits. After soak your sand in lukewarm water so that it does not repel the oil.</note>

<title id="p120r_a1">Stamped medals made from wax</title>

<ab id="p120r_b1">You can mold your relief with **wax mixed with a bit of resin to make it harder and firmer**, whatever relief that you wish, either an animal or a medal. And then, fashion a hollow out of this relief in brass or copper. Or mold your [wax] in relief and strike it in a sheet of tin. And fill [your final product] with lead, and heat it. Try [to use] blades of stone leaf to make the hollow for lizards &</ab>

<title id="p122v_a2"> Molding hollow </title>

<ab id="p122v_b2"> Wax alone cool down very soon, and does not run everywhere very well, tallow keeps its heat and run everywhere. But tallow alone is not good that is why you have to mix wax and tallow together. You can easily mold hollow bodies of crawfishes, or bodies of other small animals, but it isn't so easy to mold hollow their legs. </ab>

<note id="p122v_c2"> The first part of your mold which is first casted on [...] clay cracks more easily on fire than [...] </ note>

<title id="p133r_a1">Hard wax to imprinting seals</title>

<ab id="p133r_b1">One makes these [seals] out of white wax which is harder than the other and one mixes in it some cerussite or leaded white very finely ground such that it is as hard as you like and mix in a drop of turpentine to bind it. Afterwards mix it in the color that you want. It is in wax that goldsmiths start.</ab>

Very strong wax

Mix your wax with resin and red bole Do not cast very hot

SOMETHING INTERESTING FROM THE DICTIONNAIRE DE L'ACADEMIE

FRANCAISE : BOL D'ARMENIE : reddish earth from Armenia, gilders use it.

Blacksmiths use it also for horses, and almost all of them are in ignorance of the right word and call it Brouillamini (THE WORD BROUILLAMINI IS IN THE MANUSCRIPT)

<ab id="p151r_b1">

The white wax from which you had made your sulphured black wax hasn't so much matter when dry and cleaned, and doesn't leave any lump in your mould, also it flow very gently out of the mould. Coal which is mixed with the white wax could leave some matters in the mould, but they can be burned and reduced to ashes which can be empty by blowing. You can open your mould when the wax is melted if there aren't any delicate thing which could break in your mould. Open the clamps made of lute, then open your mould and cover it with a coat of common lute, then dust the whole thing with crushed

bricks in order to better handle the mould. let dry the lute softly instead of drying it on fire which would melt the wax. When the wax has flowed out of the mould, burn the wax and the coat which remain in the mould. when your mould had been heated once, lute again because bad plaster make the mould shrink, the joints would open and make burrs. Do not heat your mould twice if you cast only lead or tin, but the lute must...

<ab id="p151r_b2"> Cast cold black wax in the mould. It is necessary to open half of your mould to cast, if the figure made of black wax breaks, it is not a problem because you can rework it with the point of a warm wire. You could also join the pieces in the mould by joining very well the two half parts of the mould. when the figure is large, cross inside the mould wires in order to hold the core </ab>

Additional Research

Hugh Platt, p. 48

But if you will caste any imbossed patterns, of waxe, or any other slender or curious paternes, that be under cutte as they terme it. s. such as stande anticke wife, and whereof you may see some partes behinde, which will not suffer them to come oute of the moldes without breaking either the patternes or the moldes, then must you use this devise following. Take one pound of common glew, put thereto one ounce of yellow waxe (some put two or three ounces) but first dissolve the glew by a gentle fire, with a little water into a thicke body, and after this solution, put in your waxe, into which waxe, some doe use to put a little quantity of the fine powder of charcole searced, and some mingle the blacking only that commeth of the smoke of waxe or rosen therewith.

Hugh Platt, p. 59

Note also that you must fist cast all your curious patternes in yellow wax tempered with the fine powder of smale cole, and wrong through a cloth, and some think it best to put in the smale cole powder when the wax beginneth to coole, and then to stir it well that they may incorporate together. But if you wil cast of in red wax, then you must put in some red ocre insteade of smale cole, to color your wax withall.

Hugh Platt, p. 60

In this manner following you may cast of in wax, and also in waxen moldes, which is a delicate, and necessarie secret for them that can tell how to use the same to the best purpose. You must take three quarters of a pound of rosen (yet some use no rosen at all) and a pound of yellow wax, and an handfull of sifted ashes, melt them altogether, & put in the ashes when the rest is molten...you may cast therein infinitely with a mixture consisting of two partes wax & one parte rosen, but the same bee but of a temperate heat when you pour it in, lest you melt your moldes...

