Powder of Ox Bone and Rock Salt

BnF Ms Fr 640 p089r

**Orignal Manuscript**

(fig. 1 BnF MS Fr640 p089r powder of ox bone and rock salt)

**French Transcription**

Sable dos de bœuf brusle et sal gemme

Je les ay pulverises separem{ent} & subtilies sur le porphire le plus que jay peu Puys jay mesle aultant dun que daultre & repasse sur le porphire Je lay apres humecte dans un papier replie dans une serviette mouillee qui est plus tost faict quau serain de la nuit ou a lhumeur de la cave Et nen ay point trouve qui despouille plus net que cestuy cy Il veult estre asses humide Et si tu le veulx gecter fort tanvre fais quil soict plus chault Il est venu en estain doulx fort net co{mm}e le principal Et ha soubstenu plusieurs gects Pour lestaim je croy quil nen fault point chercher de meilleur Ne pour le plomb fin aussy qui vient quasi plus net que lestaim ~~Tou~~ Los de pied de bœuf est tousjours si aride tout seul que sans estre mesle dune part ou deulx de quelque sable gras & ayant liaison co{mm}e le tripoly les sels le foeultre les cendres & choses semblables il ne despouilleroit pas & ne mouleroit pas net aussy car il sesmie

**English Translation**

Powder of ox bone and rock salt

I pulverised them separately and ground them finely on the porphyry as much as I could. Then I mixed all of one with the other and re-ground it on the porphyry. Afterwards I moistened it in [a sheet of] paper folded in a moist napkin which is made wet more quickly from the moisture of the night, or the [moisture of] the cellar. I have never found [one] which can be removed more cleanly from the mold than this, though it needs to be quite moist. And if you want to cast small works, make it very hot. For tin, I believe that you cannot find a material that takes to powder better, and even for use with fine lead which has almost better results than tin. The bone of an ox hoof is always dry, that is why you must mix it with fatty sand, so it will bind like tripoli, salts, felt, ashes and similar materials. [If you do not mix all of one with the other,] it will not turn out from the mold and will not mold cleanly because it crumbles.

**Annotation**

This is a recipe of sand for sand casting. The sand is a mixture of the powder of ox bone and rock salt. The author-practitioner suggested pulverizing and mixing the two ingredients, and then moistening them with the moisture of the night or in the cellar. This kind of sand, according to the author, is good for casting tin or lead. In BnF Ms Fr 640 many recipes are devoted to recipes for sand casting. Most of these recipes contain a dry component and a wet component. The dry component is the sand, and the wet component is the binder that holds the sand together. For example, in p084v, the recipe includes burnt bone of ox hoof and a thick broth of elm root. And in p118v, the sand is the powder of plaster, brick, and feather alum, and the wet binder is sal ammoniac, water and wine.

According to Biringuccio, the sand is usually composed of powders “made of crushed brick, tripoli, vine ashes, tiles, and glazed drainpipes, or burned emerey, calcined tin, straw, and of burned paper and horse dung as well as of young ram’s-horn ashes and many other things,” and the binder is usually a “magistry of salt.”[[1]](#footnote-1) A recipe of good sand should be fine and take the metal well, and the binder should make the sand strong and hold together when the sand is dry.[[2]](#footnote-2) Therefore, if we compare the recipe from p089r with other recipes from the same manuscript as well as recipes from Biringuccio, p089r seems unusual because no wet binder except from water is mentioned. What is powder of ox bone and how to make it? Can powder of ox bone and rock salt bind together simply with water? What serves as the binder? Is regrinding necessary? Furthermore, what is the fatty sand the author-practitioner was talking about and what did the author-practitioner mean by dry and fatty? Below, I will first introduce the two components in this recipe and the preparation methods for these two components. Then I will analyze what serves as the binder in this recipe. Finally, I plan to end the discussion of this recipe by analyzing the concept of fat and lean/dry. As this paper follows our reconstruction process, the answers to questions above become clear. Our experiment proves that in the field of sandcasting, the paradigm of fat and dry/lean is used to describe the binding ability of sand or salt when they are moistened with water. This knowledge system originated from

**What is the Powder of Ox Bone and How to Make it?**

P089r does not give any information about what the powder of ox bone is and how to produce it, but we can get a clue from other recipes in BnF Ms Fr 640. In p067v of this manuscript, the author-practitioner mentioned that the bone should be “well burnt two times and pulverized.” [[3]](#footnote-3) So we assume the powder of ox bone should be calcined and ground bone ash.

