

Baking and Knowing: Iterative Processes and Iterative Teaching in a Historical Laboratory

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The Making and Knowing Project, a pedagogical research initiative based at Columbia University, was founded in 2014. Its key aim is to investigate a manuscript written by an anonymous craftsman who likely worked around Toulouse c.1580 (Figure 1).¹⁵ The manuscript, now published by the project as a digital critical edition, contains a collection of over 1000 instructions, recipes, and observations on a wide range of craft processes – from mold making and metal casting to weaponry, sleight-of-hand tricks, pigment making and even creating imitation gemstones. In order to study such a wide-ranging and enigmatic text, the project has embraced novel methodological and pedagogical approaches that incorporate hands-on, digital and scientific experimentation in combination with more traditional historical and linguistic analysis. Such an approach requires flexibility and ingenuity from both teachers and students, as no participant has expertise in every field. Making and Knowing fosters a mode of working that relies on iterative collaboration both as a means of doing research and as a pedagogical model. This way of working is rather novel in the twenty-first century university, particularly in the humanities and social sciences, but actually connects us to the early modern artisans like the anonymous author of the Toulouse manuscript, who used trial and error, learning by doing, and apprenticeships to learn their craft.

While the identity of the author-practitioner who wrote Ms. Fr. 640 is still unknown to us, given his focus and deep knowledge on mold making and casting, it is possible that he worked closely with professional goldsmiths who had undertaken apprenticeships and series of examinations in order to practice the craft as a master and member of a guild.¹⁶ A sixteenth-century craft apprenticeship would have required careful observation, hands-on experience, and learning on the job under a master. The Making and Knowing graduate laboratory seminar follows a highly accelerated apprenticeship model, training students by hands-on activities, supporting them to take on projects of their own, and encouraging them to develop their own activities in line with this research-led hands-on pedagogy in their future careers. My own case is unique in that I took the lab class as a PhD student in Spring 2016 and then became a Postdoctoral Scholar on the project in Fall 2017, mentoring students just three semesters after I had been one myself. But in many ways, my transition from student to mentor mirrors the path of every student who takes the lab course ‘apprenticeship’ and becomes a relative expert over the course of a semester. While most students do not become teachers of the lab class, they do gain a mastery over their material by writing a publishable essay that makes a contribution to the field, having been edited and reviewed by academics and often conservators, curators, and scientists with specialized expertise.

¹⁵ BnF Ms. Fr.640 is held in the Bibliothèque nationale de France. For a full transcription and translation, see Making and Knowing Project, Pamela H. Smith, Naomi Rosenkranz, Tianna Helena Uchacz, Tillmann Taape, Clément Godbarge, Sophie Pitman, Jenny Boulboulé, Joel Klein, Donna Bilak, Marc Smith, and Terry Catapano, eds., *Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640* (New York: Making and Knowing Project, 2020), <https://edition640.makingandknowing.org>.

¹⁶ For more about the manuscript and the anonymous author-practitioner, see Pamela H. Smith, “An Introduction to Ms. Fr. 640 and its Author-Practitioner,” in *Secrets of Craft and Nature*, https://edition640.makingandknowing.org/#/essays/ann_300_ie_19.

