Tin and its Uses in Ms. Fr. 640

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Metals of various sorts play an essential role in many of the recipes in BnF Ms. Fr. 640. In particular, tin is one of the most frequently used metals throughout the manuscript, with the author-practitioner often relying on several different tin-lead alloys in various recipes for casting in particular. More exactly, tin is referred to 287 times throughout the manuscript; lead is referred to slightly less frequently at 281 times, while iron is referred to 231 times, and copper is referred to only 135 times. Although tin could be mined in only a few locations throughout Europe, it was widely used at the time of the manuscript's writing, corroborated by the strong presence of tin in the

manuscript. This practical ubiquity was perhaps even more true of tin when it was alloyed with lead or copper in order to make pewter for tableware and bronze for bells, organ pipes, sculptures, and many other common items, a fact toward which the author sometimes gestures when he notes that a particular recipe calls for tin that has not been used for any other purpose previously.1 In his focus on metals, the author-practitioner's work coincides with a new development and dissemination of knowledge about tin and other metals that had begun around the midpoint of the sixteenth century and that was reflected in learned works as Georgius Agricola's *De re metallica* (1556). At the same time, the author-practitioner's treatment of tin and other metals is unusual when compared to these other works.

One of the most intriguing, and at first sight puzzling, aspects of the use of tin in the manuscript is the wide range of adjectives the author-practitioner uses to qualify the metal. For instance, the author-practitioner at various times recommends the use of *estain de glace* (looking glass tin) as well as tin that is either *fin* (fine), *aigre* (brittle), or *doux* (soft/sweet), frequently without providing further explanation. Clarifying the different qualities of tin is essential to understanding and reconstructing many of

the recipes found in Ms. Fr. 640. On fol. 6v (http://edition640.makingandknowing.org/#/folios/6v/f/6v/tl), for example, a recipe for stamping tin ornaments to be used as household furniture decoration relies on the special qualities of *doux* tin at several points. Situating this use of *doux* tin within a broader context of other uses of tin both throughout Ms. Fr. 640 and in similar texts produced during the period gives insight into the author-practitioner's knowledge and employment of metals and his relationship to early modern discourses on metalworking. Furthermore, an investigation of the meaning behind terms such as *doux* speaks to the question of the author-practitioner's tacit knowledge, an issue relevant for the entries throughout Ms. Fr. 640.

This essay will begin by examining early modern texts on metalworking and their discussions of tin. It will consider the author-practitioner's approach to working with tin in Ms. Fr. 640, focusing on the advantages and disadvantages he describes of various qualities of tin and speculating about their identities. As the author-practitioner frequently links tin with lead due to the useful alloys the two metals produce, a portion of the essay will focus on the various qualities of lead used in the manuscript

and the ways those qualities differ from and complement those of tin. Finally, the essay will describe attempts to reconstruct a recipe found on fol. 6v (http://edition640.makingandknowing.org/#/folios/6v/f/6v/tl) for easily creating tin ornaments; since this recipe appears to depend upon the unique qualities of *doux* tin, it gives insight into the qualities and identity of this particular metal. Further insights into the qualities of *doux* tin are gleaned from a subsequent recipe on fol. 7r (http://edition640.makingandknowing.org/#/folios/7r/f/7r/tl) that provides directions for creating a gold paint to decorate the tin ornaments created in the preceding recipe. Together, these two recipes point to the author-practitioner's interest in imitating the look of rarer or more expensive materials by the artistic exploitation of more common materials. It also suggests something about the broader social situation in which the author-practitioner was writing and perhaps the goals that he assumed his readers would have in mind in attempting his recipes.

Although tin was used throughout early modern Europe in a broad range of applications, there were only three major sources of European tin: northwestern Iberia, southern Germany, and southwestern England, with the latter tending to have the

strongest hold on western European markets.2 In fact, the author-practitioner himself discusses the differences between English and German tin on fol. 139r (http://edition640.makingandknowing.org/#/folios/139r/f/139r/tl), claiming that English tin is extremely hard and thus is frequently alloyed with lead by English miners soon after being mined. In contrast, German tin tends to be much softer and apparently does not need to be alloyed before being sold and put to use. Despite the author-practitioner's presence in Toulouse, he does not speak of Iberian tin. In any case, it is clear that the author-practitioner was aware of the sources of his metal and took account of how the qualities of metals from different sources might affect their use. Additionally, his comment about English tin being mixed with lead serves as a reminder that metals in the early modern world were not always as pure as modern readers might assume, and that purity was, perhaps, not considered as essential to the identity of a metal as the qualities it exhibited in use. After all, despite English tin being mixed with lead, the author-practitioner nevertheless refers to it as tin.