Biringuccio, p. 220 in "The General Procedure and Methods for Making Moulds for Casting Bronze"

The pattern should be a body of a harder material than the thing you wish to mould with and of a substance that is not swollen or disintegrated by moisture. Its archetype may be of marble, bronze, lead, or any other metal, or also of wood, wax, tallow, gypsum, sulphur, or other plaster compositions---in short, of whatever you may have or whatever succeeds best for you, depending on whether the works are large or small and easy or difficult to mould.

Biringuccio, p. 221

Some make it one way and some another; each proceeds as he has learned or as his judgment or ability dictates. Thus for the outer part one man makes his first models of wood, another of clay, others of wax, tallow, or other fusible or combustible materials so as to be able to empty them with heat or by burning them inside the moulds, or even to take them out in pieces.

Biringuccio, p. 228

Anyone who wishes to make the patterns for statues in order to cast them later in bronze, even though he himself is the artificer who made them, must take many things into consideration: first, whether they are

large or small, and whether they are wholly round or only in part; then of what material they are made, for the way that can be followed if they are of wax cannot be used if they are of clay, wood, marble, or even of plaster; like wise he must consider whether or not it has irons inside to support it.

Biringuccio, p. 231

There are also others who make their statues of tow and paste, on an iron, and if the statue is to be clothed, they dress it with a thick or thin canvas covered with glue as painters do with their models to be drawn. Then they even it up with wax and tallow mixed with turpentine and finish it exactly.

Biringuccio, p. 232 - casting in wax in plaster molds

Biringuccio, p. 330

It is also customary to make a plaster capable of being worked easily by hand in making medallion portraits, leafwork, or scenes in bas-relief so that they can be moulded for making them in bronze if you wish. To do this, take two parts of very pure white wax, one of white lead, and a little goat's tallow, and mix them all together. Plasters are also made with various gums, also with wax and Greek pitch or ship's tar. They can be made with any kind of glue or anything that hardens with heat or cold. Once, when I did not have wax for my needs, I melted soap and moulded with it. When I did not have plaster of Paris, I have used sulphur and brick dust, or two parts of Grecian pitch and one of wax.

...wax that had been softened by hand in hot water, but not melting

Cellini, p. 72 "XV About Medals"

Now as to their making. The first thing to be done is to make a model in white wax of the head, the reverse, and whatever there may be, to the exact size and relief of the final work, for we know this was how the ancients did it.

The white model in wax is made as follows: Take a little pure white wax, add to it half the quantity of well-ground white lead, & a very clean turps. It depends on the time of year as to whether you put much or little turps, winter requiring half as much again as summer. With wooden sticks [*fuscelletti*] it is worked on a surface of stone, bone, or black glass, & thereupon---for the ancients and the moderns are at one here---it is made in the gesso just as the cardinals' seals were, of which I erewhile told you. Then you take what are called the *taselli*, or iron implements used for stamping medals, just as in the case of the *pile* and *torselli* you used for stamping coins; only in this case they are made alike and not dissimilar like the latter.

Cellini, p. 100-101

Wax is also used in gilding processes

Cellini, 105

Wax is used in etching copper with aqua fortis

Cellini, 118

Using wax in casting process (casting wax model) -- seasonal importance for temperature

After you have filled it with wax let it thoroughly cool for a whole day---if it be summer, say two days. ...I tell you this, the fact of your having let the wax stand for that day or two according to the season of the year, will cause a slight shrinkage in the wax of about the space of a hore's hair, and so you will find it quite easy to remove this first piece from your figure.

Experiment 3: Tallow in the workshop/laboratory

Like wax, tallow had many functions in the process of casting. Tallow could be used as a medium to create patterns, as a release agent for separating patterns from molds, and in candles to "smoke" the molds prior to casting. We plan to leverage Julianna's previous experience in rendering beef tallow at home to explore the properties of tallow; during the visit to Ubaldo's workshop, the tallow candle Julianna made was "too pure" to properly smoke the molds, so it is possible to attempt another tallow candle that is less refined. When using tallow as a medium to make patterns, the 50/50 tallow-wax mixture was very soft; Biringuccio writes of a recipe that involves mixing in just a small amount of tallow to a wax mixture---this is another possible area of inquiry. Rendering other fats, like pig fat or goat fat, might also be a possibility.

