ADAM VAN VIANEN.

Johan Smith pinxit — *Theodor van Kessel fecit in aqua forti.* — *Christiaen van Vianen excudit.*

The Unsurpassed Silversmithing Techniques of Adam van Vianen: His Silver Ewer Unravelled

• JOOSJE VAN BENNEKOM, ELLEN VAN BORK AND ARIE PAPPOT* •

The brothers Adam (1568/69-1627) and Paulus (c. 1570-1613) van Vianen are celebrated for their works of art in silver in the auricular style,[1] known in Dutch as *kwab* (figs. 1, 2)[2] It flourished in the Netherlands in the early seventeenth century and is characterized by the use of ornaments inspired by anatomy or cartilage, such as skin folds, muscles and skulls, as well as sea creatures like stingrays.[3] The brothers' 'signature style' culminates in Adam's silver ewer (1614), made to commemorate his late brother Paulus, and today one of the masterpieces in the Rijksmuseum's collection (figs. 3, 4). Originally made in silver, it was gilded in Scotland in the nineteenth century.

Adam van Vianen lived and worked in Utrecht all his life.[4] While he developed his high-quality silversmithing skills and unique style in the Netherlands, his younger brother Paulus worked abroad.[5] Paulus began his training in Utrecht. With a great talent for drawing and modelling, he possessed the perfect skill set to become a master in the silversmithing trade; he is documented as working for Duke Wilhelm v in Munich from 1596 until 1601,[6] after which he worked in Salzburg as a *Hofgoldschmied* for Archbishop Wolf Dietrich von Raitenau until 1602. From 1603 onwards, he worked as Rudolf II's court goldsmith in Prague until he succumbed to the plague in 1613.

< *Fig. 1*
THEODORUS VAN KESSEL after JOHAN SMITH, *Portrait of Adam van Vianen*, 1630-60.
Engraving and etching, 263 x 197 mm. Amsterdam, Rijksmuseum, inv. no. RP-P-OB-47.678.

Fig. 2
JACOB LUTMA after JOHANNES LUTMA THE ELDER, *Auricular Cartouche with the Painter (and confidant on art affairs at the court of Rudolph II) Hans von Aachen, the Goldsmith Paulus van Vianen (on the painting), and the Sculptor Adriaen de Vries (in the back)*, 1653.
Etching, 218 x 178 mm. New York, Metropolitan Museum of Art, inv. no. 69.554.6.

Fig. 3
ADAM VAN VIANEN, *Lidded Ewer*, 1614. Silver-gilt, h. 25 x w. 14 x d. 9 cm. Amsterdam, Rijksmuseum, inv. no. BK-1976-75; purchased by the Rijksmuseum, with the support of the Prins Bernhard Cultuurfonds, the Rembrandt Association and the Stichting tot Bevordering van de Belangen van het Rijksmuseum.

Fig. 4
Detail from *Lidded Ewer* (fig. 3)

In Prague, he worked alongside great masters such as Adriaen de Vries and Bartholomeas Spranger. During his travels, Paulus absorbed and adapted styles and techniques by artists from other parts of Europe. He was praised and renowned for his silver objects decorated with figurative scenes, in which he incorporated auricular ornaments (figs. 5-7). The year after his death, the Amsterdam silversmith's guild commissioned Adam to make a commemorative work in silver, a remarkable request that attests to Paulus's great reputation as an artist.[7]

Adam's ewer is still shrouded in mystery. Tradition has it that it was made from a single piece of silver. Von Sandrart, for example, had reported this as early as 1675.[8] Some art historians and art dealers have

Figs. 5-7
PAULUS VAN VIANEN, *Ewer and Basin with Scenes from the Story of Diana*, 1613. Silver, ewer: h. 33, w. 15, d. 8 cm, basin: h. 40, w. 50 cm. Amsterdam, Rijksmuseum, inv. no. BK-16089-A, B.
5 *Basin*.
6 *Ewer*.
7 Reverse of the *Basin* (fig. 5); both the front and back of the dish are fully worked and ornamented.