The author-practitioner of Ms. Fr. 640 was certainly not the first individual in early modern Europe to commit his knowledge of metals and metalworking to writing. In the middle of the

sixteenth century, three major authors contributed to the scholarly awareness and systematization of knowledge about metalworking: Vannoccio Biringuccio (1480–1539), Georgius Agricola (1495–1555), and Lazarus Ercker (1528–1594). Agricola's *De re metallica* in particular treats the unique qualities of tin as well as the tin mining process, as do Biringuccio's somewhat earlier *Pirotechnia* (1540) and Ercker's somewhat later *Beschreibung aller fürnemisten mineralischen Ertzt und Bergwercksarten* (1574).3 All three texts, considered foundational works of early modern metallurgy, reflect the development of an alleged "proto-industrial" revolution of the sixteenth century, which resulted in rapid progress in the fields of both mining and metallurgy; they suggest a new interest among educated audiences in understanding the knowledge and practices of miners and others who worked with metals.4

The works of Biringuccio, Agricola, and Ercker reveal important aspects of early modern conceptions of tin. Biringuccio, for instance, notes both the easy availability of tin and the fact that it melts at a relatively low temperature, making it a much easier material to work with than other metals. Moreover, he writes, "this metal, either pure or when mixed with lead, stands up well

under the hammer, so that if desired, it can be spread out thinner than paper."5 Here, one sees two important qualities of tin that are also given in Ms. Fr. 640. First, tin is noted to be relatively soft and malleable, allowing one to manipulate it with a hammer. Second, it can be made into extremely thin sheets. As will be shown below, this second quality is especially important for the author-practitioner's use of tin for household decorations.

Agricola also focuses on the softness of tin, noting that tin which cracks when struck with a hammer contains too many impurities and must be melted down again.6 The ease with which one could manipulate tin—the relatively low heat needed to smelt it and the way it could be bent or hammered until extremely thin—was an important quality for Agricola and the author-practitioner of Ms. Fr. 640. Intriguingly, while Agricola does mention the special methods used to smelt tin in Iberia,7 he does not include references to the different qualities of tin from different sources such as England and Germany, as does the author-practitioner. Agricola and Biringuccio appear more concerned with describing the processes related to mining, assaying, and smelting rather than the small-scale, particular manipulation discussed in Ms Fr. 640.

Like Biringuccio and Agricola, Ercker focuses primarily upon the processes of mining and assaying tin, noting the relatively low melting point of tin when compared to other metals.8 Notably, Ercker's discussion of tin evinces an abiding concern with ensuring that tin is pure. For instance, he describes a method for determining whether tin is alloyed or otherwise contains admixture by comparing the weight of a sample of the tin with that of a ball of tin known to be pure. However, he does note that this method assumes that both tin samples have been taken from the same mine, since tin from different mines does not have the same weight, even if equal in purity.9 This concern for the sourcing of metals, though not as detailed as the author-practitioner's, is absent from Agricola and Biringuccio. Accordingly, it seems that the author-practitioner is concerned primarily with using his materials in order to produce useful, decorative, or curious objects, while authors such as Agricola, Biringuccio, and Ercker are more interested in providing a systematic overview of the knowledge and processes used in working with metals, including mining, assaying, and smelting.

