**p140v**

**p012r**

**Translation [from tl\_p012r, 20 December 2014]**

<title id=”p012r\_a1”>Molding sulfur</title>

<ab id=”p012r\_b1”>Sulfur is improved by mixing in soot black or powdered sanguine, which makes it harder and more resistant, after letting it melt entirely until it becomes liquid and similar to oil. Mixing it with verdigris, you can use it for casting a lizard or something else in plaster, very cleanly.</ab>

<note id=”p012r\_c1”>You must not cast it until it has quite down and lost all its bubbles and eyes, and its surface has fallen and become flat as water. Soot black gives it a fine luster and makes it neater. Use yellow sulfur of the best kind, as the greyish natural sulfur is no good. Don’t cast it in the wind and cold for it would fill with bubbles.</note>

**Annotation: Concerning the Uses of Sulfur for Casting**

Rozemarijn Landsman & Jonah Rowen

[All figure file names have been abbreviated for readability, and are preceded by “AnnotationFall2014\_LandsmanRowen\_Sulfur\_ …”; e.g., “AnnotationFall2014\_LandsmanRowen\_Sulfur\_Fig1\_BreadMold.jpg” is here shortened to “Fig1\_BreadMold.jpg”]

From the number of references in BnF. Ms. Fr. 640 and contemporary sources, sulfur appears to have been a versatile material in early modern fabrication processes. The manuscript refers several times to sulfur as a material for casting, and this annotation will focus on these recipes. Our primary question is why, and under what circumstances, sulfur would be an advantageous material to use for pouring and molding. Our method of inquiry in addressing this question is to examine the material properties of sulfur itself when melted and poured into molds, as well as to follow the manuscript’s directions for additives to sulfur in order to test the effects that other materials have in the casting process. In addition to our questions regarding why and when sulfur would have been used for casting, and what sulfur would be mixed with and why, these experiments and this research aims to address whether the material of sulfur itself carried any semiotic meaning for the author of BnF. Ms. Fr. 640, and whether the material properties of sulfur (e.g., flammability and brittleness) are significant in the author’s descriptions or directions. This annotation begins by reading closely some of the directions that the manuscript gives for casting in sulfur. It then proceeds to describe the series of experiments we performed, to discuss the textual sources in combination with experimental findings, and to conclude with suggestions for further research. To answer our questions, we will focus on two recipes that explicitly discuss casting in sulfur: folio 140v, “To cast in sulfur”; and folio 12r, “Molding sulfur”.[[1]](#footnote-0)

**Text of the Recipes**

The recipe “To cast in sulfur” [*Pour gecter en soufre*] on fol. 140v explains, “To make a clean cast in sulfur [*Pour gecter nettement en soufre*], arrange the pith of some bread under the brazier, as you know how to do. Mold whatever you want & leave it to dry & you will have a very clean work [*tu auras ton ouvrage fort net*].” The word *nettement* is an adverb translated as “clean” here, but Randle Cotgrave provides the alternative translations “neatly, cleanely, purely, cleerely, smoothly, smug”; and *net* or *nette* (“you will have a very clean work”)as “Neate, cleane, pure, cleere; spotlesse, unspotted; polished, smooth; briske, smug; faire.”[[2]](#footnote-1) The word *fort* or *forte*, which as an adjective means “strong” or “tough,” is in this case also used as an adverb, for which Cotgrave gives the definition “verie, most, verie much, mainely, exceedingly, excessively, extremely, vehemently.”[[3]](#footnote-2) The achievement of a smooth surface in molding and casting is a significant criterion of success in the description of this type of process. This is further illustrated by the lines in the left margin, next to the passage from fol. 140v quoted above, “Try sulfur passed through melted wax [*Essaye le soufre passe par la cire fondue*], since it won’t catch fire & won’t make more little eyes [*doeillets*, or *d'oeillets*].” The phrase “passed through” is unclear, but could mean melting the wax first and adding the solid sulfur subsequently, since the recipe seems to emphasize that the wax is already melted. The “little eyes” or “eyelets” mentioned here may refer to air bubbles that form within the heated material, which can damage an otherwise well-poured cast, hence affecting its smooth surface.[[4]](#footnote-3) Another criterion is that the cast object may be easily removed from the mold, which may also be one of the connotations of the author’s use of the word *net*.[[5]](#footnote-4)

