

Ms Fr 640 Experiments

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Craft & Science: Object Making in Early Modern Europe

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Experiment A:

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.

Key recipes:

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

Other related recipes:

- 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"

step 1. make list of ingredients

step 2. transcribe into modern list of instructions / steps

step 3. formulate initial investigative questions

Plan: begin with lead free version of recipe 85v and compare it with 84v and 68r (in terms of the binding materials). **need to find non-egg white recipe as comparison point as well

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 . . .

Steps:

1. order ingredients
2. choose objects to model (something that has the potential to differentiate between casts/molds)
3. iterate: create sand-molds

Ingredient List

- Wine (what kind of wine would be best?)
- Elm root (as per Joel's notes, we could also use inner bark, available via Amazon)
- Eggs
- Salt water
- Burnt oysters (Donna can get oyster shells; doing research into whether we can calcinate them in a kiln nearby)
- Tammy cloth (wool?)
- Sand of Toulouse (what should we use instead?)

Experiment Protocol

Experiment 85v "Sand Experiments"

1. Cook Sand of Toulouse two times in a skillet.
2. Pass cooked sand through a fine tammy cloth (wool - discussion) like the double seive the apothecaries use (opportunity for historical research).
3. Do not grind on the porphyry.
4. [create infusion with elm root) ingredients?
5. Moisten sand in infusion with elm root
6. Mold object (Large piece of portrait of Jesus used in manuscript) for ideal thickness of coin of forty sols.
7. 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 iwth no wind
- if mold is thin add a card
- cast in the place where your medal is least thick & where the relief is lowest.</ab>

Experiment 84v "Sand, for the most excellent lead of all, for large and small reliefs</title>

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 (time period?)

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}

add'l 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

1 Four types of sand a. **chalk** b. crushed **glass** c. **tripoli** and d. burnt **linen**,

- A. 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**.
- B. 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**.

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

-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.

-

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.

Notes on key recipes 69r, 84v, 85v

folio 69r (lots of promise!)

hardly used sand

hot copper matter - lead for large works not necessary for small (yes!)

bulls' feet
pure wine
elm tree roots
burned linen
olive oil
beaten egg white
latten
box frames
molded tripoli/Burnt felt /salt ammoniac (something fatty to act like glue)
according to (<http://www.ganoksin.com/borisat/nenam/buffing-material.htm>) tripoli is a polishing compound;
it is available on Amazon.com <http://www.amazon.com/dp/B001Q8WRLK/ref=nosim?tag=finishingcominc>

84v - "Eau Magistra" *Could be interesting to try these different binders with the same sand, observe differences

different options for magistra:

Salt water (not good, because releases gas when heated and causes bubbles)
wine boiled with elm root
- what kind of wine? where to source elm root?
try burnt oysters [boil with wine instead of elm root?]

85v - "Sand Experiments"

***example of elm root infusion working very well with the sand of Toulouse -- might be interesting to try this one?**

sand of Toulouse

"well recooked two times in a skillet"

passed through a fine tammy cloth (like a double sieve that apothecaries use)

moistened with an infusion of elm root

it worked well "without having to tire myself"

molded cleanly on one side of the relief and on the other concave

thickness: coin of forty sols

cast very hot

Noted: sand from a mine is best, receives all metal, it will bubble when used hot, not the best for large works

Key Recipes (text from Manuscript)

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>

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>

Notes on related recipes

49r sand for lead casting : problem: lead!

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 make the tin ticker.
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"

***lets not work with crushed lead, yeah?**

crush white led, 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

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>

Research (outside of Ms Fr 640)

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 magistry 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 B:

Wax as medium

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.

Key Recipes:

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

Ingredient List

- Wax
- Turpentine
- Butter
- Resin (need to determine what this is and/or which resin to use)

Notes

- Some recipes specify white lead as a mix-in, but we will not be experimenting with that.

Key Recipes from Ms Fr 640

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>

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 &

Additional Research

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 think to be done is to make a model in white wax of the ehad, 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 coold 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 C:

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?

Ingredient list:

- Tallow (refined beef fat)

Experiment Protocol

[Coming soon!]

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/btv1b10500001q/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 in other Manuscript recipes

folio 13

<title id="p013v_a4"> SNAKES </title>

<ab id="p013v_b4"> 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 </ab>

<title id="p013v_a5"> CANDLES </title>

<ab id="p013v_b5"> [Candlesticks are never good candles when it is windy because it always melts however good is the tallow used.](#) </ab>

tallow fruit for a year
folio 50

<note id="p081r_c1a">Tallow makes things fill with bubbles</note>

The opening of the scabbard is called the mouth and on top of it is the shape of the knife. </ab>

<ab id="p096r_b1c"> The stitch which is a leather rim set on the edge of the knife shape is made to stop frogs. </ab>

<ab id="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. </ab>

<ab id="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. </ab>

<ab id="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. </ab>

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.