The author-practitioner's practical text leads him to employ a variety of different tins throughout the manuscript. On fol. 5r

(http://edition640.makingandknowing.org/#/folios/5r/f/5r/tl), for instance, he includes a recipe for steel mirrors that involves the use of "soft [*doux*] tin, that is to say fine [*fin*], which has not yet been used." In other words, *fin* tin is that which has not been melted down and recycled after having been used for some other application in the past. The identity of *doux* tin is less straightforward. The author-practitioner frequently uses *doux* in contrast to *aigre*.10 While these terms sometimes seem to indicate the properties of sweetness and sourness, they at other times seem to point to softness and brittleness. The qualities of softness and fineness are attributed to tin and other metals in various places throughout the manuscript. In particular, as noted above, they are frequently contrasted with the opposing qualities of brittle tin. As the author-practitioner notes on fol. 48v (http://edition640.makingandknowing.org/#/folios/48v/f/48v/tl), "There is fine & soft tin & brittle tin [*estaim fin & doulx & estaim aigre*]. … Soft [*doulx*] tin is more even than the brittle one, which is whiter and seems to be burnished like a mirror." In a subsequent entry on "Pewterers" on the following page, fol. 49r (http://edition640.makingandknowing.org/#/folios/49r/f/49r/tl), he again suggests that "there are two kinds of tin, one of them nearly like lead, which runs better, the other brittle [*aigre*], which becomes thicker." If *doux*

tin is malleable and adequate for use in various tasks, *aigre* tin can be much more troublesome to work with. As the author-practitioner continues, “brittle [*aigre*] tin is found mixed into *saulmons*, easy to cut, but difficult to put to use & melt if it is not mixed with the other soft [*doulx*] one. And without this, it would become waste.”11 In other words, brittle tin is useful only when mixed with either soft tin or lead and is more or less useless on its own.

As to the identity of this brittle tin, the author-practitioner gives modern readers a possible clue on fol. 48v (http://edition640.makingandknowing.org/#/folios/48v/f/48v/tl), where he notes that both tin and lead “become brittle [*sesgrissent*] having been put back to melt often or for a long time, and they thicken and burn, in such a way that even when one melts a *saulmon*, the tin thickens at the bottom if, while casting, one does not stir it often.” Perhaps, then, brittle tin was simply tin that had been melted down repeatedly as craftsmen used it for any number of purposes. Over time, it would lose much of its malleability and softness, becoming too brittle to be used without admixture or alloying. Indeed, modern work with tin and tin-based alloys shows that tin subjected to repeated cycles of heating and cooling will

begin to develop cracks, making it less suitable for use.12 Such an identity for brittle [*aigre*] tin fits well with the recipe on fol. 5r (http://edition640.makingandknowing.org/#/folios/5r/f/5r/tl), quoted above, in which the author-practitioner suggests that its opposite, soft [*doux*] tin, is also called "fine, which has not yet been used." In other words, fine [*fin*] tin appears to be that which had not previously been melted and would therefore have retained more of its malleability and softness, while brittle tin seems to have been that which had already been put to use and was then melted down again for reuse, repeatedly, until it became brittle and began to melt less easily. Given the ambiguity surrounding the use of these terms in the manuscript, however, this identification can remain only tentative.

The author-practitioner seems to have had a thorough knowledge of lead-tin alloys and the qualities one could expect from various mixtures, especially for use in casting. As he notes on fol. 84v (http://edition640.makingandknowing.org/#/folios/84v/f/84v/tl), "for casting, there is only soft [*doux*] lead that wants to be cast very hot, and soft [*douls*] tin." However, the author-practitioner does not simply use these metals in their original form but rather frequently advises readers to alloy them in various ratios in

order to achieve better results. For instance, on fol. 110v (http://edition640.makingandknowing.org/#/folios/110v/f/110v/tl), which features a recipe for making metal lifecasts of plants and animals, the author-practitioner notes, “if your medal, plant, or other thing for molding is thin & fine, do it so that there is more tin, much more than lead, namely less than the fourth part lead for three parts tin. And still, one puts lead only to form an alloy. On the contrary, if you want to mold something strong & thick, put a lot more lead in than tin.” Even just a small amount of another metal, then, could produce more desirable qualities. The author-practitioner also makes clear that his alloy ratios result from his own experimentation. Further down the page, in lines that seem to have been added later, he remarks, “since then, when molding with fine and new lead, I put into one lb two ounces of fine tin. And when molding with fine tin, I put in two ounces of fine lead for one pound.” As a result, he boasts, “I made plants & snakes just like nature.”