claimed that several of Adam's objects have an unusually high silver content, making the alloy used in this piece a subject of debate.[9] Is it true that the ewer is made of one piece, and did Van Vianen indeed use a different silver alloy? And was Adam inspired by other artists, or did he himself develop this process for his tour de force? In an attempt to answer these questions, the ewer was submitted to extensive technical examination at the Rijksmuseum metal conservation studio, using X-radiography to study the construction, and X-ray fluorescence (XRF) to analyze the alloy. Reconstructions of silver alloys, based on contemporary sources, were also made to gain insight into the silver refining and alloying techniques at that time.

The Construction of the Ewer

A silversmith has several technical options when making a vessel. It could be cast, although this was not often done, as casting makes the walls of the vessel rather thick, and consequently heavy and expensive. A more common and easier method is to compose the ewer from individual parts; the main body of the vessel is raised, and smaller parts, such as the handle, spout and feet, which are often cast, are attached with solder (fig. 8). The third option is the most challenging: the near impossible method and technique of raising the object entirely out of one piece, including the handle and spout.

Although the ewer had been studied at the Rijksmuseum in the past, and a theory as to the sequence of its fabrica-

tion was presented by Joosje van Bennekom at the symposium held during the *Kwab* exhibition in 2018, there was still no conclusive answer to the question as to whether Adam van Vianen's ewer was made by the third method; raising the object out of a single piece.[10] Pursuing the problem, the ewer was studied again at the Rijksmuseum's new X-ray facilities that same year.[11] The construction is easier to judge if the object rotates while being X-rayed than it is from single radiographs.[12] No solder seam, which can be recognized as a thin white or black line, was found on the body, on the foot or in the delicate decorations around the larger shapes of the body. The only place a thin line did appear was on a small part on the inside of the handle, close to the body (figs. 9-11). The radiographs revealed that the whole ewer was indeed made by hammering one sheet of silver.

If we are to understand the exceptional steps Van Vianen took while creating his ewer, we need to know how the basic shape of a ewer is made. The first step is to cast a flat, relatively thick disc in silver. This is then hammered until it is approximately 1 to 1.5 mm thick and cut or sawn to the right diameter. The process makes silver 'hard' and less malleable. The silversmith judges when the silver is almost too hard to work and requires annealing in a charcoal fire, which relieves the accumulated stress in the material. After annealing, the silver is quenched in water. It is subsequently pickled in an acidic solution to remove copper oxides from the surface, as these oxides are very hard and can cause irregularities if they are incorporated during the next rounds of hammering. After this basic sheet is made, the smith will start raising the silver upwards with a raising hammer. A silversmith has to master this skill to perfection. He aims to hit the silver with the hammer exactly where the

Fig. 8
ANDRIES GRILL, *Ewer and Basin*, 1649. Silver, ewer: h. 27, w. 25, d. 16 cm, basin: diam. 59 cm. Amsterdam, Rijksmuseum BK-NM-13270-A, B; on loan from the Regenten van het Deutzenhofje. The foot and handle of the ewer are both raised separately, the handle has a soldering seam along its back.