Bone ash is a common material for sandcasting. In BnF Ms Fr 640, other than this recipe (p089r), the author-practitioner also mentioned the use of bone ash in p067v “ox hooves for sand”, p069r “sand”, and p084v “Sand, for the most excellent lead of all, for large and small reliefs.” The author-practitioner believed that bone ash is an ideal material for casting since it enables the easy removal of the mold from the cast objects. In p067v, the author-practitioner pointed out bone ash “is the cleanest sand one can find for firing.” In the recipe on p089r, the author claimed that bone ash is ideal sand for casting since he had “*Et nen ay point trouve qui despouille plus net que cestuy cy Il veult estre asses humide* (never found [one] which can be removed more cleanly from the mold)” and he believed that the bone ash takes fine lead and tin better than any other materials. Our experiment, as I will show later in this annotation, also shows that bone ash and rock salt take tin well and can be removed cleanly. But they cannot be removed cleanly from sulfur.

The source of bone ash, according to p089r, should be ox hoof bone, which means the bones inside the hoof and the bone that connect the hoof to the lower part of the leg. On p067v, the author-practitioner also chose the bone of ox hoof to be the source of bone ash. In the early modern period, we can find many other kinds of bone used for bone ash. For example, on p069r from BnF Ms Fr 640, the author-practitioner pointed out that “[t]he human bones are the best for casting when they are calcined…[s]heep foot bones are even better than the ox foot bones.” Cennini mentioned that bone from the second joints and wings of fowls are good for treating panels.[[4]](#footnote-4) Biriguccio’s *Pirotechnia* mentioned ash made of young ram’s-horn, leg bones of horses, donkeys, and mules.[[5]](#footnote-5) But since the author-practitioner of Ms. Fr. 640 chose ox hoof bone particularly in two recipes concerning casting, it seems that ox hoof bone is one of the most commonly used material for bone ash. Since ox hoof is hard to access, we chose cut-up cow’s hoof bone and calf’s leg bone in our experiment.[[6]](#footnote-6) The result By comparing the bone of ox hoof and the leg bone, we found that the ox hoof bone is much denser and harder than the leg bone, so we consider ox hoof to be a better source of bone ash (fig. 2 and fig. 3).

The calcination process is not recorded in detail in the manuscript. On p067v, the author-practitioner did not give any information about the temperature and the time needed for calicination. Other recipes from the same period were also very brief about the process. For example, Cennini described the production of bone ash as “put them into the fire; and when you see that they have turned whiter than ashes, draw them out, and grind them well on the porphyry.” [[7]](#footnote-7) Biringuccio mentioned using a furnace to calcine the bone and then pound and sift the bone ash, but he did not provide any information about time or temperature. The absence or the simplicity of description of the calcination process may suggest that the knowledge of calcination was a common in the sixteenth century, and this common knowledge even lasted until the seventeenth century. For example, Moyse Charas, a seventeenth-century author, used “ordinary” to describe the fire for calcination.[[8]](#footnote-8) The wide usage of bone ash in other kinds of craft and medicine further supports our assumption that calcination belonged to common knowledge. Cennini mentioned using burnt and pulverized bone ash for treating the panels.[[9]](#footnote-9) Biringuccio mentioned using bone ash to made cupels--little vessels ready to receive melted metal in order to refine the metal in smelting.[[10]](#footnote-10) In a seventeenth-century medicine book, the author recorded a recipe of a styptic ointment which include calcined bone ash as one of the ingredients.[[11]](#footnote-11)

We referred to the production process of bone ash in bone china industry for our modern reconstruction. The main component of bone ash is Tri-Calcium Phosphate in the form of Hydroxyapatite Ca5(OH)(PO4)3.[[12]](#footnote-12) Bones are calcined at up to 1250 °C to produce commercial bone ash for bone china manufactory.[[13]](#footnote-13) According to Galeano and Gracia-Lorenzo, at over 650 °C (1202 °F), the organic components are completely removed. The bones turned black at 400 °C (752 °F) and then turned grey between 450 (842 °F) and 600 °C (1112 °F). At 650 °C (1202 °F), the bones became white.[[14]](#footnote-14) Based on Cennini’s description about the color of bone ash, we consider 650 °C as the lowest temperature for calcination.

