Calcined Oysters: Investigating Oysters, Calcination and Marginalia

**Bnf. Ms. Fr. 640, folio 84v, *“Eau Magistra”***

Aulcuns trouvent que l’eau sel n’est pas bonne, pource que le sel pette au foeu, & par consequent doibt faire soufler. Il n’y a que le vin bouilly avecq racine d’orme.

Le charbon pour poncer faict bien despouiller, mays on trouve que celuy de saule faict soufler; celuy de chaisne ou fayan faict bien sans soufler.

[Note] Essaye huitres bruslées.[[1]](#footnote-0)

**Bnf. Ms. Fr. 640, folio 84v, *“Eau Magistra”***

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.

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.

[Note] Try burned oysters.[[2]](#footnote-1)

The recipe in Bnf Ms Fr 640, page 84, titled “Eau Magistra,” briefly describes a process of making a binding agent from elm root and wine. It includes a marginal note next to the main body of the texts that reads, in French, “Try burnt oysters [Essaye huitres bruslées]”[[3]](#footnote-2) The note is embedded within two sections of the text: this recipe on *eau magistra,[[4]](#footnote-3)* and a collection of marginal notes on sand for sand casting that can be read together in the left margin of the text as an addition to the previous experiment on the page, “Sand [Sable].”[[5]](#footnote-4) The reader’s perception of the location within the text directly determines the interpretation of the recipe. If perceived as belonging to the other marginalia in a vertical column it is located within a context of different types of sand. If perceived horizontally with the main body of the text, it is located within a context of Eau Magistra options as binders.[[6]](#footnote-5)

The question is further compounded by the fact that the only two other references to oysters present in Bnf Ms Fr 640, also both appear as marginal notes. A note on page 80v in the recipe “Casters of small tin work” reads, “Try calcinated [*calcinèe*] oyster shells; they are said to be excellent for moulding.”[[7]](#footnote-6) On page 49r next to a recipe titled “Lead casting,” another note mentions oyster shell, though the meaning is less clear: “Poncet. They cast by soldering [using what] the glass-makers use. Lump [of metal] of… Calcinated [*calcinèe*] oyster shell.”[[8]](#footnote-7) These additive suggestions raise issues concerning whether their peripheral placement is significant. What is their relationship to the text?Should we consider these in the tradition of Michael Camille’s work which has called attention to both the value of marginalia and the relationship between the author and reader of a text?[[9]](#footnote-8) There is a long tradition of readers’ interacting with texts via note, annotations, and images in marginalia varying in function from directing attention to particular sections, to exegesis to engaging in dialogue with the author.[[10]](#footnote-9) However, questions of authority and mediation are further complicated in the marginalia of this text where the author is both reader and writer. In this case, the marginal writing may reflect a second or later iteration of his experiments or a reflection on his experience. Did the manuscript author actually try to work with oyster shells or did he observe someone else perform this technique?[[11]](#footnote-10) If they are untested suggestions, should they be considered asan invitation to experiment? If so, this implicitly raises the issue of the manuscript’s intended audience. Furthermore, this line of inquiry may help shed light on the larger mystery of the author’s identity and profession.