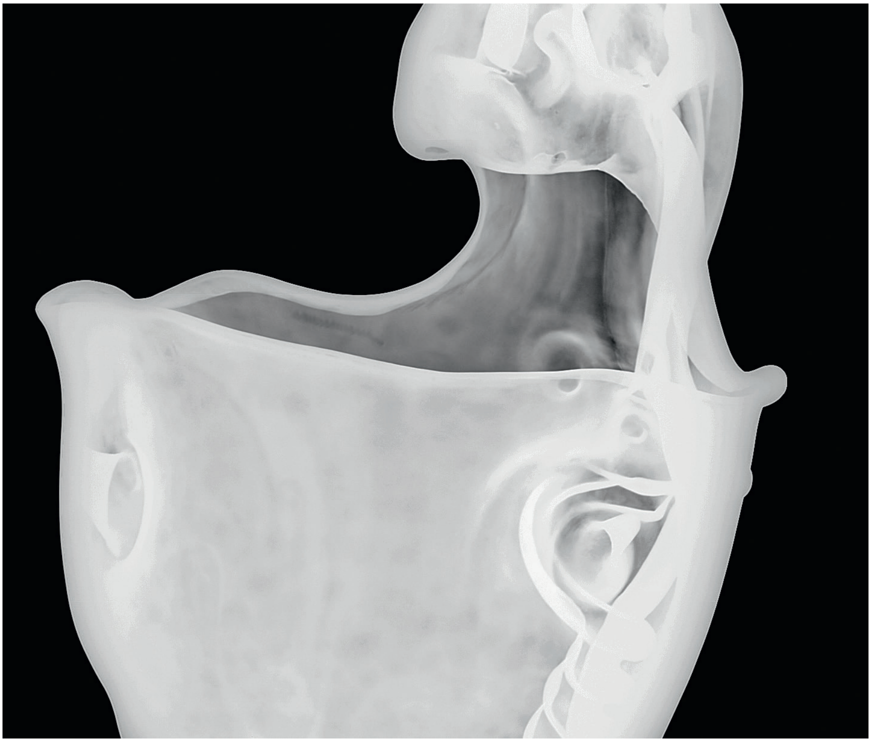
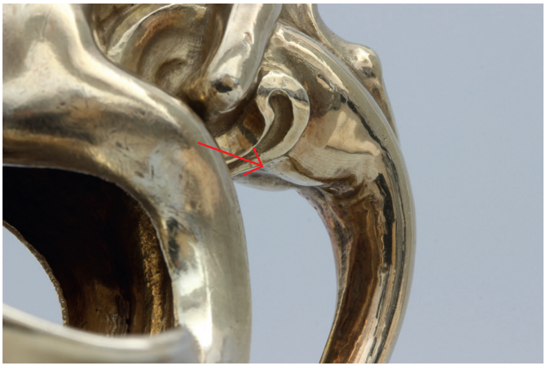
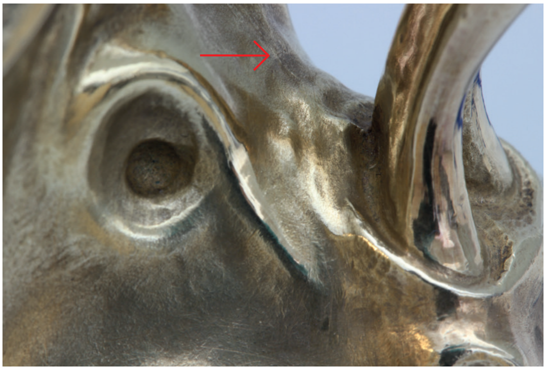
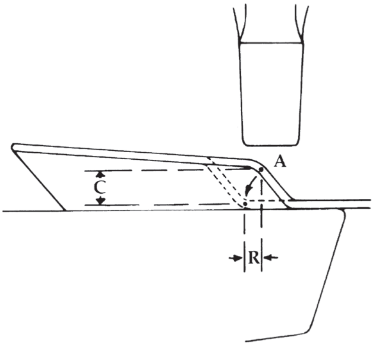


Fig. 9
X-ray of the handle from Adam van Vianen's *Lidded Ewer* (fig. 3). The white hairline at the back shows the seam.





Figs. 10, 11
Details of the handle of Adam van Vianen's *Lidded Ewer* (fig. 3). The thin lines are indicated by the arrows.

