Michelle Lee, with Pamela H. Smith.

Fol. 84r

“*Eau Magistra*” on fol. 84r provides instructions to make a liquid binder for casting sand. Variations of Eau Magistra in BnF. Ms. Fr. 640 call for ingredients such as elm root, wine (or vinegar),[[1]](#footnote-0) and “burnt oysters,” likely a reference to their calcined shells.[[2]](#footnote-1) The Eau Magistra on fol. 84r calls for finely ground and dissolved sandever or rock salt, moistened in tartar oil. Our investigation of this recipe helped to illuminate the meaning of the categories “fat” and “lean” that scholars have identified in other early modern writings as forming an important aspect of the understanding of materials in early modern Europe.[[3]](#footnote-2) Fat and lean appear to have been an important binary paradigm, perhaps having explanatory functions similar to the Aristotelian categories of wet/dry and hot/cold. In any case, our investigation of this recipe revealed an unexpected sensory aspect to the property of “fattiness.”

It is not clear why some binder recipes in BnF. Ms. Fr. 640 are titled magistry while other binders, seemingly identical to them in function, are not denoted as such. For example, on fol. 85v the author-practitioner suggests that egg whites be beaten together with earth to make a casting sand, as the egg whites should help make the impression “come clean and sets and stabilizes the material.” Though the distinction between a magistry and a binder is not articulated in this manuscript, other contemporary sources define magistry as a liquid concoction that contains a wine or vinegar combined with a “salt.”

Nonetheless, the recipes for “magistry” and other binders in BnF. Ms. Fr. 640 share some general similarities: to help bind the dry casting material together in such a way that it allows a crisp impression of the pattern, and also to enable the sand to endure through more than one casting. The dry material, or “sand,” is often described as “dry and lean,” thus requiring a wet or sometimes “fatty” substance to bind it together.[[4]](#footnote-3) For example, in describing sand made from ox hoof bones in fol. 84v, the author-practitioner writes that “on its own it makes a clean mold. But because on its own it is very dry and lean, it demands to be well wetted and humidified with a thick broth [made from] elm root.” The author-practitioner writes on fol. 85r that “then I knew that sands used to mold big reliefs 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…. It can take as many firings as you want because it is as hard as glass.” A little further in the recipe he goes on to say that a “fat metal needs a lean sand,” using the same terminology to define the optimal combinations of metals and casting sands. This points to the importance of properties of dry, wet, lean and fat for understanding the properties of casting sands. Although the terms dry and wet used in sand casting recipes may seem to refer to the four humors, our process of reconstructing fol. 84r shows that both dry and wet/moist are used in this manuscript to support the terms lean and fatty.

In order to test the Eau Magistra recipe on folio 84r, we first sought out sandever (also commonly referred to as glass gall), as the recipe stipulates. We believed it would be especially interesting because another author understood it to be a “fatty substance floating on glass when it is red-hot in the furnace, and which being cold is as hard as stone, yet brittle, and easily broken.” As the same French-English dictionary of 1611 continues, when separated from the glass and cooled to a solid, the glass gall “forms a white crumbly mass, sometimes quite white and at other times brown and fouled, and strongly saline, but not very uniform in its composition: being sometimes merely salt, often very bitter, probably as common salt or sulphate of potash predominates.”[[5]](#footnote-4) It would appear that characteristic properties of sandever were its bitterness and saltiness. A nineteenth-century source defines sandever as composed of “all those salts contained in common alkalis that readily melt at somewhat less than a glass-making heat, and are either naturally considerably volatile, or have little if any affinity for silex, and do not unite in the composition of glass, but, being superficially lighter, rise to the top.” Apparently this byproduct of glassmaking was “generally skimmed off with iron ladles, and sold to metal refiners as a powerful flux.”[[6]](#footnote-5)

In the sixteenth and seventeenth centuries, sandever was also used as an ingredient in *crocus metallorum* in addition to antimony and saltpeter for an alchemical recipe; as a pesticide for garden walks, where it “destroys both weeds and vermin;” and seems even to have been used in France for culinary purposes, “to powder their meat, and to eat, instead of common salt.”[[7]](#footnote-6) In general, sandever had multiple uses, as De Blancourt writes:

this salt which the French call (Suin de Verre) Sandever is useful for several purposes, and in several Chymical Operations. It has besides some other Uses and Virtues that are not known, even to very few of the Learned; I could tell some very surprising and wonderful uses of it. But this may serve to whet the Industry of, and excite the Curious to further Enquiries.[[8]](#footnote-7)

Sandever as “glass gall” is now an obsolete material, impossible to obtain in modern glass making due to standardization and quality control of ingredients which ensure that byproducts such as sandever do not result from production. A toxic product called “sandever” is still produced in glass recycling. However it is now defined as the contaminants—such as asbestos—that result from the recycling of waste glass and which must be separated from the glass mass in the furnace in order to produce useable glass.[[9]](#footnote-8)