To determine the best interpretation of the recipe, we decided to reconstruct it using both readings. [fig. 1] Two of the notes refer to calcination (“*calcinées”*), while the third note speaks of burning (“*bruslèes*”). In order to determine whether these were separate processes, we needed to find out what exactly calcination was. What preparation was needed for the oyster shells? How should the shells be heated, at what temperature, and for how long? What type of transformation or transition should the oysters undergo? On page 100r of the manuscript in “Vitrified saltpeter,” the author describes calcining other stones, suggesting that different heat sources and processes can lead to different levels of purification.[[12]](#footnote-11) In “Grafting” on 91r, a marginal note reads, “When the lead gets too hot, it calcinates.”[[13]](#footnote-12) On page 83r in a recipe about sand, the author directs the reader to “[Take] finely crushed slate and pumice stone mixed together. Calcinate them three times in a covered and sealed pot in strong fire, and each time dilute them with urine.”[[14]](#footnote-13) Other materials that are listed as calcined include stone, glass, bone, and shells. A recipe on 92v about river tellins and mussel shells tells us that “The long shells that can be found in rivers of fresh water, being calcinated, make a white and very fine [impalpable] sand which moulds very clean.”[[15]](#footnote-14) In Cotgrave’s French dictionary, four entries refer to calcination. *Calciné* is defined as “calcinated, turned into dust, reduced by fire, unto pouder;” the verb *calciner* means “to calcinate, burne to dust, reduce unto pouder, by fire, any mettal or minerall.[[16]](#footnote-15) It seems that the calcined materials were often used in sand casting, but little information on the actual process of calcination---besides applying heat or fire---can be found in the manuscript or other early modern sources.

In modern scientific scholarship, oyster shells have been the subject of study due to both the problem of shells in landfills and their potential antifungal properties. Raw oyster shells principally consist of calcium carbonate (CaCO3), while calcined oyster shells are transformed into calcium oxide (CaO).[[17]](#footnote-16) The “optimal temperatures for calcination” in one modern calcination experiment was “900°-950°C” (1472°-1562°F).[[18]](#footnote-17) Another experiment exposed oyster shells to 1050°C (1922°F) and reported that the resultant powder had “turned completely into CaO after the treatment,” and that in order to produce this result, the “shell was washed several times and dried in an oven at 60°C (140°F) for twenty-four hours.”[[19]](#footnote-18)

To prepare our oyster shells, we boiled them in water and cleaned them by removing any remaining adductor mussel.[[20]](#footnote-19) We then removed the barnacles and attached shells with hammers and pliers. After the shells had been rinsed under water several times, we contained the shells in a large towel and broke them into smaller pieces with a hammer. We attempted the calcination several times: the first time, we used a small jewelry kiln heated to 1500°F, exposing just a few pieces of shell to the heat.[[21]](#footnote-20) After ten minutes, the shells had turned to white, slippery ash.[[22]](#footnote-21) The next several attempts at calcination were done with a much larger ceramic kiln.[[23]](#footnote-22) After several attempts,[[24]](#footnote-23)the shells finally calcined after heating them over a 9-hour period, in which they reached a temperature of 1800°F for an hour. The resulting powder was smooth and silky, not unlike talcum powder. This was the material we used to conduct our two experiments: in the first, we interpreted the oyster ash as an ingredient in a binding agent used to moisten a sand in a sand-casting process; in the second, we used the oyster ash as the sand itself.

In the first process, the calcined-oyster-wine decoction, we wanted to examine the performance of the decoction as a binder in comparison to the other binders tested.[[25]](#footnote-24) Modelled after the procedure for creating the elm root infusion in 84v “Eau Magistra,” we boiled two teaspoons of calcined oyster shells with one cup of inexpensive Cabernet Sauvignon on a hot plate. The powder upon contact with the wine immediately turned a teal green, then became briefly a clear emerald green, which then transitioned into a dull, opaque olive green---this was likely an oxidation reaction that produced these dramatic color changes. [fig. 2, fig. 3, fig. 4] We poured the mixture into an airtight glass container. After a few minutes, the mixture separated into a watery brown liquid on top and a muddy green mixture on the bottom. A half cup of this emulsion was then added to two cups of sifted sand and used for sand casting.