“Molding sulfur” [*Pour mouler de soufre*] on fol. 12r includes apparently similar references to strength, hardness, air bubbles, and the quality of sulfur:

Sulfur is improved by mixing in soot black [*noir à noirci*] or powdered sanguine [*sanguine pulverisée*], which makes it harder and more resistant [*plus dur et plus fort*], after letting it melt entirely until it becomes liquid and similar to oil. Mixing it with verdigris, you can use it for casting a lizard or something else in plaster, very cleanly [*fort nette*].

This can also be seen in the margin next to these directions:

You must not cast it until it has ~~quite~~ cooled down again and lost all its bubbles and eyes [*qu’il n’aye perdu toutes ses pustules & bouillons*], and its surface has fallen and become flat as water [*et ne soict bien abaissé & rendu uny co{m}me* (illegible word) *eau*]. Soot black gives it a fine luster and makes it neater [*Le noir à noircir luy donne un beau vernis & le rend plus necte*]. Use yellow sulfur of the best kind, as the greyish natural sulfur is no good. Don’t cast it in the wind and cold for it would fill with bubbles [*Ne gecte pas au vent & au froict car il soufleroit*].

This recipe, like that on fol. 140v, recommends casting in sulfur because it makes a “very clean” cast.

As described in Cennino Cennini’s *The Craftsman’s Handbook*, “soot black” is the soot collected from a lamp burning linseed oil.[[6]](#footnote-5) Cennini also provides an explanation of “sanguine”: “mark out all the outlines with dark sinoper and a little black, tempered; and this will be called ‘sanguine.’”[[7]](#footnote-6) What Cennini means by “dark sinoper” is not entirely clear. In fact, Cennini’s translator uses the term as an example of a word with a diffuse meaning, and is therefore difficult to translate: “In other cases, such as his [Cennini’s term] *sinopia*, the meaning is too general to be reduced to any single commercial term.”[[8]](#footnote-7) Vannoccio Biringuccio mentions a similar mixture of sulfur and red powder: “When I did not have plaster of Paris, I have used sulfur and brick dust.”[[9]](#footnote-8) Cennini also recommends casting with sulfur, using clay or plaster molds: “If you wish to cast medals…, melt some sulfur; get it cast in these molds, and it will be done.”[[10]](#footnote-9) The suggestion that mixing sulfur with these pigments would be “harder and more resistant” or “tougher and stronger” implies that, since sulfur itself is quite brittle and chips or cracks easily, hardening the pigments might have enhanced their durability, and thus their usefulness.

The note to the first paragraph cited on fol. 12r, again written in the left margin of the page, contains several interesting modifications to the main recipe. In particular, two other sets of terms, besides the *oeillets* from fol. 140v, are used to caution against air bubbles: “bubbles and eyes” (or maybe more accurately, “boils & bubbles,” with connotations of boiling or broth [*pustules & bouillons*]), and the verb *souffler*, for which Cotgrave gives: “To blow, breath (strongly), puffe out, send forth blasts; to sound, or wind, as a Corne[t], horne, &c.; also, to kisse behind.”[[11]](#footnote-10) Incidentally, further down on fol. 12r, under the heading “Plaster” and in the marginalia to the left of that recipe, the term *pustulles* is again used.[[12]](#footnote-11) Thus, the author gives three different terms for “bubbles” in these two recipes, each with different connotations: “eyelets,” “pustules & bubbles,” and *souffler* (something like “blown bubbles”). While the last is the least mysterious, since it is a word for a turbulent surface caused by wind and is used in precisely this context, the meaning of “eyelets” and “pustules” was not clear to us.