Thus, with no feasible way to obtain sandever for the magistry experiment, we decided instead to follow the recipe’s suggestion to use rock salt in place of sandever. It seems that sandever and rock salt are interchangeable, both in this recipe and for an eighteenth-century author who suggested in *Van Nostrand’s Engineering Magazine* that for “pig or sow iron, videlicet, the ashes of wood and other vegetables, all kinds of glass and sandever, common salt and rock salt” be mixed into the iron mass to purify it.[[10]](#footnote-9) Biringuccio also categorized rock salt in a family of salts that include potash (an important ingredient for glass making) and sal ammoniac.[[11]](#footnote-10)

In BnF. Ms. Fr. 640, sandever and rock salt are suggested for use as dry binding materials in different recipes. For example, the recipe titled “Sand from a Toulousain Mine” on fol.84r instructs the reader to use sandever as an ingredient in the sand itself: the sand, mined deep from the earth, “is excellent on its own, but to make it sustain multiple castings, I mix it with pulverized and moistened sandever, which hardens it, holds together well with it, and enables as many castings as you like.” Similarly, the recipe on fol. 89r calls for mixing together pulverized ox bone and rock salt then moistening them. As our investigation of this recipe showed, the combined ox bone and rock-salt molds produced an unexpectedly hard mold that was firmly bound together and remained intact enough to be cast more than once.

The Eau Magistra recipe on 84r specified that the resulting mold should be strong enough to withstand several castings. In order to produce the binder, we ground rock salt, mixed it with oil of tartar,[[12]](#footnote-11) then mixed it with a dry sand made from reground molds of previous castings. The main ingredients of these reground molds were pulverized brick and plaster (also containing very small amounts of ammonium chloride solution that had been used as a binder). In combination with the Eau Magistra of fol. 84r, this recipe produced a two-piece mold that, despite some crumbling and partial disintegration, remained intact enough for a second clean casting.[[13]](#footnote-12)

[[Figure 1]](https://drive.google.com/open?id=0BwJi-u8sfkVDVG9HdkVEQjAxZ3c)

[[Figure 2]](https://drive.google.com/open?id=0BwJi-u8sfkVDc090QVdxcmNOeEE)

[[Figure 3]](https://drive.google.com/open?id=0BwJi-u8sfkVDenB0Z091bXZPaXc)

[[Figure 4]](https://drive.google.com/open?id=0BwJi-u8sfkVDQk5Vek5VbmZRRUE)

Although we cannot decisively conclude from this single trial[[14]](#footnote-13) that the magistry of fol. 84r was responsible for the success of this mold, this trial did shed light on the meaning of “fat” and “lean.”

Significantly, the two recipes for mold materials that specify rock salt (or sandever) do not rely upon a wet binder such as elm root infusions and egg whites.[[15]](#footnote-14) Instead, binding action occurs when the salt mixture is moistened. Apparently, the author-practitioner understands this to be due to the “fatty” properties of rock salt (and, by extension, sandever). The fact that sandever and salt are dry materials that also successfully do the work of binders, points to their versatility as materials that apparently possess both a lean and fatty state.

How can salt be understood as “fatty”? In reconstructions of 84r and 89r, we struggled with the concepts of fat and lean, as they did not make sense within a modern understanding of salts, much less of “fat.” We began to understand the meaning of fat and lean, however, when we ground pink Himalayan rock salt for both the Eau Magistra of 84r and ox bone/rock salt sand of fol. 89r.

[[Figure 5]](https://drive.google.com/open?id=0BwJi-u8sfkVDS2x4TGltRV8xU28)

[[Figure 5a]](https://drive.google.com/open?id=0BwJi-u8sfkVDenlmbGhDQmFVMEE)

After grinding the salt in rock mortars as finely as possible and storing it in an airtight jar, we returned to the lab a few days later and found that the texture of the salt was very “sticky.” The salt had transformed from a fine, dry powder that poured freely from an outstretched hand to a sticky substance, in which the particles clearly adhered to each other, creating an unexpected sensation of resistance when running one’s fingers along the surface. The well-known material of salt unexpectedly possessed a completely different set of properties, and we *felt* the “fattiness” of the rock salt, which suddenly afforded a new workability. This allowed us to apprehend the place of “fatty” in the “science” of the author-practitioner, and it allowed us a rather different perspective than is given by our modern classification of salt as sodium chloride.