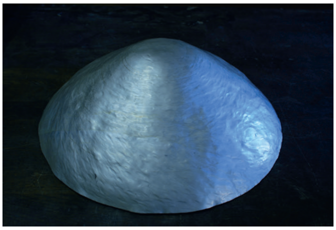


silver sheet can contract over the supporting stake on which the silver is kept at a slight angle (fig. 12). This particular procedure is repeated in many cycles until the desired height and width is reached. When the vessel is to incorporate different shapes, it is filled with pitch. The pitch is resilient enough to absorb the force of the hammer, so that the silver will not

Fig. 12
The raising process, showing a silver plate on a stake. Drawing from R. Finegold & W. Seitz, *Silversmithing*, 1983.
A point of impact
C contraction in radius of the form
R raising, or increase in height of the form

> *Fig. 13*
Work process of raising a silver vessel with a complicated form, step by step. The final picture shows the wax model that was made before the silversmith started working with the silver. Courtesy of Daan Brouwer, silversmith and conservator, Haarlem

stretch or crimp too much, and will only slightly deform in the desired direction. The silver is chased using punches and a forming hammer, from the outside to the inside, and vice versa using a snarling iron. The most intricate forms and delicate patterns can be achieved by this means. A modern representation of this process can be seen in fig. 13.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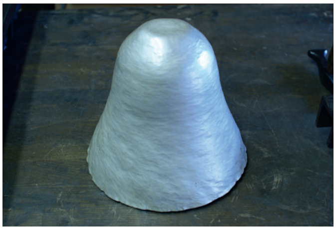
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14


15

The area where Van Vianen's extraordinary skill is most evident is in the fabrication of the handle. It takes great craftmanship to shape the handle out of the same piece of silver as the body, with a hollow part in the middle still connected to this body in two areas. The theory, which was proposed by silversmith Daan Brouwer, is that the main body was formed with a large volume on one side in the shape of a puffed ball (all raised in the silver) (fig. 14). The two opposing sides of the ball were hammered towards each other, forming a doughnut. This is the genesis of the handle: the middle parts touch, and are sawn or cut out to form the open space in the handle. After removing the middle part, the sides were connected with solder and given their final form. The solder seems only to have been used to bring the last parts of the handle together by connecting the sides. Adam van Vianen did indeed succeed in the seemingly impossible task of making the ewer out of one piece of silver, using only a minimum of solder.[13]

Making an object out of a single piece of material, or in one action, without interruption or seams, was a recurring theme in Renaissance art. In his thesis, Edgar Lein describes examples that dwell upon this topic specifically.[14] He states that the concept undoubtedly stems from the urge to match and surpass the Ancients: Pliny notes in his *Naturalis Historia* that the *Farnese Bull*, a marble statue by Apollonius and Tauriskos of Trallas (second century BCE, Museo Archeologica Napoli), was 'carved out of the same block of stone'. There are several Renaissance examples that followed this tradition, among them Michelangelo's extraordinary feat in carving his David out of one piece of marble, as recorded by Vasari and the sculptor's biographer, Asciano Condivi.[15] Making an object in one go seems to have been an artistic and technical challenge of the highest order, and this idea was also picked up by artists working in bronze. Vasari specifically mentions in his *Lives* that the three bronze figures by Rustici depicting the preaching of John the Baptist on the northern portico of the baptistery in Florence, were all cast in one go.[16] Similarly, the Italian Renaissance art critic Pomponius Gauricus stated in his *De Sculptura* (1504) that it was 'stultissimum' (of the utmost stupidity) to join in several pieces what could be made out of one piece.[17] The goldsmith-cum-sculptor Benvenuto Cellini was also driven by the idea of casting in one go so that no finishing of the bronze was necessary; the casting of his Perseus is a good example.[18] Michael Cole concludes in his book on Cellini: 'In stone, the effort was that of competing with the block's physical strength, extending a cantilevered piece from the core as dramatically as possible. With a one-piece cast, this could be converted into the difficulty of leading the metallic flow through the entire mould'.[19] Was this aim to make an object in one go also a topic of discussion in the world