Aside from casting, the author-practitioner also makes use of tin for the purpose of decorating household furniture. An example is located on fol. 6v (http://edition640.makingandknowing.org/#/folios/6v/f/6v/tl) in a recipe for creating tin ornaments that can be used to embellish mirrors,

chests, bed valances, and other items.13 To easily create these ornaments in multiples, a design is first etched into a piece of iron or copper. Then, soft [*doux*] tin is poured onto a piece of marble, and a wooden board or a roll-press is used to flatten the tin into a thin sheet. Once this is done, the tin is placed over the etched iron or copper, with a piece of felt over both, and then struck with a hammer in order to transfer the etched design to the tin sheet. This process seems designed to take advantage of the capacity of tin to be made extremely thin and malleable enough to allow the transfer of a design onto it by means of hammer blows.

Reconstructions of this recipe have shown that such a mechanical image transfer is feasible, although the author-practitioner's recommendations as written appear insufficient to produce the desired result.14 Pure tin ingots were chosen as the *doux* tin for being unalloyed and unused. Initial attempts to melt down the tin, pour it out onto a slab of marble, and flatten it out with a board showed that the tin cooled and solidified before a board could be used to flatten it into as thin a sheet as the recipe suggests necessary (*Fig. 1*). Moreover, the solidified tin was not smooth but featured various irregularities, giving it a rough

texture and making it, at least apparently, unsuitable for use as the material for an ornament. This experience perhaps suggests that the *doux* tin called for in the recipe is in fact not identical with pure tin. However, given that the author-practitioner suggests using this method or putting the tin through a roller-press, it is possible that the roller-press would have produced better results.