In experimentation, we boiled the cow’s hoof (fig. 4) purchased from a kosher butcher shop for 104 minutes and removed the remaining skin, cartilage, and other soft tissues from the bone using knives and brushes. Then we put the cleaned bone in the oven to dry at 200 °F (93 °C) for 1.5 hours and 300 °F (149 °C) for 5 hours. For the sake of comparison, we also prepared leg bones in the same manner. However, the heads of the leg bones became spongy and soft after boiling, and turned grey after being dried in the oven. The hoof bone turned white and hard after being dried in the oven, and its pieces rang like porcelain when tapped. Since the hoof bone was cleaner and denser than the leg bone, we consider hoof bone to be a better source of bone ash.

We calcined the hoof bone using an electronic ceramic kiln (Paragon) (fig. 5). We increased the temperature at 1100 °F (593 °C) per hour to 400 °F (204 °C) then kept at 400 °F (204 °C) for 30 minutes. Then we increased the temperature at 1100 °F (593 °C) per hour to 1500 °F (816 °C) and held for 60 minutes. During the calcination process, at around 692 °F (367 °C) much smoke issued from the kiln. The smoke changed color from white to black and then turned from black to grey and to white. At around 800 °F (427°C) a gust of smoke came out of the kiln and created a short and intense huff. At 834 °F (427°C) almost no smoke came out. This suggests that the organic components in the bone started to burn above 800°F. Most of the hoof bone pieces became extremely white after calcination, and a small part became grey. The bones became easy to grind in the mortar. When we ground the bone, we found some bones had a black layer inside the bone, although the surface of these bones was completely white. This suggests that the bone was not completely calcined and still had some organic components. Also, bone ash stuck to the wall of the mortar instead of binding together. The ground bone ash feels like fine sand and is greyish. On the other hand, we also purchased bone ash for bone china. This kind of commercial bone ash is calcined using modern industry methods. The commercial bone ash is extremely white and fine and looks and feels like flour.

The physical characteristics of our bone ash—fine, powdery, but cannot bind together—correspond to the author-practitioner’s description of the powder of ox bone. The author pointed out that the ash of ox hoof bones is dry and crumbles if you don’t mix it with fatty sand. On p084v, the author-practitioner mentioned that the ox hoof bone is very dry and lean and demands to be “well wet and humidified with a thick broth with elm root.” Therefore we can see that the ox hoof bone ash is not strong enough to bind together by itself. Then what about the rock salt?

**What is Rock Salt?**

Rock salt is the mineral form of sodium chloride (NaCl). It is mined from mountains and “made by Nature in the form of stone.”[[15]](#footnote-15) In the sixteenth century, according to Biringuccio, Hungary had a great abundance of rock salt.[[16]](#footnote-16) Other major salt mines in Europe include the Saltmine Berchtesgaden in Rheinberg, South Germany. Although the color of rock salt varies in each mine, the main component, sodium chloride, is the same. We chose Himalayan salt from the Khewra Salt Mine in Pakistan for our experiment (fig 6). The chemical composition of Himalayan salt includes 95–96% sodium chloride and iron oxide, which gives the salt pink color.

**Can Bone Ash and Rock Salt Bind? What is the Binder?**

On p089r, in contrast to other recipes for sandcasting, no binder or magistry was mentioned. The author-practitioner just suggested moistening the sand in a sheet of paper folded in a moist napkin, and then allowing the sand to dampen in the moisture of the night or the moisture of the cellar. On p088v, the author-practitioner used a similar way to moisten the sand made from rock salt. Here we can see that in recipes using rock salt as the sand, the author-practitioner would choose to moisten in air or paper to make the sand wet instead of directly adding liquid into the sand. This is because, as author explained in p088v, “rock salt, like all other salts, dissolves in dampness.” Since directly adding large amount of liquid into the sand will dissolve the rock salt, the author chose to use the moisture in the air and in the paper to bind the sand. In our experiment, we used a humidifier to imitate and accelerate this process. We folded a piece of linen, wet with water and squeezed out the water to the extent that it no longer dripped, folded around the sand a piece of paper drizzled with water, then folded around a layer of our mold material spread out as wide as possible on the plate (Fig. 7 and 8). Then we put the plate on an improvised open grill shelf system so that it could receive the stream of cool moist air from a cold humidifier below (fig. 9).