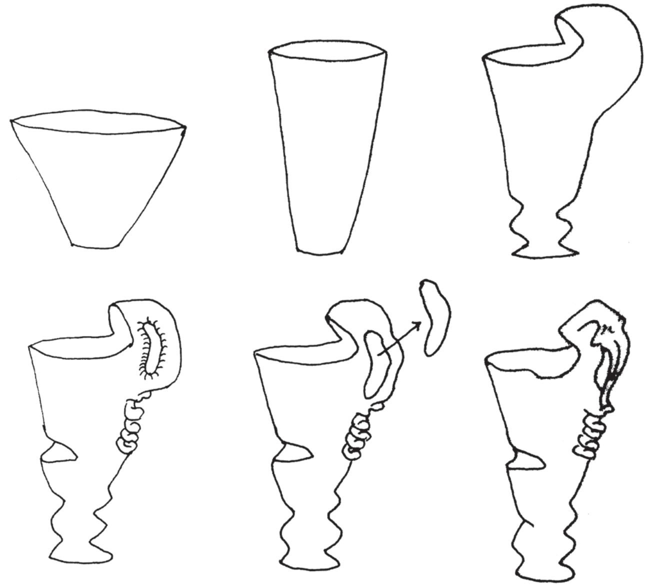


Fig. 14
Proposed workflow of Adam van Vianen's *Lidded Ewer* (fig. 3). Drawing: Joosje van Bennekom

of silversmiths and goldsmiths? Cellini wrote in his *I trattati dell' oreficeria e della scultura* (1568): 'I bossed up in high relief with my punches in the manner I described above, some fifteen little angels without ever having to solder the tiniest rent, and all this I was able to do because of my diligence, my knowledge, my patience and my mastery over all the best methods of workmanship.'[20] Cellini's statement about embossing and hammering with the avoidance of seams and solder, is the real challenge in silver, and was clearly seen as a particular sign of ingenuity. Ideas about the level of skill a sculptor should have echoed through the Renaissance world: just being a skilled craftsman was not enough, artists and artisans should develop professional awareness and reach for the highest technical challenges. Whether Adam was indeed influenced by previous manifestations of this concept, such as Cellini's famous *Saliera*, an object he would have known well, or came up with the idea by himself, he was certainly the first silversmith to set himself this challenge again and again, thus contributing to the long history of making an art object 'out of one piece'.[21]

Silver in Sixteenth- and Seventeenth-Century Europe

In the seventeenth century most silver came from four locations: the Erzgebirge in Germany, the Schwaz mine in Austria, and the mines in Bolivia (Potosi) and Mexico (Zacataces, Guanajuato).[22] Silver was often extracted from the lead-silver ore in the vicinity of the mine. It could be traded as ingots (fig. 15),

Fig. 15
Fragment of a Wooden Chest with 18 Silver Ingots, from the East-Indiaman 'Slot ter Hooghe'.
Ingots: silver, l. 14 x w. 3.5 x d. 3.5 cm, chest: wood: l. 60 x w. 27 x h. 35. Amsterdam, Rijksmuseum, inv. no. NG-1983-3. The chest sank in the Indian Ocean in 1790. These ingots were produced by the Mint of Middelburg, possibly from recycled metal.

Fig. 16
ADAM VAN VIANEN, *Map and Profile of the City of Utrecht*, 1598. Engraving, 394 x 521 mm. Amsterdam, Rijksmuseum, inv. no. RP-P-1939-990; gift of F.G. Waller, Amsterdam.
● Adam van Vianen's house, on the corner of the Zakkendrager-steeg/Oudegracht near the Jansbrug.
● The goldsmiths' guildhall since 1598 at Bisschopshof, where the old Mint was situated until 1586.
● St Eloy's Hospice, the smiths' guildhall, where Adam was a member until the new goldsmiths' guild was founded in 1598 situated at 22 Boterstraat.
● The new (1586) location of the Mint near the Munt-of Sacksteeg (Kromme Nieuwe-gracht).