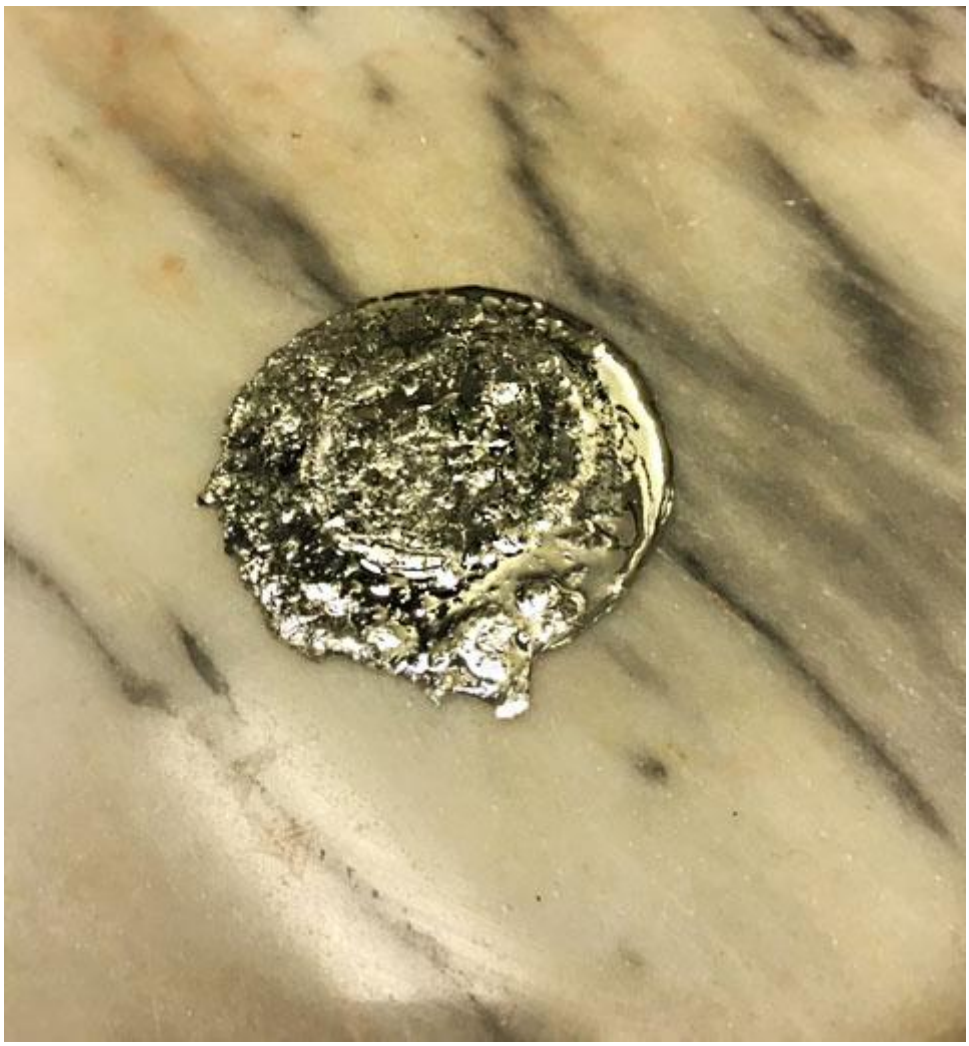

Fig. 1. Tin Poured on Marble. James Buckley, 2018. Once poured onto a marble slab, the molten tin rapidly cooled and solidified in the form of a disc. The irregular texture of the surface is clearly visible.

Moreover, attempts to transfer a design from an etched copper plate to the tin using a rubber mallet were unsuccessful, resulting in the transfer of only small traces of the design (*Fig. 2*). A standard metal carpenter's hammer, however, proved to be

more successful, providing the extra force needed to at least achieve proof of concept. Even so, the tin remained too thick and uneven to obviously be of use as an ornament. Taking direction from Biringuccio's *Pirotechnia*, attempts were made to resolve this issue by pounding out the tin with a hammer before transferring the design.15 The tin did indeed prove to be quite malleable, thinning out considerably within a relatively short span of hammering (*Fig. 3*). Moreover, the thinner tin seemed to pick up the etched design better than did the thicker tin (*Fig. 4*). In short, while it does seem possible to create something like that which the author-practitioner had in mind, doing so seems to require a greater degree of effort or skill than he articulated. Given his evident familiarity with metalworking, these gaps in the recipe perhaps suggest that he had never attempted this recipe himself, that he was only repeating information that he had gained elsewhere, or that he simply assumed that certain parts of the recipe, which had to be inferred during attempts to recreate it, would have been obvious to anyone with the means and inclination to actually create his tin ornaments.