The author did not explain the type of material from which the paper and napkin were made. In the early modern period, cotton was a luxury from Asia so most of napkin was made from hemp or linen. Therefore in our experiment, we chose a 100% linen cloth for the napkin. The paper in the early modern period was made from rags that contained raw flax and hemp fibers.[[17]](#footnote-17) In the present day conservation for old books, “cotton and hemp blends provide us a paper that has the right color and is sympathetic to the original papers.”[[18]](#footnote-18) Therefore we chose the paper made by University of Iowa Center for the Book.[[19]](#footnote-19) It contains fifty percent cotton and fifty percent linen fabric.

The ratio of the rock salt and the bone ash was not mentioned on p089r. The author-practitioner used a very ambiguous expression: mix “all of one with the other.” On p088v, the author-practitioner mentioned that he used same quantity of rock salt and sand from a mine to make the molding material. So we assume by saying mixing “all of one with the other,” the author-practitioner perhaps meant mixing one with the other in the same amount. Therefore we used the same quantity of bone ash and rock salt in our experiment.

After absorbing the damp air from the humidifier, the mixture of bone ash and rock salt started to change. We experimented with two kinds of mixtures: one was a mixture of commercial bone ash and rock salt (“commercial sand” for discussion below), another is a mixture of bone ash calcined in the lab by ourselves and rock salt (“homemade sand” for discussion below) (fig. 10). The homemade sand turned grey when being moistened and felt like beach sand (fig. 11). It was also quite coarse compared to the commercial sand.

We made five different molds in order to test the strength of the sand, the relationship between regrinding and the quality of casting, the material that separate the mold and the casting objects, and the proper material for pouring (chart 1). The experiment showed that both sands bound to themselves well and could leave a good impression. When the sand was pressed and became dry, both homemade and commercial sands were packed and hardened like cement, creating a solid mold. This result shows that the bone ash and the rock salt can bind with humidity from the air. Then which ingredient provided the binding force?

From above analysis about bone ash we know that the bone ash cannot be the binder since it is too dry and crumbly. Then what about the rock salt? Rock salt is used as both sand and binder in casting in Ms. Fr. 640. On p088v, the author-practitioner also mentioned making sand using pulverized rock salt as the sand. On p084r, rock salt is an ingredient for the magistry that binds the sand. According to the author-practitioner, the rock salt solution can provide the sand “with a binding to enable several casting.” (p084r) Furthermore, just like p089r, in the recipe on p088v, the author-practitioner only mentioned the dry components of the sand: rock salt and sand from a mine, and he used water to dampen them. In the manuscript, our author-practitioner either used rock salt water as a wet binder, or used dampened rock salt as sand that binds by itself. Therefore, it sounds like it is combination of rock salt and water that provides the binding force. As the rock salt receives water, it crystalizes and creates a binding power, which enables the seemingly dry sand to form a solid mold.

**Is Regrinding Necessary?**

On the other hand, the binding force created by rock salt and moisture forced us to regrind the sand each time to get rid of coarse grains in the sand before using it. In addition, by regrinding, we mix the bone ash and the rock salt better. Furthermore, the once ground sand left a rough surface on the cast in mold no. 1, suggesting that regrinding is necessary (fig. 13). And by comparing the casted metal from mold no. 2 and no. 6, we found the commercial sand left a sharper and more detailed cast (fig. 14). The feathers and the letters were cast more clearly in mold no. 6 than in mold no. 2 (fig. 15). This suggests that the finer the sand is, the better and more detailed the cast would be. Therefore we can say that the regrinding process has at least three effects: first, to mix the bone ash and rock salt well; secondly, to make the sand finer so that the cast will have more details; and thirdly, to break down the clumps in the sand and enable the rock salt to crystalize more evenly.