**Experiments**

In order to test some of our hypotheses and to decipher some of the more cryptic language in the two recipes from BnF. Ms. Fr. 640, we first focused our experiments on casting pure sulfur into bread, as suggested on fol. 140v, and, later in order to save time, into a standardized silicone baking mold. Then we moved on to casting sulfur with some of the pigments added, as suggested on fol. 12r, and then to casting it in combination with wax, as in fol. 140v. For our first experiment, using bread as a molding material, we patiently grew a rye yeast starter, which eventually yielded a dark and dense rye bread.[[13]](#footnote-12) After removing the bread from the oven, we scooped the “pith” of the bread out from the crust with a spoon, while the bread was still hot, and pressed it in two big pieces around the sides (front and back) of a small Buddha figurine. When dry, this was our pattern for molding.[[14]](#footnote-13) [[Fig. 1: Fig1\_BreadMold.jpg](https://drive.google.com/open?id=0BwJi-u8sfkVDaUgtQ2J1S3Jldk0)] We pierced the bread with two wooden lead pencils as indications of how to register the two sides of the mold with respect to one another, and we cut a gate into which the molten casting material could be poured. The 99.9% pure sulfur that we used came as a bright yellow powder. The material’s melting point is about 240°F, and it took around thirty minutes to solidify inside our bread mold. [[Fig. 2: Fig2\_BreadMoldPouring.jpg](https://drive.google.com/open?id=0BwJi-u8sfkVDWHhmVEpaTm1CUzg)] The result of our pour was a highly detailed, three-dimensional reproduction of the figurine, reproducing more of the surface detail of the original than the bread mold appeared to have captured, as detail in the uniformly dark color of the bread is difficult to see. [[Fig. 3: Fig3\_BuddhaFigurine.jpg](https://drive.google.com/open?id=0BwJi-u8sfkVDMFhIc01ZMDJhb0U)] The success of this experiment would inform our subsequent trials. Because this was a two-sided mold, no surface of the sulfur was exposed to air, which seems to have guaranteed the relatively smooth surface; in the one-sided bread molds created by other members of our group, the crystals of the sulfur became quite visible as the sulfur cooled.[[15]](#footnote-14)

The cast of the Buddha figurine demonstrated that pure sulfur melts easily, pours well, and picks up very detailed impressions of molds. Other pours of pure sulfur executed by the rest of the group corroborated the results of this experiment. Our next trials involved mixing sulfur with soot black[[16]](#footnote-15) in varying amounts. Few of the recipes that we considered included amounts or proportions; this left the measurements of our experiments open to question.[[17]](#footnote-16) We also experimented with the order of steps in the process: melting the sulfur and adding the pigment afterward, mixing them as powders and melting them together, and melting them separately and mixing them afterward.[[18]](#footnote-17) [[Fig. 4a](https://drive.google.com/open?id=0BwJi-u8sfkVDNUcyTDViMXJQQ1U): Fig4a\_PowderedSulfurandSootBlackinPot1.jpg; [Fig. 4b](https://drive.google.com/open?id=0BwJi-u8sfkVDYzNsR0lZZjhvSE0): Fig4b\_PowderedSulfurandSootBlackinPot2] The pigment was quite potent, and two very small spoonfuls (less than 2g) added to 11.5g of sulfur turned the mixture a rich, dark black color. [[Fig. 5:](https://drive.google.com/open?id=0BwJi-u8sfkVDd2owZ1Q3eG1ZYms) Fig5\_PowderedSulfurandSootBlack.jpg; [Fig. 6:](https://drive.google.com/open?id=0BwJi-u8sfkVDMXRJRnFxS0JOUms) Fig6\_MoltenSulfurandSootBlack.jpg; [Fig. 7](https://drive.google.com/open?id=0BwJi-u8sfkVDWnVJdlNHNklvTVk): Fig7\_SolidifiedSulfurandSootBlack.jpg; [Fig. 8](https://drive.google.com/open?id=0BwJi-u8sfkVDQ0FqQy1mQlFjSFU): Fig8\_CrystallizedSulfurandSootBlack.jpg] A smaller amount of soot black added to the same amount of sulfur still gave the melted mixture a dark black color, but when it hardened the difference became apparent: the first mixture with the larger amount of black turned dark gray, whereas the smaller amount made the casts turn a greenish color. [[Fig. 9](https://drive.google.com/open?id=0BwJi-u8sfkVDQXg5U3J0bWVwZmM): Fig9\_SulfurandSmallAmountsofSootBlack.jpg] The color of all mixtures lightened over time. When we first poured them, all the casts looked much darker than they became after they completely solidified. [[Fig. 10](https://drive.google.com/open?id=0B1Cn7jwJcDmeMzdGUVVXNHVfWU0): Fig10\_SulfurandSootBlackTimeLapse.mp4]