but was usually supplied straight to a local mint for coinage. Both ingots and coins were a medium of exchange in trade. It seems unlikely that ingots were used by silversmiths, as they commonly used silver coins to make objects, often given to them by the client who commissioned the work. It would be a big investment for a silversmith to buy an ingot as stock, unless he had a commission. The famous sixteenth-century German silversmith Wenzel Jamnitzer (1508-1585), for example, wrote in his letters that he was waiting for *Joachimsthalers* (silver coins) that Ferdinand I, the Holy Roman Emperor, had promised to send him before starting on a new object, indicating that the silver was provided by the client beforehand.[23]

Adam van Vianen's Silver

Adam van Vianen lived near the Mint, on the east side of de Oude Gracht, situated between the Viebrug and the Jansbrug.[24] In 1567, Philip II founded a central mint to centralize the coinage and ensure quality control in the Netherlands. The Mint's first location was at the Bisschopshof, near Utrecht Cathedral (Servetstraat, parallel to Lichte Gaard). It moved to a new building at Munt- or Sacksteeg (now Kromme Nieuwgracht) in 1586. The premises of the former Mint were converted into their guildhall (fig. 16) by the newly established Silversmith's Guild in 1598.[25] The inventory of the old Mint, such as cupellation or melting furnaces, was probably left behind and thus was ready to use. Van Vianen was the assay master at the guild between 1606 and 1607 and 1610 and 1611, and guild master from 1615 to 1616. He must therefore have had extensive knowledge of the chemical properties of silver.

Van Vianen most likely worked with the various silver coins used in and around Utrecht available at that time. The quality of the most commonly used coin, the *Rijksdaalder*, contained *10 penningen and 15 greynen fijn zilvers* (889/000 parts of silver in total weight, or 88.9 %), while the *Hollandse Daalder* contained *negen penningen fijn zilver* (around 808/000).[26] The quality demanded in Utrecht for silver objects with the *grote keur* (the mark used for the highest quality of silver) was *11 penningen and 8 greynen zilver (remedie drie greynen)* (934/000).[27] We know that some of the 'best' daalders contained more silver than necessary, the same amount as the *grote keur*, and could be used directly for the fabrication of objects.[28] However, the trade and melting of silver and silver alloys was highly regulated in the Netherlands. In 1520, the ordinance of the currency system prohibited silversmiths from melting or selling coinage and silver alloys without bringing them to the mint.[29] This implies that the silversmiths could not have worked with coinage, and were dependent on the Mint for their silver. A later ordinance dated 1586 declared that money changers were not allowed to sell any silver or bullion to the silversmiths.[30] In 1606 a new currency ordinance ruled that money changers were allowed to sell silver to silversmiths, but only for use in their workshop and nowhere else.[31]

Whether these regulations were always complied with is not easy to establish. Their existence at least indicates that silversmiths often used currency for trade or as raw material, a situation adversely affecting the local currencies. As silversmiths appear to have received silver coins from their clients, they must have had ways of checking and adjusting the purity to match the grade set by the guild. Some silversmiths might have refined small quantities of silver in their own workshops, and these could be added to a larger, low grade batch to raise the silver content. Others may have turned to the local mint to acquire high purity silver for the same purpose.

As we saw in the introduction, it has been said that some of Van Vianen's objects have a very high silver content. However, these measurements were often done by different institutions with variations in the settings of the equipment used, and only on very few areas of the silver.[32] Such limited measurements can give unrepresentative results. The *Kwab* exhibition at the Rijksmuseum in 2018 presented the perfect opportunity to determine the alloy of several works made by Adam van Vianen using the same method, as many of his objects were brought together.[33] Five objects by Adam van Vianen were suitable for analysis (fig. 17).[34] Their alloy was analyzed with X-ray fluorescence (XRF).[35] X-ray fluorescence is an analytical technique that can be used non-destructively to determine the alloy composition of metals.[36]

Figs. 7a-e
The silver alloy of these five objects by Adam van Vianen was measured by means of X-ray fluorescence.

a) *Lidded Ewer*, 1614
Amsterdam, Rijksmuseum, inv. no. BK-1976-75.