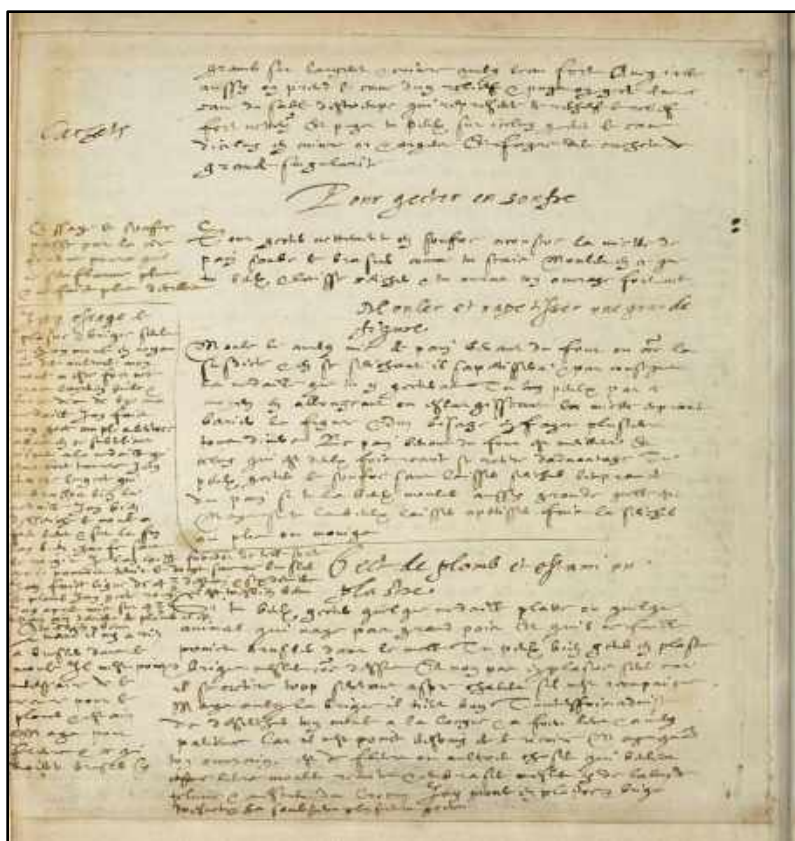


Figure 1: *Recueil de recettes et secrets concernant l'art du mouleur, de l'artificier et du peintre* BnF Ms. Fr. 640, fol. 140v. This folio is a typically text-laden example of the rest of the manuscript, featuring headings, entries, and marginal annotations. Some of the pages also include figures. Two of the three breadmolding processes are outlined on this page.

Image from Gallica Online.

Making and Knowing is ambitious both in scope and approach, and relies on a committed team based at Columbia, the energy and enthusiasm of graduate students, and a global network of collaborators. Research is led by pedagogy; students of the semester-long ‘Craft and Science’ class, (most of whom are graduate students of History, Art History, or Literature, although we have taught some exceptional undergraduates and MFA students) undertake skill building training to introduce them to hands-on experimentation in the Making and Knowing lab, including sessions with a visiting ‘expert-maker’ who offers specialized classes in an area of early modern craft.¹⁷ Students

¹⁷ “The Making and Knowing Project: Intersections of Craft Making and Scientific Knowing,” www.makingandknowing.org. For more about the project, see Pamela H. Smith and The Making and Knowing Project, “Historians in the Laboratory: Reconstruction of Renaissance Art and Technology in the Making and Knowing Project,” *Art History* Vol. 39, no. 2 (2016): 210–233; Pamela H. Smith, “New Directions in Making and Knowing,” *West 86th* Vol. 21, no. 1 (2016): 3–5; Donna Bilak, Jenny Boulboulé, Joel A. Klein, Pamela H. Smith, “The Making and Knowing Project: Reflections, Methods, and New Directions,” *West 86th* Vol. 21, no. 1 (2016): 35–55; Pamela H. Smith, Amy R. W. Meyers, Harold J. Cook, *Ways of Making and Knowing: The Material Culture of Empirical Knowledge*, Paperback Edition (Chicago: University of Chicago Press, 2017). Pamela H. Smith, “The Making and Knowing Project,” Exhibition Catalog, *L'Accademia all'académie: il disegno dal vero come pratica storica e sapere contemporaneo* (Rome, 2017); Pamela H. Smith, “Des recettes et des secrets à l’expérience: le ‘Making and Knowing Project,’” *Toulouse Renaissance*, Musée des Augustins, Toulouse (Paris: Somogy éditions d’art, 2018): 340–43; Tianna Helena Uchacz, “Reconstructing Early Modern Artisanal Epistemologies and an ‘Undisciplined’ Mode of Inquiry,” *Isis* Vol. 111, no. 3 (2020): 606–613; Tillmann Taape, Pamela H. Smith, and Tianna Helena Uchacz, “Schooling the Eye and Hand: Performative Methods of Research and Pedagogy in the Making and Knowing Project,” *Berichte zur Wissenschaftsgeschichte* Vol. 43, no. 3 (2020): 323–40.

then select an entry or series of connected entries from the manuscript and embark upon an interdisciplinary research project, closely supported by the core Making and Knowing team of Pamela Smith the principal investigator, postdoctoral scholars, and the project manager to investigate a material or process described in Ms. Fr. 640, to better understand both the entry's place in the manuscript and its wider implications in the understanding of early modern craft, art, and science.