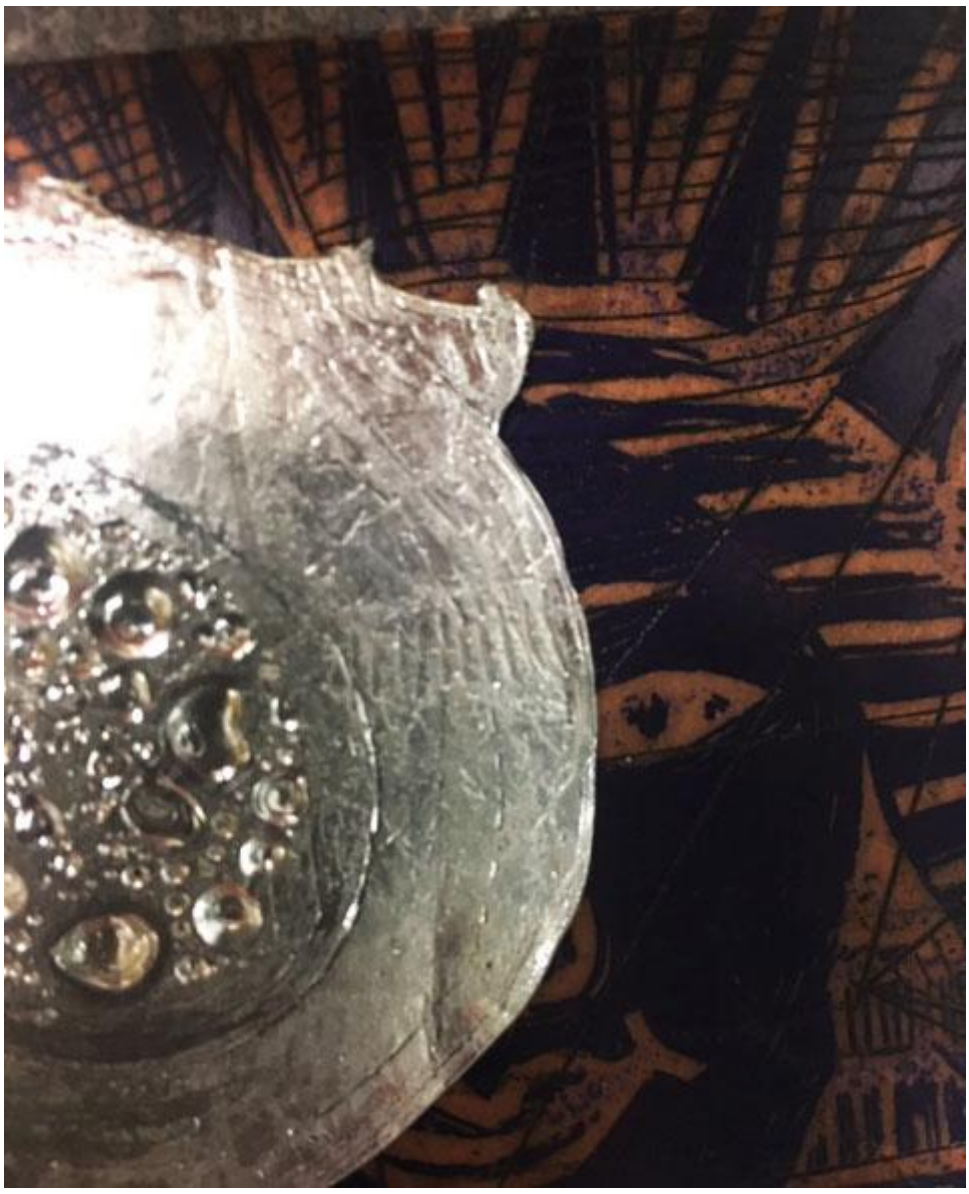

Fig. 2. Tin with Etched Design. James Buckley, 2018. While some traces of the design are visible on the tin, it does not seem adequate to the author-practitioner's purposes.