We thus concluded that these terms, fat and lean, rely very directly upon sensory interaction with materials. In the early modern period, the body itself was a tool in experimentation by which practitioners came to know the properties of materials and the possibilities they afforded or precluded.[[16]](#footnote-15) Our modern knowing of this material through its chemical composition differs from the early modern practitioner’s, which was a deeper, more intimate knowing through the bodily senses. This intimacy between practitioner and material was so close that it often was connected to–and could cost them–their health. Pamela Smith writes that “the body…was also implicated in the work: the bodies of metalworkers and the very matter upon which they labored interpenetrated each other: bad breath could prevent the adhesion of metal gilding, and, conversely, metal fumes were known to shorten the lives of metalworkers.”[[17]](#footnote-16) Sensory testing of materials and ingesting food for medicinal ends were not separated by a great distance—both involved the same types of substances and qualities, including cold, hot, wet, dry, fat, and lean, and both contributed to the intimate connection between practitioner and materials, which helped reinforce an understanding of materials in the language of qualities and properties that could be apprehended by the senses.

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Unknown, “Sandiver, or Glass Gall.” *Glass, Brick, Pottery and Glass Journal* 6 (1879): 77.

1. “Eau Magistra” in BnF. Ms. Fr. 640, fol.87v. [↑](#footnote-ref-0)
2. “Eau Magistra” in BnF. Ms. Fr. 640, fol.84v. [↑](#footnote-ref-1)
3. Pamela H. Smith, “The matter of ideas in the working of metals in early modern Europe,” in *The Matter of Art: Materials, Practices, Cultural Logics, c. 1250-1750*, ed. Christy Anderson, Anne Dunlop, Pamela H. Smith (Manchester: Manchester University Press, 2014). [↑](#footnote-ref-2)
4. Notable instances of “lean and fatty” in the manuscript include but are not limited to: p089r, p088v, p086r, p077r, p069v, p069r, p159r. p085r, p142v, p053r, and p165r. [↑](#footnote-ref-3)
5. Randle Cotgrave. *Dictionarie of the French and English Tongues.* (London: Printed by Adam Islip Anno, 1611), s.v. “sandever.” [↑](#footnote-ref-4)
6. Unknown, “Sandiver or Glass-Gall” in *Brick, Pottery and Glass Journal* 6 (1879): 77. [↑](#footnote-ref-5)
7. Antonio Neri, *The art of glass, wherein are shown the wayes to make and colour glass, pastes, enamels, lakes, and other* curiosities, trans. Christopher Merret (London: Printed by A.W. for O. Pulleyn, 1662), 277. [↑](#footnote-ref-6)
8. Jean Haudicquer de Blancourt, *The art of glass, showing how to make all sorts of glass, crystal, & enamel ... Illustrated with proper sculptures* (London: Printed for D. Brown. T. Bennett, [etc., etc.], 1699), 58. [↑](#footnote-ref-7)
9. Glen Cook (Senior Research Associate at the Corning Glass Museum), email message to D. Mellon titled “RE: query: glass gall,” 11 November 2014. [↑](#footnote-ref-8)
10. Josh Payne. “Decarburization and Purification by Means of Cinder, Ashes, Salt, Silex, Potash and Clay”, *Van Nostrand’s Engineering Magazine* 1 (1728): 194. [↑](#footnote-ref-9)
11. Vannoccio Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, trans. Cyril Stanley and Martha Teach Gnudi (New York: Dover Publications, 1990), 112. [↑](#footnote-ref-10)
12. Oil of tartar is distinct from cream of tartar, which is white crystallized potassium bitartrate found on the sides of wine barrels. As defined by Newton, oil (sometimes called salt) of tartar is potassium carbonate, created when potassium bitartrate is calcined. [↑](#footnote-ref-11)
13. An unknown variable caused a yellowish-gold coloring to the medal cast in the mold made with the Eau Magistra of fol. 84r. Although we initially believed it to be caused by the rock salt, the medals cast in our ox bone and rock salt molds (fol. 89r) did not result in this color, even though these molds contained a much higher ratio of salt than the Eau Magistramold. Other medals previously cast in the same brick/plaster sand also displayed the same sort of discoloration to a lesser extent, but at the time of writing, it is hard to positively identify what caused the coloring. [↑](#footnote-ref-12)
14. We unfortunately could not conduct multiple trials for this project as planned, and we urge anyone interested in performing this experiment to conduct multiple trials, especially with clean sand that has not been employed in casting before and thus has not had other binders mixed into it. [↑](#footnote-ref-13)
15. Recipes calling for egg whites and elm root as binders include, but are not limited to, the following: p084v, p082r, p083r, p085v, p087v, p085r, p086r, p087v, p069v, and p072r. For further discussion of these two ingredients used as binders, please refer to AnnotationFall2014\_CataldoVisco\_binders. [↑](#footnote-ref-14)
16. Smith, 44. [↑](#footnote-ref-15)
17. Ibid. [↑](#footnote-ref-16)