Due to the unique insights offered by the manuscript, and the methodological diversity encouraged by Making and Knowing, student research often leads to new insights and ground-breaking discoveries, the outcomes of which are revealed in peer-reviewed essays, often illustrated with photographs, films, and even animations, that are included in the digital critical edition of the manuscript.¹⁸



Figure 2: L to R, A model is pushed into moist bread pith; molten sulfur or wax is poured into the hollow; once hardened, bread is broken away from the cast wax or sulfur; the impression is revealed.

Images courtesy of the Making and Knowing Project.

Take the case of bread molding. Ms. Fr. 640 contains three mentions of bread as a material that can be used to take an impression of another object quickly and neatly. This impression can be used as a mold into which sulfur or wax is cast. The author-practitioner's instructions are clear and yet brief: "To cast neatly in sulfur, arrange the bread pith under the brazier, as you know. Mold in it what you want & let dry, & you will have very neat work."¹⁹ (Figure 2) On the same page, he suggests that it is possible to shrink a figure by imprinting it in bread ("Bread coming from the oven is better" he notes), letting the bread dry, and then casting inside the shrunken hollow. A number of pages later, he includes instructions to mold "promptly" and says that "if you are in a hurry, make the first imprint & hollow form in bread pith, prepared as you know, which will mold very neatly. And into that, cast melted wax, which will give you a beautiful relief."²⁰ These instructions offer insights into the kind of intermediate processes that artists must have relied on in the sixteenth century, akin to making a 3D printed prototype in resin before casting in gold for a modern jeweler, but for which very little evidence survives. Sulfur or wax can both be melted down and reused, making them frugal choices for such testing, and the bread mold itself is destroyed in the casting process (it needs to be crumbled off, once dry, from around the cast so these test molds do not survive either). We have found no contemporary written accounts of this ephemeral process either, showing how Ms. Fr. 640 offers new insights into early modern craft practice.²¹

¹⁸ Many of these essays are available to read at Making and Knowing Project, *Secrets of Craft and Nature*, <https://edition640.makingandknowing.org/#/essays>.

¹⁹ Making and Knowing Project, *Secrets of Craft and Nature*, <https://edition640.makingandknowing.org/-/folios/140v/tl>.

²⁰ Making and Knowing Project, *Secrets of Craft and Nature*, <https://edition640.makingandknowing.org/#/folios/156r/tl>.

²¹ For more on these ephemeral intermediate processes, see Pamela Smith, Tianna Uchacz, Sophie Pitman, Tillmann Taape, and Colin Debuiche, "The Matter of Ephemeral Art: Craft, Spectacle, and Power in Early Modern Europe," *Renaissance Quarterly* Vol. 73, no. 1 (2020): 78-131. <https://doi.org/10.1017/rqx.2019.496>.

As this process is so quick, and uses a range of materials with which many students are familiar (bread, wax), we use it in the lab as a skill building exercise early in the semester. First, students are given sourdough starter to take home, instructed in how to feed and grow the starter, and are then asked to bake bread in as historically accurate a way as possible. This is a greater challenge than it initially seems, raising all kinds of generative research questions: What was bread in the sixteenth century? How was it made? Who made it? What temperature were the ovens? What kind of flour was used? Few recipes for bread survive from this era, either because baking was common knowledge and so writing down instructions was redundant or less informative than oral transmission, or because professional bakers were the ones who produced bread for their communities and learned by observation. In other words, bread making and baking were communicated tacitly rather than verbally. Nevertheless, we encourage students to document their choices, compromises, and observations throughout the process, to get them used to taking copious written and photographic fieldnotes. While the bread is still hot from the oven, the students make impressions into the “pith” of the bread using household objects such as keyrings or plastic bottles. They then bring their bread, and their new hands-on insights into its material properties, to class. In order to emphasize the importance of following safety protocols, we also ask the students to find and read the Material Safety and Data Sheets for wax and sulfur, include any required safety measures in their written protocols and field notes, and ensure that everyone is wearing the appropriate lab coats and goggles before melting and pouring into casts. The results are swift and striking; the casts successfully take on a high level of detail from the impressions of the models left behind in the bread, offering the artisan a quick and cheap idea as to how an object might look when cast in a more expensive and laborious material such as silver (see Figure 2).