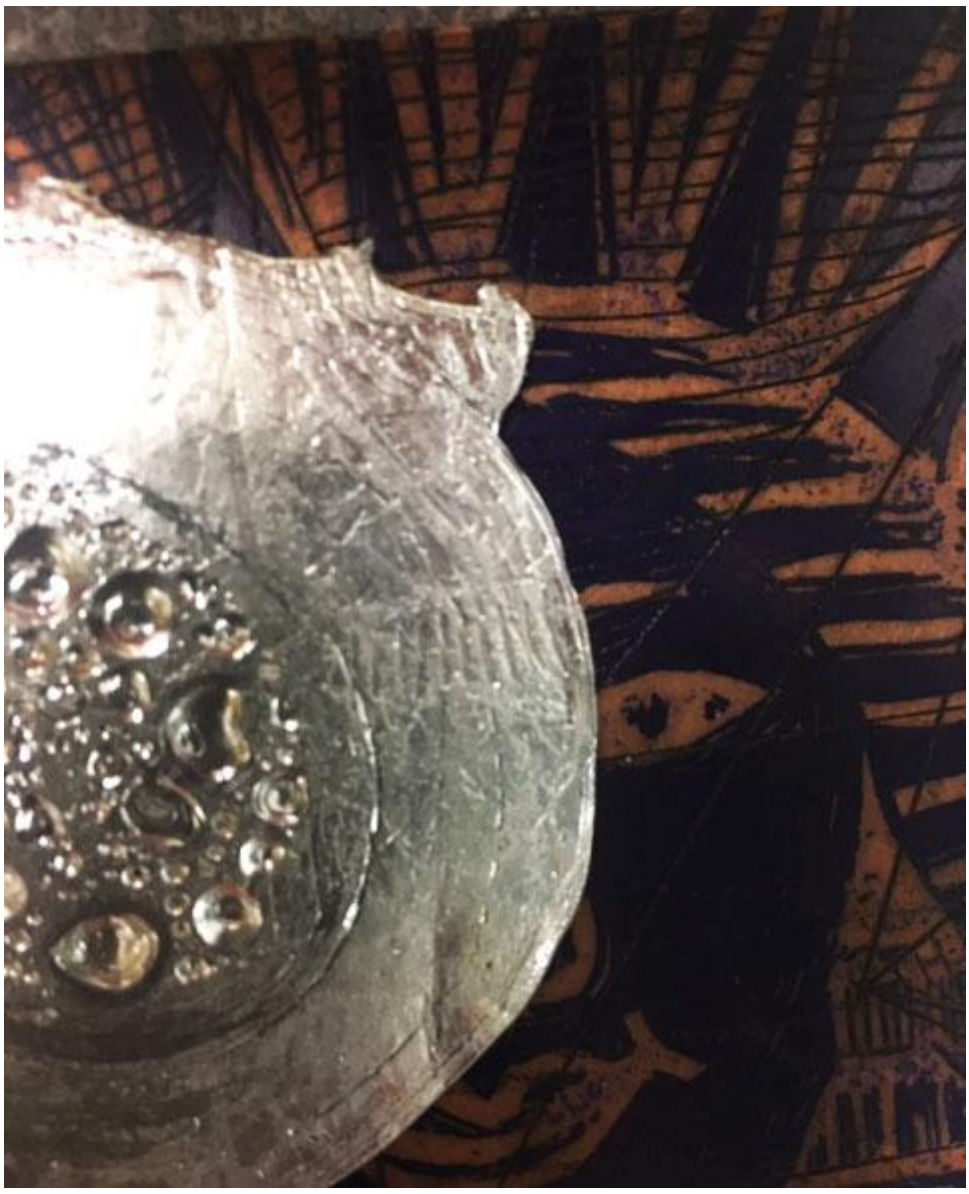

Fig. 3. Hammered Tin. James Buckley, 2018. The hammered tin is clearly quite a bit larger. In addition, the surface irregularities were evened out as part of the hammering process.