Our other experiments with pigments were much less successful. For “sanguine” we mixed a Venetian red pigment (also from Kremer Pigments, used for our “sinoper”) with a very small amount of lamp black, as per Cennini’s instructions. [[Fig. 11a](https://drive.google.com/open?id=0BwJi-u8sfkVDbHlrbmFxb1BzVTA): Fig11a\_PowderedSulfurwithSanguine.jpg; [Fig. 11b](https://drive.google.com/open?id=0BwJi-u8sfkVDZXoxalVwUXVhVnM): Fig11b\_MixedPowderedSulfurwithSanguine.jpg] When combined with the sulfur, the powders appeared to form a homogeneous mix, but after we poured the mixture, the materials visibly separated from one another, so that the poured cast was dappled yellow and red. [[Fig. 12](https://drive.google.com/open?id=0BwJi-u8sfkVDREhYaVpMUU9maXM): Fig12\_SulfurwithSanguine.jpg; [Fig. 13](https://drive.google.com/open?id=0BwJi-u8sfkVDRktIMGQzaU1HQ2s): Fig13\_SulfurwithDarkerSanguine.jpg]

We began our experiments with sulfur and wax with similar doubts about how well the materials would mix, because in earlier trials with bread molding, other group members found the ingredients did not combine well. The line from fol. 140v, “*Essaye le soufre passe par la cire fondue*,” could, once again, imply a number of procedures, and we attempted several: melting wax then adding powdered sulfur, melting wax then adding solid sulfur (in chunks), and melting each separately and combining them. The different forms of the sulfur appeared not to affect the results of these experiments. When sulfur, in either a solid or molten liquid state, was combined with wax, the two materials remained visibly separate, reminiscent of oil added to water. [[Fig. 14](https://drive.google.com/open?id=0BwJi-u8sfkVDb0RtYVlSM0Z3Yms): Fig14\_MoltenSulfurwithWax.jpg]

For carrying out these experiments another recipe from the manuscript was useful, “Wax for molding,” from fol. 109r:

Since the wax is molten, they have some sulfur in a spoon or crucible and pour it in the molten wax. And with the sulfur going to the bottom or staying on top, it stays where it is and mixes only its substance [*substance*] in the wax, and renders it more meltable [*fusible*; fusible/mixable/combinable[[19]](#footnote-18)] when warming it, in such a way that having molded it, [the wax] gently melts in the mold like butter, without leaving any blister or boil [*pustule ou bouillon*]. Also be warned to not give it too much heat.[[20]](#footnote-19)