In the Fall 2018 semester, following the skill building activity, Min Lim, a Columbia MA student of International and World History, decided to focus on bread molding for her research project and annotation (Figure 3). Lim’s prior experience as a highly skilled home baker and her research for her undergraduate thesis on bread in the early Roman empire meant that she already had both hands-on and historical knowledge about breadmaking. I was assigned as her postdoctoral mentor, which meant collaborating with her on close-reading the manuscript for bread as a material and molding as an artistic process, examining secondary sources for similar methods of using bread as a molding material, developing a series of experiments to test the manuscript’s methods, sourcing appropriate materials for experiment, ensuring lab safety, and editing drafts of the research paper. My personal experience as a student in the lab made me highly aware of the demands of such a challenge; as a graduate student, undertaking original research for publication, about an obscure historical process and using a chemical laboratory full of potentially hazardous materials is an unusual and intimidating task. I was keen to stress the benefits of trial and error and the necessity of making educated and explicit guesses, challenging Lim to bring in her own past experiences as a baker and researcher of historic bread.²²

Lim built upon the class skill building activity by focusing on the author-practitioner’s claim that bread could be used to “shrink” a larger figure. Her baking expertise enabled her to immediately observe and exploit the various plasticities and “crumbs” of bread – i.e. to bake a variety of loaves using different types of flour and then compare and contrast their ability to make clear impressions of objects, to shrink, and to hold molten sulfur. Lim discovered that bread made with wheat flour (and thus high in gluten) was the most successful in shrinking a form as per the author-practitioner’s instructions and in taking a clear impression. This confirmed work done by a former lab student, Emma Le Pouésard, who had analysed the linguistic terms for bread in the manuscript and noted the predominance of wheat bread in sixteenth-century Toulouse.²³ What’s more, Lim was able to identify another historical source which outlined a similar and more-thoroughly articulated account of the bread molding process, albeit one published in 1828, about 250 years after Ms. Fr. 640. Lim’s findings, now published as part of the digital edition, make a clear contribution to the field of early modern studies, revealing this hitherto unstudied artistic

²² The Making and Knowing Project has revealed the importance of encouraging students to see ‘failure’ as an integral and productive part of the research process. See “The Lab - 09 - Focus on Unexpected Successes and Failures,” Making and Knowing Project YouTube channel, <https://youtu.be/um0MHat3LWs>. For a thoughtful response to failure by three former Making and Knowing students, see Kathryn Kremnitzer, Siddhartha V. Shah, and Wenrui Zhao, “Three Recipes for Historical Reconstruction,” *Common Knowledge* Vol. 24, no. 3 (2018): 389–396. <https://doi.org/10.1215/0961754X-6939781>.

²³ Emma Le Pouésard, “*Pain, Ostie, Rostie*: Bread in Early Modern Europe,” in *Secrets of Craft and Nature*, https://edition640.makingandknowing.org/#/essays/ann_046_fa_16. <https://www.doi.org/10.7916/vmhr-4038>.

processes and adding to our surprisingly scant knowledge about the making and many craft uses of bread in sixteenth-century France.²⁴ Lim built upon the insights of her classmates, and confirmed the findings of a former student, demonstrating how hands-on techniques are often developed through iterative and collaborative processes. Making and Knowing pedagogy is also iterative; as a former student, I was acutely aware of the challenges of this unique classroom environment, and strove to support my mentee throughout various stages of planning, experimentation, research, writing, and publishing, while encouraging her to take on the role of being principal researcher in her own project. It is our sincere hope that many of our students go on to careers in which they will develop this research-driven pedagogy of hands-on experimentation, rooted in historical sources, and continue the apprenticeship/journeyman/master model of learning by doing and knowing by making.



Figure 3: Min Lim and Sophie Pitman in the Making and Knowing Lab, pouring molten sulfur, October 2018. Photo taken by Caroline Surman. For more images, see the Making and Knowing Project Flickr, <https://www.flickr.com/people/128418753@N06/>

We are also keen to share our approaches with educators and researchers. The Making and Knowing Project is preparing a *Research and Teaching Companion* to *Secrets of Craft and Nature in Renaissance France* that will include syllabi, hands-on activity assignments, and video demonstrations that can be reused and scaled to any classroom, studio, or kitchen. Sample assignments and student projects are available in the Project's *Sandbox*: <https://cu-mkp.github.io/sandbox/>. The bread molding activity can be found here:

<https://cu-mkp.github.io/sandbox/docs/breadmolding-assignment.html>.