c) *Ewer with Scenes Depicting the legend of Marcus Curtius*, 1619.
New York, Metropolitan Museum of Art, inv. no. 2018.194a/b.

b) *Ewer*, c. 1620
Amsterdam, Rijksmuseum, inv. no. BK-NM-11402.


a


b


c

d

d) *Cup*, 1618
Amsterdam,
Rijksmuseum,
inv. no. BK-NM-12539.

e) *Dish*, 1624
Amsterdam,
Rijksmuseum,
inv. no. BK-1956-25.

e

This technique is currently used to measure dated Dutch silver with a reliable provenance in the Rijksmuseum collection and others. These chemical data can provide information about when or where an object was made and shed light on workshop practice throughout history. Interestingly, all five of the objects that were tested proved to have a much higher silver content (97-98%), and a lower copper and bismuth level than is commonly found in works by Van Vianen's contemporaries,[37] or was required by the assay office (93.5%) (fig. 18).[38]

Adam most likely used this type of alloy because it is more malleable, so he could obtain extreme deformation without cracking. Today, some modern silversmiths work with a high percentage silver for exactly this reason.[39] Interestingly, the lower bismuth percentage was only found in Van Vianen's later works, the highly raised ones, where the silver was deformed to a great extent. This change in the composition of the material could be because his designs became more extreme, which demanded more from the silver's suitability in terms of deformation. Adam was unique among his contemporaries in using this low-bismuth, high-purity alloy, which he might have prepared himself. As assay master at the guild, he would have had the equipment and knowhow to do so.

Historical Silver Refining Techniques

To better understand Adam's choice of material, we researched the known silver refining techniques at the time, and used these techniques to refine silver in the same way, to see how pure the silver would be after refining, and to establish whether these refining methods delivered a similar alloy to the one Adam van Vianen used. Contemporary sources were consulted to determine what kind of silver refining recipes were in use in the sixteenth and seventeenth centuries that could have been used by the mint or in a private workshop to produce workable silver. Most publications on silver ores, mining and extracting metal from the ore were written by Germans, as many silver mines in the sixteenth century were situated in the Habsburg area (now Germany, Austria and the Czech Republic). We selected two contemporary books published on a larger

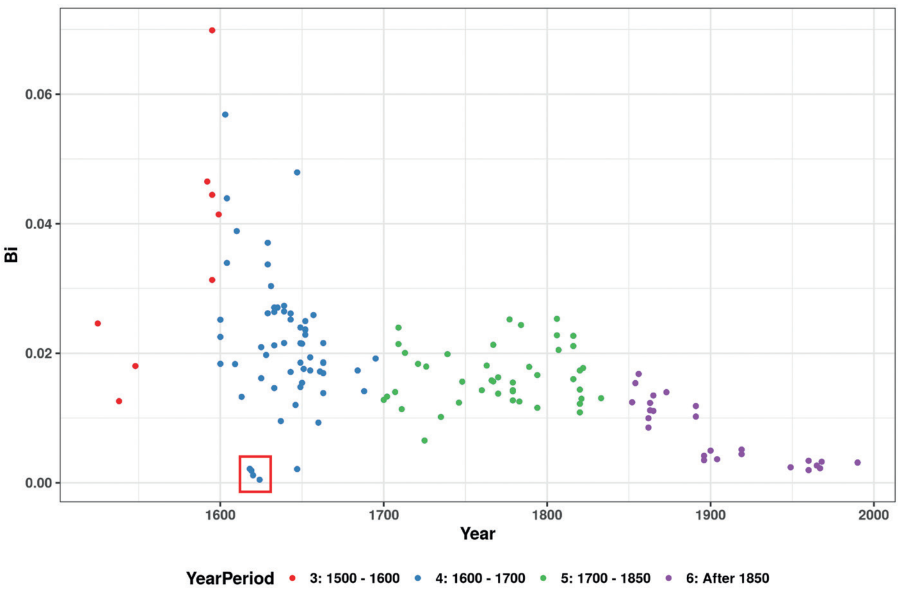


Fig. 18
Bismuth (Bi) mass percentage of the five silver objects by Adam van Vianen (fig. 17) and provenanced silver objects from the Netherlands, measured by means of X-ray fluorescence. The dots in the red rectangle represent the median of the alloy of the highly raised objects made by Adam van Vianen, the other dots are silver objects from the Netherlands, made in different periods.