The significant part of this recipe for our experiments is the second sentence, “And with the sulfur going to the bottom…,” since this implies precisely that the sulfur and the wax do *not* mix or fuse. Instead, the sulfur turned a reddish color at the bottom of the liquid wax. We now felt we understood that this is what the author meant in reporting that the sulfur should be “passed through” the wax. The results of these pours in which we passed the sulfur through the wax were very smooth, milky, homogeneous surfaces, with a large amount of detail. They had all of the definition of sulfur casts but appeared less brittle, and they also contained all of the malleability of wax, without its translucency (a characteristic that makes it difficult to see detail on wax impressions and therefore makes them more challenging to work with). [[Fig. 15](https://drive.google.com/open?id=0BwJi-u8sfkVDTW5qUFQxX1lqNVk): Fig15\_SpectrumfromPureSulfurtoPureWax.jpg] Furthermore, the back sides of these sulfur-wax casts did not crystallize visibly in the way that pure sulfur or sulfur mixed with pigments did; instead, the back surface that was exposed to the air was as smooth as the front. [[Fig. 16](https://drive.google.com/open?id=0BwJi-u8sfkVDTFRGYlRiUDhnaHM): Fig16\_SulfurwithWax\_Backs.jpg] Our final experiment with sulfur and wax was to melt one of these mixtures back to a liquid state. As predicted, they gradually re-separated. [[Fig. 17a](https://drive.google.com/open?id=0BwJi-u8sfkVDOVJab240a1JSRHM): Fig17a\_SulfurwithWaxReseparating1.jpg; [Fig. 17b](https://drive.google.com/open?id=0BwJi-u8sfkVDQ2V4SXpfSmdBWk0): Fig17b\_SulfurwithWaxReseparating2.jpg]

**Open Questions and Conclusion**

Further experiments involving sulfur and its additives would include a study of and experiments with all of the recipes that mention sulfur in the manuscript,[[21]](#footnote-20) although that may be difficult to achieve. The most common combinations, aside from sulfur with wax, include the addition of metal filings (copper and iron), tin, ammonia salt, resin, and verdigris. Additionally, further trials with other pigments for “sanguine” besides the Venetian red pigment that we used would help to determine the author’s meaning in that suggestion. Along similar lines, the proportions of the various materials could be explored in more depth; we only had time to test proportions within a relatively small range. Further philological or hermeneutic research into the author’s use of language might also help to determine the actual ends of casting in sulfur, and why making the material *plus dur et plus fort* was a valuable goal. Additionally, while empirical observations seemed to corroborate the author’s comments about the hardness and brittleness of the various mixtures, more accurate testing with appropriate instruments would provide interesting insight.

While very few positive conclusions can be drawn from either these experiments or the text of the recipes, we can say with certainty that sulfur was used as a casting material for good reason, since its capacity for accepting detail proved excellent in almost all experiments. Whatever alchemical associations the material carried for others—Biringuccio mentions these properties and practitioners skeptically[[22]](#footnote-21)—few traces of those ideas are evident in the recipes from BnF. Ms. Fr. 640 that we studied. Instead, sulfur is used quite practically, and when its deficiencies as a material (its color, luster, or brittleness) make it inappropriate for certain tasks, the author suggests augmenting it with other materials. That sulfur is also used in so many other ways, including as an ingredient in pigments and in a variety of other recipes, attests not only to the material’s availability and versatility, but perhaps more significantly, to its *perceived* versatility.[[23]](#footnote-22) For all of the different uses documented, one can infer that others were tried but did not produce a desired result. Therefore it may not be too speculative to suggest that sulfur metonymically represents the process of trying and assaying, or in other words, of “experimenting” itself. The prevalence of sulfur in recipes ranging from coloring to casting to “boil[ing] an egg in cold water without fire”[[24]](#footnote-23) provides evidence that the material was both commonly used and tried in a breadth of applications. Even in its uses in casting explored here, one of its purposes was likely to experiment with the level of detail one can achieve with a carved pattern or mold.[[25]](#footnote-24) It would seem that, in its ubiquity in trying and testing in this manuscript, sulfur both connoted the idea of experimentation and, as a versatile material, invited further actual trials.

Although sulfur, along with mercury and sometimes salt, was considered by alchemical writers to be one of the “principles” of all metals, and is therefore ubiquitous in discussions of that subject, BnF. Ms. Fr. 640 is not an alchemical treatise.[[26]](#footnote-25) Lawrence M. Principe criticizes Steven Shapin and Simon Schaffer for claiming that alchemical experiments were not rigorous and repeatable.[[27]](#footnote-26) Our research and experimentation has demonstrated that the claims made in regard to casting sulfur in BnF. Ms. Fr. 640 *are* repeatable. Addressing the reproducibility of alchemical practices would be beyond the scope of the present annotation, but we have been able to conclude that the author-practitioner provides practical—and practicable—advice on procedures for casting using sulfur.