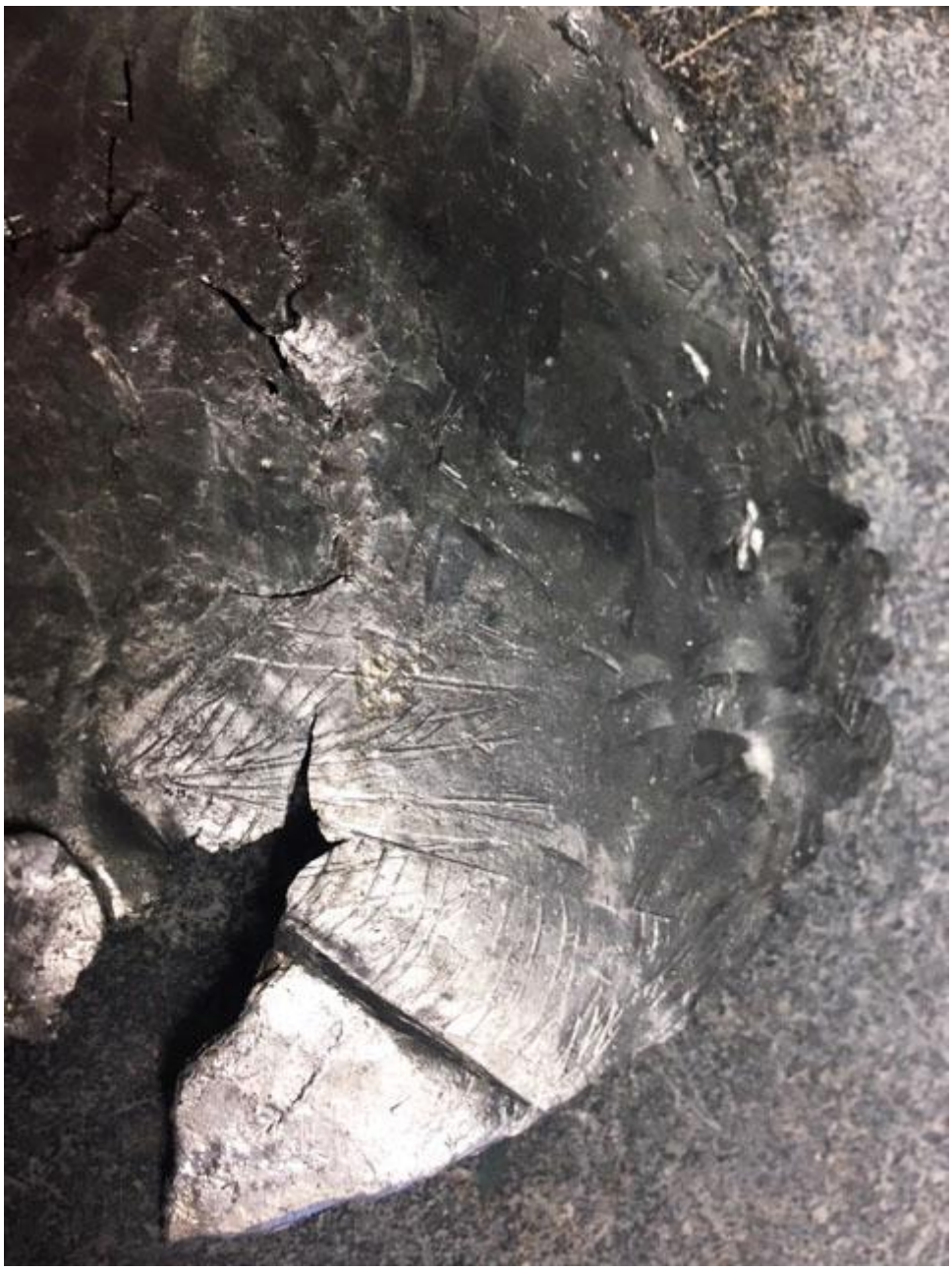

Fig. 4. Design on Hammered Tin. James Buckley, 2018. Once hammered out, the tin seemed to take the design better than it had previously, but time did not permit a full reconstruction.

Intriguingly, the next entry in the manuscript (on fol. 7r (http://edition640.makingandknowing.org/#/folios/7r/f/7r/tl)) offers advice on how to gild and mount the tin ornaments created by following the recipe on fol. 6v (http://edition640.makingandknowing.org/#/folios/6v/f/6v/tl). Included in this subsequent recipe is advice for making an adhesive as well as for creating a gold pigment to be painted on or placed over the tin ornament depending on the materials one had to hand. The result, according to the author-practitioner, is that "it will be beautiful like fine gold." In other words, the intention behind these two recipes, when taken together, is not merely to create pleasant decorations for one's furniture, but also, perhaps, to imitate more expensive, delicately carved furniture decorated with gold leaf. This aspect of the recipe provides insight into the manuscript itself as well as broader social conditions. The author-practitioner's use of art to mimic the properties of materials that would have been more difficult or expensive to acquire, such as gold leaf, suggests the interest among artists and presumably their patrons as well in the value of imitation, even in the context of household furniture. Although individuals who could acquire embellished tin ornaments like the ones the author-practitioner describes already had the means to afford a

certain measure of luxury,16 they nevertheless desired to imitate the styles and fashions of those even wealthier than themselves.

It is clear that the author-practitioner had a detailed knowledge of metals and metalworking. While he was writing in the same period as other authors interested in systematizing knowledge of metals and making it available to learned readers, his goals differed from theirs in important ways. Most obviously, Ms. Fr. 640 exhibits no evidence of attempts to systematize metalworking knowledge. Instead, the author-practitioner focuses on describing the qualities of tin and other metals relevant to his recipes and uses. Moreover, the author-practitioner experimented with tin, lead, and other metals in order to create alloys that would better serve his purposes. In the case examined here, the special properties of tin were exploited to create finely detailed ornaments for household furniture. Furthermore, in light of subsequent recipes attempting to give these ornaments the appearance of gold, it is clear that the author-practitioner had an abiding interest in imitating the properties of rarer or more precious materials through the ingenuity of art, an interest borne out by other essays exploring the manuscript's entries.17 At the same time, the apparent lack

of detail found in recipes like that for tin ornaments on fol. 6v (http://edition640.makingandknowing.org/#/folios/6v/f/6v/tl) raises questions about which of the techniques in the manuscript the author-practitioner had actually tried, as well as the tacit knowledge he possessed, or assumed others would possess, that, although necessary for achieving a successful result, he omitted from the recipe.

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