In preparing our sand for this casting, we pulverized and then sifted pre-used molds made of a 1:1 mixture of brick dust and plaster. After stirring the decoction to reconstitute the suspension of the ash particles in the wine, we gradually added approximately half a cup total of calcined oyster wine infusion to two cups of sifted sand. It was easy to achieve the desired texture for sand casting; the mixture would hold together when squeezed into the palm of the hand, but dissolved with the pressure of a fingertip. [fig. 5] We built the mold around a plaster pattern dusted with charcoal, and the resulting pattern was crisp and clear.[[26]](#footnote-25) [fig. 6] A day later, the mold was dry and ready for the metal pour. We poured molten tin into the mold and the resulting cast object was extremely fine in its detail---indeed, the best cast accomplished in our research. [fig. 7] The mold, however, did not survive; it broke apart and was only able to be cast once. [fig. 8]

In the second process, we used the sifted calcined oysters as the sand. Two cups of calcined oysters were mixed with the whipped egg whites of two eggs. This did not seem to moisten the oyster shell "sand" sufficiently; the sand seemed to absorb the moisture much more quickly that the brick dust molds---it would not "clump" enough to to be a useful packed mold material. Out of eggs in the lab, we used some of the remaining elm root emulsion we had on hand.[[27]](#footnote-26) We kept adding this until the mixture would "clump", but then the mixture had the qualities of being wet and dry at the same time; the calcined oyster shells seemed "dry", but when squeezed, water would come out. It was as if they were both absorbing and repelling the water. [fig. 9, fig. 10]

We made our box mold according to the sand-casting process described in Bnf. Ms. Fr. 640 on folio 118v, building the wet sand around a plaster pattern and leaving the mold to dry.[[28]](#footnote-27) We placed extra sand in a plastic cup. Unexpectedly, when we checked on our mold several days later, the sand had expanded out of the frame into a useless, dry pile. An exothermic reaction had occurred; the lime present in the CaO reacted with the moisture, which resulted in a mold that “puffed up” and disintegrated. We could not use it for a metal pour. [fig. 11]

Looking back at the successful sand-casting in the first experiment, it is possible that the fine oyster ash might have mixed with the brick dust and plaster of pulverized molds from previous castings to produce a finer sand that resulted in a much finer impression.[[29]](#footnote-28) The manuscript does not say explicitly to mix the oyster shells with another sand, but this is how the successful cast worked; the oxidation reaction that produced the brilliant green color in the wine might hold the key to the success of the experiment. The calcined oyster shells had already been exposed to moisture, so they had already undergone a reaction. Meanwhile, the wine still acted as a binding agent in the mold.[[30]](#footnote-29) It would be interesting to see if the oyster ash that produced the exothermic reaction could be used again as a sand in a box mold; perhaps this sand would be capable of hardening and maintaining an impression in which to cast metal. Further experimentation with oyster ash is certainly worth pursuing further.

A hands-on approach in the laboratory paired with textual research enabled us to explore in what ways the oyster marginalia might illuminate more details about the construction of the text and the author’s role as both writer and reader of his own text. Our findings suggest that the author knew or speculated about the promising properties of oyster shells, but he had not yet perfected a protocol for their successful use. The presence of distancing language, phrases such as “try” or “it is said to be…” appear to indicate that the author was less personally familiar with the use of oyster shells as a material. Perhaps he heard it suggested or observed them in another context. But unlike other more confidently phrased imperatives---in “Casting in a box mold” on folio 118v, for example, the author writes in first person---he offers no tips, warnings, or reminders that would suggest a hands-on-familiarity with the processes. Perhaps these notes were untested by the author and instead intended as suggestions for future experiments.

Emogene Cataldo, Julianna Van Visco

**List of illustrations**

Figure 1: Detail of Bnf. Ms. Fr. 640, folio 84v. Note the placement of the note “Essaye huitres bruslées,” which is the last marginal note on the right side of the folio.

Figure 2: The white calcined oyster powder turned green immediately upon contact with the red wine.

Figure 3: Once on the hot plate, the mixture turned a brilliant emerald green, and then a lighter, more opaque green.

Figure 4: Once the mixture turned a dull, olive green, it did not change. After being poured into a glass container, the mixture separated into a green substance and a red-brown liquid.