Key recipes:

- 109r "Working in rough with wax"
- 80v "Casters of small tin work"
- Other text examples from outside the manuscript?

Experiment Protocol

Part 1: Rendering fats into tallow

Experiment with the following variables:

- type of meat (beef/pork/other)
- number of times rendered (1/2/3)
- rendering method (dry/wet)

Method A: Slow Cooker (dry method)

1. Remove excess meat
2. Chop fat into small pieces and/or grind it up.
3. Put animal fat in slow cooker.
4. Set to low for 5 hours.
5. Strain melted fat with cheese cloth.
6. Repeat

Method B: Oven (wet method)

1. Remove excess meat
2. Chop fat into small pieces and/or grind it up.
3. Put animal fat in large glass tray with water
4. Cook (what temp) for 5 hours.
5. Strain melted fat with cheese cloth.
6. Repeat.

Part 2: Mixing tallow with wax for molding

Variables:

- other ingredients (see wax section above)
- beeswax, olive oil, butter, turpentine
- proportions of tallow to other ingredients

Part 3: Create a firmer tallow candle for smoking molds

We anticipate this will be related to the type of fat and # of times rendered.

Ingredient list

- Tallow (refined beef fat)
- Tallow (refined pork fat)
- Tallow (animal fat:beeswax)

Recipes from Ms Fr 640

p109r Working in rough with wax

When the **wax** is too hard, **one mixes in some turpentine or a bit of butter, which renders the wax malleable, and cleaner than tallow, which the Italians mix in**, because oftentimes, it is necessary to put the tools into the mouth, [tools] which are better when made from **box wood** or **antler**.

folio 80 (although this may be too complex)

casters tin box molds tallow folio 166

<http://gallica.bnf.fr/ark:/12148/btv1b10500001g/f166.image>

<title id="p080v_a1">Casters of small tin work</title>

<ab id="p080v_b1">They usually cast from solder the things that should not become hollow, because these require fine and soft tin. However, these things would not otherwise lose their coat or become hollow if they are mixed or include glass tin in them, just like they mix a little [glass tin] in the soft tin. They engrave their work on stones of which the sharpening stones or barber's files are made. These are found in great flakes near the mountains, and resemble slate. You can find these [rocks] in three colors: one reddish, that is not as perfect as the others because it does not sustain heat; [another] one is the color of dark slate, and the other is whitish. When they work a relief, first they print it on paper maché, which is one finger thick, to serve as a pattern. After planing the stones and rubbing them together, they use a compass or little iron tools to engrave their figures. They make their moulds with three or four stones, to make a circle or a square with the stones which join perfectly because the stones are of equal size. **Before casting, they rub the mould over with tallow, and it [the mould] absorbs it quickly because it is hot. [Then, having [put] fine powder of quicklime into a cloth, they rub the mould using pounce in beating the linen on top, then blow it a little on top; this prevents bubbles [from forming].?] The main thing is that you make some vents. If the work is big, they do as it is shown [on the picture]. They make a hole in the medal, somewhere where it is least visible, and with a bit they pierce the mould on the side of the medal. And if they want their work to last, they pierce [it] somewhere and fit in a piece of cork. Lead or tin will not damage it.** </ab>

<note id="p080v_c1a">Make sure the pegs of your frame fit in easily so it will open with ease without moving anything else. Your tin box moulds should fit well, and the table should be very flat. </note>

<note id="p080v_c1b">Try to engrave with distilled vinegar.</note>

<note id="p080v_c1c">Try calcinated oyster shells; they are said to be excellent for moulding.</note> [image]

Notes about tallow from Ms Fr 640

folio 13

SNAKES

It is said that if you say to a snake in greek Snake snake, it will run away, as well as if in Greek you will call a swine uon and it will come

CANDLES 13V_b5

Candlesticks are never good candles when it is windy because it always melts however good is the tallow used.

folio 50

tallow fruit for a year

p081r_c1a

Tallow makes things fill with bubbles

The opening of the scabbard is called the mouth and on top of it is the shape of the knife.

p096r_b1c

The stitch which is a leather rim set on the edge of the knife shape is made to stop frogs.

"p096r_b1d"

When the estelles are well flattened, the sword is laid down on them and with some black stone the width of the blade and the length is marked and then with a chisel, the excess is cut, And a plane is used to even properly following the marks.

"p096r_b1e"Then the two estelles are stuck edges to edges and all along only following the knife shape and not elsewhere, And that is to make the scabbard velvet leather hold.