Our research has only been able to raise the question as to whether the author-practitioner responsible for BnF. Ms. Fr. 640 omitted mentioning sulfur’s applications to alchemical processes simply because those uses were so widespread as to be common knowledge, or whether these omissions constitute evidence of a more deliberate disinterest in chrysopoetic alchemy (as displayed by Biringuccio). Further research would be necessary to determine what allusions to alchemy exist in the manuscript. Nonetheless, based on the number and variety of recipes that suggest using sulfur (and, presumably, others that were not included) our work with sulfur allows us to conclude that the author-practitioner’s methods were not only predicated on experimentation but that for him sulfur seemed metonymically to stand for the process of experimentation.

1. A complete list of recipes that mention the word *soufre* are the following (\* denotes relevance to casting in sulfur; † denotes a pigment): fol. 3r, “Imitation coral”; fol. 12r,\* “Molding sulfur”; fol. 12r, “Paper”; fol. 12r, “Plaster”; fol. 13r (irrelevant; “sulfur steam”); fol. 35r, “To boil an egg in cold water without fire”; fol. 43r, “Purpurine”; fol. 44v, “Stucco”; fols. 46r-v (irrelevant; “sulfur oil,” or oil of vitriol); fol. 50r,\* “Molding”; fol. 68v (irrelevant; “smoke of sulfur”); fol. 73r,† “Making grey wood”; fol. 73v,† “Brown copper color”; fol. 74r, “Vermilion”; fols. 75v-76r,† “Recipe for coloring all wood”; fol. 76v,† “Making cheap and very beautiful gold color”; fol. 79r,† “Making bronze and gold coloring”; fol. 81r, “Earth for molding”; fol. 99r (apparently irrelevant); fol. 104r,† “Good mixture to color gold”; fol. 109r,\* “Wax for molding”; fol. 117v (irrelevant; “sulfur oil”); fol. 118r (irrelevant; “sulfurous marcasites”); fol. 120r, “Sand for casting gold”; fols. 126v-127r, “Plants that are burned in the core with difficulty”; fol. 129r, “Viperine snake”; fol. 129v, “Casting a spider on a leaf”; fol. 131v,\* “Molded wax”; fol. 138r, “Wetting sand to mold flat medals”; fol. 139v, “Casting wax to mold an animal that one has not got”; fol. 140r,\* (untitled); fol. 140v,\* “To cast in sulfur”; fols. 169v-170r, “How to reduce a round form into a hollow one”. [↑](#footnote-ref-0)
2. Randle Cotgrave, “*Nettement*,” “*Net: m. nette: f.*,” in *A Dictionarie of the French and English Tongues* (1611), http://www.pbm.com/~lindahl/cotgrave/658.html. [↑](#footnote-ref-1)
3. Cotgrave, “*Fort. (Adverb)*,” *A Dictionarie of the French and English Tongues*, http://www.pbm.com/~lindahl/cotgrave/457.html. [↑](#footnote-ref-2)
4. This was a concern of Benvenuto Cellini’s as well. In his instructions “On the Art of Niello” (that is, on a slightly different subject, although his recipe for niello contains sulfur) he writes, “The only object of this burnishing is to stop up certain bubble-holes that sometimes come during the process.” See Benvenuto Cellini, *The Treatises of Benvenuto Cellini on Goldsmithing and Sculpture*, trans. C.R. Ashbee (Whitefish, MT: Kessinger Publishing, 2006), 9. For *oeillets*, Cotgrave gives, “A little eye; also, an oylet-hole…,” *A Dictionarie of the French and English Tongues*, http://www.pbm.com/~lindahl/cotgrave/670.html. [↑](#footnote-ref-3)
5. Biringuccio writes on the uses of sulfur for casting and more broadly: “As I told you, sulfur melts and by means of its fusion one can mold any desired object from it as if it were plaster of Paris, wax, or melted metal. It serves human needs in medicine, in the purifying and bleaching of wool, and in divers other things. But the greatest quantity today is consumed in making gunpowder.” See Vannoccio Biringuccio, *The Pirotechnia of Vannoccio Biringuccio: The Classic Sixteenth-Century Treatise on Metals and Metallurgy*, trans. Cyril Stanley Smith and Martha Teach Gnudi (New York: Dover Publications, 1990), 90. [↑](#footnote-ref-4)