Figure 5: Applying the “squeeze test” mentioned in 118v, “Molding in a box frame.” The mixture can be squeezed together, but readily falls apart after applying slight pressure with a fingertip.

Figure 6: The fine, detailed impression of the mold.

Figure 7: The resulting tin cast from the mold; the black substance is from smoking the mold with a flame before pouring the molten tin.

Figure 8: After one cast, the edges around the mold fell apart, making it unable to take a second cast.

Figure 9: Notice the moisture on the table after packing the calcined oyster sand mold.

Figure 10: While other sands might fall in the middle of these scales, the calcined oyster shell sand was dry, prone to crumbling, yet both absorbed and repelled moisture.

Figure 11: The oyster shell mold produced an exothermic reaction, resulting in the exansion of the sand, which was completely dry and produced no salvageable impression.

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1. Marc Smith, Professor of Paleography, École des chartes, has noted that this marginal note does not necessarily belong to the “Eau Magistra” entry, but rather part of the preceding entry titled “Sand” [*“Sable”*]. [↑](#footnote-ref-0)
2. See Note 1. [↑](#footnote-ref-1)
3. Bnf Ms Fr 640, 84v, “Eau Magistra.” [↑](#footnote-ref-2)
4. See Cataldo and Visco, “Eau Magistra”: Investigating Binders for Sand-casting.” [↑](#footnote-ref-3)
5. Bnf Ms Fr 640, 84v, “Sand.” [↑](#footnote-ref-4)
6. See Cataldo and Visco Field Notes, 14-15 October 2014, “Sand casting,” for further details on sand-casting recipes. [↑](#footnote-ref-5)
7. Bnf Ms Fr 640, 80v, “Casters of small tin work” [↑](#footnote-ref-6)
8. Bnf Ms Fr 640, 49r, “Lead casting” [↑](#footnote-ref-7)
9. See Michael Camille, *Image on the edge: the margins of medieval art* (Cambridge, MA: Harvard University Press, 1992). [↑](#footnote-ref-8)
10. For more on reading as a visual mode see William H. Sherman, *Used Books: Marking Readers in Renaissance England* (Philadelphia, PA: University of Pennsylvania Press, 2009). [↑](#footnote-ref-9)
11. For an Early Modern perspective on observing workshop practices, see T.L. Davis, *The Life of Denis Zachaire: An account of an alchemist’s life in the sixteenth century* (Edmonds, WA: The Alchemical Press, 1993). [↑](#footnote-ref-10)
12. Bnf. Ms. Fr. 640, 100r, “Vitrified saltpeter.” [↑](#footnote-ref-11)
13. Bnf. Ms. Fr. 640, 91r, “Grafting”: “Quand le plomb chaufe trop, il se calcine.” Marginal note. [↑](#footnote-ref-12)
14. Bnf. Ms. Fr. 640, 83r, “Other sand”: “Charbon de sarment & terre argille bien tamisée tant d’un que d’aultre, & le joindre ensemble avecq glaire d’oeuf bien battue, puys le faire calciner dans le four, & pour en user le destremper en vinaigre.” [↑](#footnote-ref-13)
15. Bnf Ms Fr 640, 92v, “Sand of river tellins and mussels”: “Les coquilles longues qui se trouvent aulx rivieres d’eau doulce, estant calcinées, font un sable blanc impalpable qui moule fort net.” [↑](#footnote-ref-14)
16. See Randle Cotgrave, *A Dictionary of the French and English Tongues* (London: Adam Islip, 1611), s.v.”c*alcination*,” “*calcinatoire*,” “*calciné,*” and “*calciner*.” [↑](#footnote-ref-15)
17. CaO (s) + H2O (l) Ca(OH)2 (aq) (ΔHr = −63.7 kJ/mol of CaO). For more on the chemistry of slaked lime, see Bassam Z. Shakhashiri, “Lime: Calcium Oxide CaO,” in “*Science is Fun*,” University of Wisconsin, Madison. Accessed 19 December 2014, <http://scifun.chem.wisc.edu/chemweek/PDF/LIME\_CalciumOxide.pdf> [↑](#footnote-ref-16)