We tried brandy and charcoal powder as material to separate the pattern from the sand. Brandy did not work well while charcoal powder did a good job in separating the pattern as well as separating the two halves of the double-sided mold. We tried pouring tin and sulfur in the mold. The sand took tin well and molded cleanly, while in the case of sulfur, the sand stuck to the sulfur and could not be removed (fig. 16). Therefore this type of sand is only good for casting metals like tin and lead, but not good for sulfur.

**What is the Fatty Sand? The Concept of Fatty and Lean/Dry**

As we have discussed above, it is the rock salt and water that created the binding power. In the manuscript, the author-practitioner attributed the binding power to fatty sand. “The bone of an ox hoof is always dry, that is why you must mix it with fatty sand, so it will bind like tripoli, salts, felt, ashes and similar materials.” In this recipe, the fatty sand refers to rock salt. Although the rock salt is crumbly when it is dry, when moistened with water, the salt crystalizes and binds together. In p084r, the author mentioned using rock salt as one of the ingredients for magistry, which served as a binder for sand. Therefore we can say that it was the moistened rock salt that served as a binder in this recipe.

The paradigm of fat and lean was used to describe many phenomena of nature in the early modern period. In agriculture, fat and lean were used to describe productive soils; in metal works, fat and lean were used to describe the fluidity of metals; in casting, Biringuccio believed that lean sand received fatty metal well.[[20]](#footnote-20) According to Pamela Smith, this paradigm “appears to have arisen not only in observation by and of farmers, but also from the practices of foundrymen in which it played a central part in the making of molds and crucibles, and in the alloying of metals.”[[21]](#footnote-21)

In Ms. Fr 640, fatty and lean/dry were used to describe the property of sand. Fatty means the sand binds to itself and clumps together when being moistened with simply water. For example, on p143r, calcined slate is fatty because it swells and is retains bumpiness. On p069r, the author-practitioner pointed out that the crumbly sand should be mixed with something fatty that binds. On p084v, the author-practitioner mentioned that fat sand “sticks together neatly.” Fatty sand does not work for casting metal that is too hot (p088v). Furthermore, according to the author-practitioner, fatty sand puffs and does not receive subtle impression well (p084v).

In contrast, dry or lean means the sand is crumbly and will not bind together well, just like bone ash. For example, on p069r, the author-practitioner pointed out that lean and arid sand does not bind at all. However, although lean sand is crumbly, it takes fat metal well (p084). In the manuscript, the author-practitioner offered several ways to improve the lean/dry sand. One way is to moisten the dry sand with magistry or good pure wine, and the dry sand needs more liquid binder than other sand (p069). Another way is to mix dry sand with fat sand and moisten them with water (p084v, p089r). Therefore, it seems that the moistened fat sand has something in common with magistry in terms of their usage as a binder. And if we look at the content of magistry, we can find that we can find many ingredients in magistry belong to fatty sand. For example, on p089v, the author-practitioner believed ammonia salt is fatty sand. Then on p118v, the author-practitioner used sal ammonia water as a binder. The rock salt in our recipe is also used as binder as well as fatty sand. Therefore we may have an assumption that the salt used for creating liquid binders may all belong to the category of fatty.

The paradigm of dry and fat in the system of sandcasting might be related to the system of soil. For example, on p069r, the author-practitioner wrote, “you will also find sand in lean soils…much better than those from fat and strong soils.” As we have discussed above, lean sand is better than fatty sand in casting as long as it is moistened with binder, so we may assume that dry/lean soil produces dry/lean sand, while fat soil produced fat sand. However, the paradigm of fat and dry in sand is different from the system of humors. In Biringuccio, salt is of a hot and dry nature while in the world of sandcast, rock salt and ammonia salt are fatty.[[22]](#footnote-22) Therefore we can say that the paradigm of fat and lean/dry is a theorized concept describing the property of sand. This paradigm is used by early modern metal artisans to make the right sand mixture for the right metal, and to make the right binder for the right sand. This knowledge system is different from the knowledge system of humorism, and need further investigation.

**Conclusion**

Through our experimentation and textual based analysis we answered the questions that we raised at the beginning of this paper. In short, this recipe means to create a sand for casting using calcined ox hoof bone and rock salt. The calcination process of hoof bone was omitted by the author-practitioner because the knowledge of calcination was a common knowledge in the early modern period. By simply moistening the mixture of bone ash and rock salt with water, the sand will have a binding force to make a mold. The mysterious binding force comes from the crystallization of rock salt. This recipe is good for casting fatty metals including tin, but is definitely not good for all fatty materials: the sulfur cannot be cast cleanly in this kind of sand. The ideal material to separate the mold and the model is charcoal powder.