6. “There is another black which is made in this manner: take a lamp full of linseed oil, and fill the lamp with this oil, and light the lamp. Then put it, so lighted, underneath a good clean baking dish, and have the little flame of the lamp come about to the bottom of the dish, two or three fingers away, and the smoke which comes out of the flame will strike on the bottom of the dish, and condense in as mass. Wait a while; take the baking dish, and with some implement sweep this color, that is, soot, off on to a paper, or into some dish; and it does not have to be worked up or ground, for it is a very fine color.” Cennino d’Andrea Cennini, *The Craftsman’s Handbook: “Il Libro dell’Arte”*, trans. Daniel V. Thompson, Jr. (New York: Dover Publications, 1960), 22-23. Also peripherally relevant is the “black sulfured wax” recommended on fol. 139v. Cellini also mentions using “black wax”: “To see better how you are getting on, you may occasionally press in a little black wax, or whatever colour pleases you better, to gauge the projections.” See *The Treatises*, 65. Cellini does not describe how to make “black wax,” but the recipe “Casting Wax to mold an animal that one has not got,” on BnF. Ms. Fr. 640 fol. 139v includes a definition of black wax that contains charcoal. [↑](#footnote-ref-5)
7. Cennini, *The Craftsman’s Handbook*, 95. [↑](#footnote-ref-6)
8. Daniel V. Thompson, “Preface,” *The Craftsman’s Handbook*, xiv. He continues: “To translate *sinopia*, “Venetian red,” would be to fix arbitrarily upon one of many perfectly good reds, all of which Cennini would unhesitatingly have called *sinopia*; and that to no good purpose, for there are almost as many shades of Venetian red in modern trade as there are colormen who sell that universal pigment.” *The Craftsman’s Handbook*, xiv-xv. Cennini mentions dark sinoper several other times but without specifying in further detail how one would make the pigment. [↑](#footnote-ref-7)
9. Biringuccio, *The Pirotechnia*, 331. [↑](#footnote-ref-8)
10. Cennini, “How to Cast Medals,” *The Craftman’s Handbook*, 130. Interestingly but incidentally, under the same heading, Cennini also suggests hardening plaster using a red additive, “red lead”: “And if you wish to do them just with plaster, mix ground red lead with it; that is, mix the dry powder with the plaster. And make it as stiff as you think best, to suit yourself.” [↑](#footnote-ref-9)
11. Cotgrave, *A Dictionarie of the French and English Tongues*, http://www.pbm.com/~lindahl/cotgrave/877.html. [↑](#footnote-ref-10)
12. Fol. 12r, “Plaster”: “rub it well with your finger, and if it makes bubbles, throw on more powder of the said plaster and crush it with your finger,” and in the margin, “it makes no more bubbles. Then once more throw and sprinkle plaster powder on top and leave to set well, then scrape the powder off.” [↑](#footnote-ref-11)
13. In none of its bread-molding recipes does BnF. Ms. Fr. 640 specify the type of grain or bread that should be used for making bread molds. [↑](#footnote-ref-12)
14. On fol. 140v, below “To cast in sulfur,” what follows is a recipe entitled, “Molding and reducing a big piece,” which gives the instructions, “Mold it with the pith of the bread just out of the oven, or like that aforementioned.” [↑](#footnote-ref-13)
15. See the cast of the dinosaur figurine from Jenny Boulboulle’s bread mold. Jenny Boulboulle “Class Notes 3 October 2014,” Dinosaur cast. [↑](#footnote-ref-14)
16. Obtained from Kremer Pigments, a company specializing in historical pigments, which sells it as “furnace black” or “lamp black.” [↑](#footnote-ref-15)