18. See Jong-Hyeon Jung, Kyun-Seun Yoo, Hyun-Gyu Kim, Hyung-Keum Lee, “Reuse of waste oyster shells as a SO2/NOx Removal Absorbent,” *Journal of Industrial and Engineering Chemistry*, 13.4 (2007) 512-517. doi. [↑](#footnote-ref-17)
19. Ronge Xing, Yukun Qin, Xiaohong Guan, Song Liu, Huahua Yu, Pengcheng Li, “Comparison of antifungal activities of scallop shell,oyster shell and their pyrolyzed products”, *Egyptian Journal of Aquatic Research* 39 (2013) : 83-90.I Available online 5 September 2013. *doi*: 10.1016/j.ejar.2013.07.003. [↑](#footnote-ref-18)
20. Many thanks and sincerest gratitude to Donna Bilak, Ph.D., for procuring these shells from the Grand Central Oyster Bar, boiling them, and helping us remove barnacles and prepare them for calcination. [↑](#footnote-ref-19)
21. We were able to do this thanks to Jeanette Caines, who let us use her small kiln at the Jewelry Arts Institute in midtown Manhattan and was an invaluable resource for guiding this reconstruction. [↑](#footnote-ref-20)
22. We tried also to calcine a whole shell, but the shell exploded in the kiln. See Cataldo and Visco Field Notes, 5 November 2014, “Calcinating oyster shells trial run.” [↑](#footnote-ref-21)
23. We are grateful to Julia Walther, professional ceramicist, and her advice on operating kilns. [↑](#footnote-ref-22)
24. We were able to produce a crushed oyster ash that was gray in color in one of the first attempts, but this was not fully calcined; calcined oyster ash is slippery and white in color. See Cataldo and Visco Field Notes, 24 November 2014, “First kiln attempt” as well as 5 December 2014, “Successful oyster calcination.” [↑](#footnote-ref-23)
25. See Cataldo and Visco’s annotation on binders, as well as Bnf. Ms. Fr. 640,84v, “Eau Magistra.” [↑](#footnote-ref-24)
26. These were skills and processes we learned during the residency of expert maker, dhr T.P.C. (Tonny) Beentjes of University of Amsterdam. [↑](#footnote-ref-25)
27. This substitution seemed to be very much in the spirit of the manuscript and the Making and Knowing project. As William Eamon has written, “Even in some writers of books of secrets -- Isabella Cortese and Leonardo Fioravanti, for example -- discouraged readers from deviating from their instructions, readers did not shy away from experimenting with ingredients and procedures, substituting ingredients, changing the amounts specified, and even pronouncing them useless in their experiments found them so.” Taken from

    William Eamon, “How to Read a Book of Secrets,” in *Secrets and Knowledge in Medicine and Science, 1500 -1800,* eds. Elaine Leong and Alicia Rankin. (Ashgate Publishing Limited, 2011), 34. [↑](#footnote-ref-26)
28. We are grateful for the expertise of Tonny Beentjes, [Official Title], who guided us as we reconstructed sand casting techniques from Bnf. Ms. Fr. fol. 118v, “Casting in a box mold.” [↑](#footnote-ref-27)
29. See Fall2014Annotation\_CataldoVisco\_Binder [↑](#footnote-ref-28)
30. Biringuccio suggests that wine alone can be used as a binder in sand casting. See Vannoccio Biringuccio, *The Pirotechnia of Vannoccio Biringuccio. The Classic Sixteenth-Century Treatise on Metals and Metallurgy*, trans. and ed. by Cyril Stanley Smith and Martha Teach Gnudi (New York: Dover Publications, 1990), 328. On folio 69r in the recipe “Sand,” the manuscript author also mentions wine alone as a binding agent for sands in casting processes. [↑](#footnote-ref-29)