"p096r_b1f"Then the sword is put in the estelles and they fit it in that way perfectly in the scabbard which is all sewed, And they rub what is glued directly on the knife shape with some tallow to run into the scabbard.

Additional Research

Cellini, p. 93: Writing about soldering

I have said nothing about borax, for it stands to reason, as anyone who knows anything about his business is aware, that no soldering can be done without it. If it turn out that, owing to the length of the pieces, some of them are not completely soldered and that fresh solder and borax is needed, I used instead of water to take a bit of tallow candle in order not to have cool the whole of my large piece & on this ointment I put my new solder and borax, and this had the same effect as the water.

Biringuccio, p. 230 (making patterns)

One way is to mould from it piece by piece in plaster of Paris, if it is small and easily handled, and then to cast a wax pattern inside this mould. If it is large and unwieldy it must first be greased with good tallow, pig fat, or oil, or else covered with tin foil or with beaten gold or silver.

Biringuccio, p. 230 (lost wax, inside of the mold)

Then take pure wax or a composition of wax and tallow or of some other things that becomes liquid with heat and apply it all over [the inside] to the thickness in bronze that you wish the statue to be.

Biringuccio, p. 233

When they wish to make the moulds for casting in bronze they make them [the patterns] of potter's clay. When they are freshly made, they grease them well with pig fat or make a surface of tallow, or, if they wish, they could cover them with tin foil.

Biringuccio, p. 327 - smoking molds

Dry and bake them well and then put them in their places in the spaces in the frames as their marks will show you. Then smoke them well with the flame of a tallow candle or with that of a little turpentine.

Biringuccio, p. 328 - molding with wet sand ("green sand")

By pounding all these [ingredients, sand] are incorporated and mixed together well. Then take urine or wine and moisten it, and mould whatever you wish with the moistened material in frames or wooden boxes...Then cover them with soot as usual, with the smoke of turpentine or a tallow candle.

Burke, Peter. Ed. Economy and Society in Early Modern Europe: Essays from Annales. pp. 101-102 catalogues changes in the price of cattle, meat and dairy products in years 1551-1600, then 1601 to 1650, noting 143% and then 17% increase in tallow prices. [note: economic changes regarding price of tallow in late 19th/early 20th century lead to development of sls - not from this book]

properties (an interesting link describing properties and mixtures of tallow including one with beeswax and paraffin) note: paraffin not processed until 1830.

http://www.culinart.net/printcatalog/how_to_make_tallow_sculptures.pdf

Preliminary Schedule

Week 1: Oct. 27-Nov. 2

Priorities:

- **Finish drafting experiment protocol, due 10/31**
- Textual research
- ~~Finish field notes~~
- Begin sourcing materials; contacted butcher for animal fats,
- ~~Set dates for working days in NJ or in lab;~~ **Nov. 16th childcare reserved!**

Julianna

- ~~Add pics from today, reorganize pictures in Wiki~~
- ~~Kiln contacts~~ **sent text**
- ~~find Piemontese, start searching~~ **(Luto e cimatura da fonderia tra i segreti alchemici di Alessio Piemontese.)**

Emogene

- ~~Add video to field notes and author~~
- ~~kiln contacts~~
- ~~Hugh Platt~~
- Start to look at French transcriptions (underway)

Week 2: Nov. 3-9

(NOTE: No Class Nov. 3, 4)

Priorities:

- Source all materials
- Begin preliminary work for casting
- Wax experiments in lab on Friday?
- Calcinate oyster shells (Work this out with Donna)

Notes:

- Check to see if we will have enough box molds?
- Sand: Home Depot
- Wine: Trader Joe's ([Cabernet Sauvignon](#) or Sauvignon Blanc)
- Elm Root: Amazon
- Tripoli — do we need this?
- Pattern to mold: large coin?
- Tammy cloth: restaurant supply store?
- Eggs

Week 3: Nov. 10-16

Priorities:

- Make sand molds (in NJ or lab)
- Finish wax experiments (in lab)
 - Butter
 - Turpentine
 - Resin?

November 16 - Lab day in NJ (fingers crossed for good weather!)

Week 4: Nov. 17-23

Priorities:

- Finish casting, write up lab notes
- Additional experiments/research

Week 5: Nov. 24-30

THANKSGIVING (Emogene is out of town Wed-Sun)

Writing up lab notes, writing up annotations

Week 6: Dec. 1-5

Finish annotations; submit final draft