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²⁴ Min Lim, "To Shrink an Object: Bread Molding in Ms. Fr. 640," in *Secrets of Craft and Nature*, https://edition640.makingandknowing.org/#/essays/ann_076_fa_18. DOI: <https://www.doi.org/10.7916/vsnc-4x81>.

sandbox

The "Sandbox" space makes available a number of resources that utilize and explore the data underlying "Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640" created by the Making and Knowing Project at Columbia University.

[View the Project on GitHub](#) [cu-mkp/sandbox](#)

BREAD MOLDING RECONSTRUCTION ASSIGNMENT

HIST GU4962: Making and Knowing in Early Modern Europe: Hands-On History
The Making and Knowing Project, Columbia University
Last updated 2021-08-19

The 16th-century artisanal/technical manual, BnF Ms. Fr. 640, contains hundreds of entries that describe making processes and techniques from the Renaissance. These include instructions for and observations about painting, gilding, arms and armor production, plant cultivation, and making molds and metal casts.

Two unique entries from this manuscript describe a process for using freshly-baked bread as a quick mold into which wax or sulfur can be poured, creating a cast wax/sulfur object. Both entries are found on [folio 140v](#) - follow the link to review the full entries in [Secrets of Craft and Nature. A Digital Critical Edition of BnF Ms. Fr. 640](#). Excerpts from the translations of these entries are copied below:

Folio 140v



Translation

For casting in sulfur

To cast neatly in sulfur, arrange the bread pith under the brazier, as you know. Mold in it what you want & let dry, & you will have very neat work.

Molding and shrinking a large figure

Mold it with bread pith coming from the oven, or as the aforesaid, & in drying out, it will shrink & consequently the medal that you will cast in it. You it can, by this means, by elongating and widening the imprinted bread pith, vary the figure & with one image make many various ones. Bread coming from the oven is better. And the one that is reheated twice retracts more. You can cast sulfur without leaving the imprint of the bread to dry, if you want to mold as big as it is. But if you want to let it shrink, make it dry, either more or less.

You are tasked with baking bread, loaves of which will become molds into which you will cast wax or sulfur. While modern bread is typically made with yeast, a common historical rising agent was a sourdough starter. Some of you have been given sourdough starter which you can use for making the bread for the molds. Others may wish to explore creating their own sourdough starters at home (there are many online resources about how to do this safely). After looking into these options, you may logistically only be able to bake bread with yeast (and that is ok). Start experimenting!

The first step in your process will be to learn to bake bread. Eventually, you should follow an early modern bread recipe (see links to recipes further on in this document) to make your molds. As much as possible, try to think about (and research) what bread would have been like in the sixteenth century.

Objectives:

1. To experiment at home with bread baking
2. To experiment at home with reconstructing the process of making molds from bread, following the entries in BnF Ms. Fr. 640.
3. To gain familiarity with the process of methodical interpretation of Ms. Fr. 640 entries, and the writing of an experimental protocol
4. To begin thinking about the nature of materials — what is bread as a material in the workshop? What was it used for in the sixteenth century? What properties does it have that make it useful? Does it fit into some sort of informal taxonomy of materials and properties? Today we take bread for granted as a food, but how might its uses in the workshop re-orient that understanding?

Instructions for reconstruction at home:

Note: your experience with the Historical Recipe Reconstruction will be useful to you in this assignment. Make use of the previous years' Reconstruction templates. Keep detailed field notes of your experiences.

- Carefully read the bread molding recipes, "For casting in sulfur" and "Molding and shrinking a large figure," both on [fol. 140v](#) in Ms. Fr. 640.
- In your Field Notes, write an experiment protocol that lays out how you interpret the Fr. 640 recipes and the step-by-step process which you will follow in reconstructing them.
- When you have finished the first part of the experiment (i.e., bread molding at home), comment on anything you had to change in your protocol and why.
- You will need to choose an object to use as your molding pattern (what you will press into the bread to create an impression).
- Include your protocol and comments in your field notes about this process.
- **Have your completed molds ready for casting in the Lab during class.**

A few tips:

- You are welcome to work alone or in groups of two.
- Sourdough starter: Best to keep the portion you are saving in the refrigerator between bread baking sessions. Do not use the entire starter for a single loaf of bread, but instead feed and divide it, always saving a cup or so for your next loaf.
- Start early with the experiment as it will take you some time to become adept at making bread, and you may need more than one try at the mold making. (You may also eat up some of your baking experiments!)
- For the molding pattern for your one-sided or two-piece mold, you will need to choose a relatively uncomplicated object, such as a key, flat shell, a large medallion or necklace pendant, as a pattern.