This recipe shows the concept of fat and lean/dry in the early modern period. The evidence in BnF Ms Fr 640 shows that the paradigm of dry/lean and fat was used to describe the binding ability of sand. Fatty sands bind to themselves when being moistened, while dry sands are crumbly and cannot bind well. However, since dry sand receives fatty metal well, it is a good material for sand casting. To make the dry sand bind, one can either mix it with fatty sand or add a large amount of wet binders such as magistry into it.[[23]](#footnote-23) We can find many types of salts fells into the category of fatty, such as sal ammoniac, rock salt, saltpeter, and sandever.[[24]](#footnote-24) Interestingly, in the manuscript we can find many of these salts also belongs to the ingredients of magistra. Therefore we can say that the choice of binder is related to the fattiness of the salts. In sum, early modern metal artisans used this paradigm to make the right sand for the right metal, and to make the right binder for the right sand. In a larger context, this paradigm in the knowledge system of casters might be related to the system of soil. However, it seems that this knowledge system is different from humorism, and is probably a paralleled system to describe and analyze the property of matters. However, how these two systems coexisted and related to each needs further investigation.

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1. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, translated and edited by Cyril Stanley Smith and Martha Teach Gnudi, New York: Dover Publications, 1990, 324. [↑](#footnote-ref-1)
2. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, 324. [↑](#footnote-ref-2)
3. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, 137. [↑](#footnote-ref-3)
4. Cennino d’Adrea Cennini, *The Craftsman’s Handbook*, 5. [↑](#footnote-ref-4)
5. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, 137. [↑](#footnote-ref-5)
6. Ox means castrated male kept for draft purposes. Male usually have denser bones than the female, and the draft labor might make the bone even denser. Therefor we assume that denser bones were preferred by early modern craftsman for the creation of bone ash. [↑](#footnote-ref-6)
7. Cennino d’Adrea Cennini, *The Craftsman’s Handbook*, 5. [↑](#footnote-ref-7)
8. Moyse Charas, *The Royal Pharmacopœea,* *Galenical and Chymical: according to the practice of the most eminent and learned physitians of France: and publish'd with their several approbations,* London : Printed for John Starkey ..., and Moses Pitt ..., 1678, 129. [↑](#footnote-ref-8)
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11. Moyse Charas, *The Royal Pharmacopœea, Galenical and Chymical: according to the practice of the most eminent and learned physitians of France: and publish'd with their several approbations*, 129. [↑](#footnote-ref-11)
12. Digitalfire Ceramic Materials Database, http://digitalfire.com/4sight/material/bone\_ash\_123.html. [↑](#footnote-ref-12)
13. “Production Of Bone Ash For The Manufacture Of Bone China.” *Industrial Ceramics*, no.843, 1989, 767-770. [↑](#footnote-ref-13)
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15. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, 107. [↑](#footnote-ref-15)
16. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, 112. [↑](#footnote-ref-16)
17. http://paper.lib.uiowa.edu/european.php. [↑](#footnote-ref-17)
18. Tim Barrett, email to Diana Mellon on 11/11/14. [↑](#footnote-ref-18)
19. Our special thanks go to Professor Timothy Barrett. Professor Barrett offered great help to us to understand the early modern paper production method. He also provided the paper that we use in this experiment. [↑](#footnote-ref-19)
20. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, 324. [↑](#footnote-ref-20)
21. Pamela Smith, “The matter of ideas in the working of metals in early modern Europe,” *The Matter of Art: Materials, Practices, Cultural Logics, c. 1250-1750,* Christy Anderson, Anne Dunlop, Pamela H. Smith, eds., Manchester University Press, 2014, 64. [↑](#footnote-ref-21)
22. Biringuccio, *The Pirotechnia of Vannoccio Biringuccio*, 108 [↑](#footnote-ref-22)
23. For the definition of magistry, see annotation on “p084r magistry.” [↑](#footnote-ref-23)
24. See annotation on “p084r magistry.” [↑](#footnote-ref-24)