17. When they did, there was a varying level of specificity: the recipes “Brown copper color” and “Vermilion” on fols. 73v and 74r include measurements in ounces and pounds, respectively. More frequently, measurements are given in relative quantities. Measurements are often given for one ingredient but not for others. [↑](#footnote-ref-16)
18. Because soot black consist almost entirely of carbon, the melting point of which is 3550°F, this last one was not successful. [↑](#footnote-ref-17)
19. Cotgrave definition is: “*Fusible*: fusible; meltable, which may be melted.” *A Dictionarie of the French and English Tongues,* http://www.pbm.com/~lindahl/cotgrave/473.html [↑](#footnote-ref-18)
20. On fol. 131r, the recipe “Molded wax” repeats a similar instruction: “Do not add to your wax all the drugs you are preparing, but only melted sulfur, as the candle melts, and also candle smoke. Melted sulfur falls down to the bottom of your mold, but lets the wax keeps some of its quality, melting it but leaving it a little firm.” [↑](#footnote-ref-19)
21. See n. 1. [↑](#footnote-ref-20)
22. On pp. 86-87 of *The Pirotechnia*, Biringuccio doubts that sulfur is a “principle” for metals, as the alchemists argued, “because I do not believe that either of these [mercury or sulfur] really occurs except in similar elemental substances. I say this because I have never seen sulfur found in any metal mine, or metal near any sulfur or mercury ore,” yet he proceeds, “The alchemists hold sulfur in great reverence as a material agent in all their operations because of its heat and dryness and because of its yellow color.” He continues to describe silk workers’ use of the material for bleaching and women’s use of it as hair dye. See *The Pirotechnia*, 90. [↑](#footnote-ref-21)
23. Sulfur was also a readily available material, as evidenced in numerous inventories from sixteenth-century Europe, where it is referenced in different colors and forms, including yellow and grey, in cakes or as a paste, gathered from volcanic regions. See inventories in Jo Kirby, Susie Nash and Joanna Cannon, eds., *Trade in Artists’ Materials: Markets and Commerce in Europe to 1700* (London: Archetype Publications, 2010), 258 (inventory of Venetian color seller Jacopo d’ Benedetti), 351 (in the stock of the English storekeeper William Watkyns), and passim (in the large scale vermillion making carried out in several European centers). [↑](#footnote-ref-22)
24. Fol. 35r, “To boil an egg in cold water without fire”. [↑](#footnote-ref-23)
25. Cellini recommends that “you will do well to make wax impressions from time to time, while you are cutting, to see how you are getting on.” *The Treatises*, 73-74. [↑](#footnote-ref-24)
26. William R. Newman, “What Have We Learned from the Recent Historiography of Alchemy?” *Isis* 102, no. 2 (June 2011): 313-321. [↑](#footnote-ref-25)
27. Shapin and Schaffer characterize the difference between “The experimental ‘laboratory’” and “the alchemist’s closet in that the former was said to be a public and the latter a private space.” Shapin and Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton: Princeton University Press, 1985), 57. Principe does not appear to object to their argument regarding public, as opposed to private, experimentation. See Principe, “Apparatus and Reproducibility in Alchemy,” in *Instruments and Experimentation in the History of Chemistry*, ed. Frederic L. Holmes and Trevor H. Levere (Cambridge, MA: The MIT Press, 2000), 56. Whether the author of BnF. Ms. Fr. 640 practiced his experiments in public or private settings is not an answerable question at this stage of research, but the fact that the manuscript exists is at least one form of making the author’s work available outside of his workshop, whatever that space may have been. [↑](#footnote-ref-26)