Helpful sources on making sixteenth-century bread:

- [John Evelyn's bread recipes](#), including varieties of French bread
- The Food Timeline- Bread History (good bibliography): <http://www.foodtimeline.org/foodbreads.html#breadhistory>
- Early English Bread Project: <https://earlybread.wordpress.com/>
- The Recipes Project: <http://recipes.hypotheses.org/>
- The Wellcome Library has digitized nearly all its recipe manuscripts. You can search the library here: <http://wellcomelibrary.org/>
- Monumenta Culinaria et Diaetetica Historica
- Corpus of culinary & dietetic texts of Europe from the Middle Ages to 1800: <https://www.staff.uni-giessen.de/gloning/kobu.htm>
- Dutch Cooking History (with some English content): <http://www.kookhistorie.nl/index.htm>

Helpful resources in *Secrets of Craft and Nature*:

Secrets of Craft and Nature in Renaissance France. A Digital Critical Edition and English Translation of BnF Ms. Fr. 640, edited by Making and Knowing Project, Pamela H. Smith, Naomi Rosenkranz, Tianna Helena Uchacz, Tillmann Taape, Clément Godbarge, Sophie Pitman, Jenny Boulboulle, Joel Klein, Donna Bilak, Marc Smith, and Terry Catapano. New York: Making and Knowing Project, 2020, <https://edition640.makingandknowing.org/>.

- Le Pouésard, Emma. "Pain, Ostie, Rostie: Bread in Early Modern Europe." http://edition640.makingandknowing.org/#/essays/ann_046_fa_16.
- Le Pouésard, Emma. "Bread as Mediating Material: Tactile Memory and Touch in Ms. Fr. 640," http://edition640.makingandknowing.org/#/essays/ann_050_fa_16.
- Landsman, Rozemarijn and Jonah Rowen. "Uses of Sulfur in Casting." http://edition640.makingandknowing.org/#/essays/ann_007_fa_14.
- Lim, Min. "To Shrink an Object: Bread Molding in Ms. Fr. 640." http://edition640.makingandknowing.org/#/essays/ann_076_fa_18.
- Fall 2018 student work - [Resource: Breadmolding and Casting Slideshow](#) (Note: for additional help and resources, try following the Field Note links in the essays above and in the Slideshow)
- Spring 2020 Vassar Seminar project videos on Breadmaking: <https://vimeo.com/419949231> and Breadmolding: <https://vimeo.com/419940044>

Optional exploration: the uses of bread in the early modern workshop

If you have time, search in other sources for other uses are made of bread in the workshop:

1. Alessio Piemontese, *Book of Secrets* (1555); various English versions on EEBO; French versions on Gallica; Italian versions... (For English: Search for Ruscelli, Girolamo, *The secretes of the reuerende Maister Alexis of Piemount Containyng excellent remedies against diuers diseases, woundes, and other accidents, with the manner to make distillations, parfumes, confitures, diynges, colours, fusions and meltynges. ... Translated out of Frenche into Englishe, by Wyllyam Warde* (1558).
2. Hugh Platt, *The Jewell House of Art and Nature: Containing diuers rare and profitable Inventions, together with sundry new experimentes in the Art of Husbandry, Distillation, and Molding* (London, 1594). EEBO

3. Cennino Cennini, *Il libro dell'Arte (The Craftsman's Handbook)*, trans. Daniel V. Thompson, Jr. (New York: Dover, 1960).
4. Vannoccio Biringuccio, *Pirotechnia* (1540), trans. Cyril Stanley Smith and Martha Teach Gnudi (repr., Cambridge, MA, 1966).
5. Theophilus, *The Various Arts: De Diversis Artibus*, ed. and trans. C. R. Dodwell (Oxford: Clarendon Press, 1986).
6. Benvenuto Cellini, *Two Treatises*, trans. C. R. Ashbee (repr. 2006).

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