scale in German, giving the most precise descriptions of recipes on refining silver: Calbus of Freiberg (and unknown authors), *Bergbuchlein und Probierbuchlein*, Leipzig 1524,[40] and Lazarus Ercker, *Beschreibung aller-fürnemisten Mineralischen Ertzt, und Bergwercks arten, wie dieselbigen, und eine jede insonderheit, der Natur und Eigenschafft nach, auff alle Metale Probirt,* Prague, 1574 (figs. 19, 20).[41]

As well as the information on parting noble metals and assaying, these books provide more practical tips, for example how to make silver more malleable, or how to refine silver on a larger scale before making an object. It appears that other books, such as Agricola, *De Re Metallica*, of 1556, or much later publications such as the 1721 Dutch text by Willem Van Laer, the *WegWyzer voor Aankoomende Goud en Zilversmeden*,[42] all describe a roughly similar silver refining recipe for a larger amount of silver. This tells us that down the centuries silver refining was performed in the same way until the nineteenth century, when different processes took over. Since Freiberg and Ercker's books both give an almost identical recipe for


Probier büch-
lein/auff Gold/Silber/kupffer/
vnd Bley/Auch allerlay Metall
wie man die zů nutz arbayten vñ
Probieren soll.
Allē Müntzmaystern/Wardeyn/Gold
werckern/Berckleüten/vñ kauffleütē
der Metall zů nutz mit grossem fleyß zů
samen gebracht.

Fig. 19
A silversmith weighing silver (probably after cupellation), at the back a furnace. Engraved title page of Calbus of Freiberg, *Probierbuchlein*, 1534 edition (Augsburg). Munich, Bayerische Staatsbibliothek. Rar. 4351, https://www.digitale-sammlungen.de/de/view/bsb10862382

Fig. 20
Refining according to the test procedure. Woodcut from Lazarus Ercker, *Beschreibung: Allerfürnemisten Mineralischen Ertzt, und Bergwercks arten* …, Prague 1574, p. 62. Munich, Bayerische Staatsbibliothek, BHS I C 182, https://www.digitale-sammlungen.de/de/view/bsb10173803

A furnace
B air vents
E scorifier
F test
H muffle
K ball to make the test in ash
N cooling water test
L hammering the silver after melting

Fig. 21
Furnace for refining silver on a larger scale according to Agricola descriptions in the area where the experiments by means of the test procedure were carried out.

purifying a larger quantity of silver by means of a 'test' (scorifier), this recipe was selected as the most important to investigate.[43] Freiberg's recipe was chosen as the guideline, and parts of the recipe that were relevant for our research are given below. The recipe states: 'Take an iron ring, two or three fingers high, depending on how large a piece of silver you want to have, which, for up to fifteen marks [of silver],[44] should be one span wide. Fill the ring with crushed bone ashes that shall have been passed through a fine sieve and shall be slightly moistened, and pound as hard as you can. Then hollow out the inside of the test to the shape that the piece of silver is to have … When you have made the test as described, put it in the forge or between burnt brick, pile charcoal all around it, and leave the empty test two, three, or four hours in the fire to let it bake and become thoroughly aglow … Next put it in fresh fire and put the silver right in it. Let it melt unassisted and when it starts to drive, remove the charcoal and dust from the test and with dry birch wood or a large piece of fir or birch charcoal build a bright fire on the test … let it continue to cupel until you see the little flames disappear and fade, and it blicks.[45] If you extinguish [the fire] at this point and quench [the silver] you have crude silver. If you [wait until] it becomes enveloped in clouds and darkness and then remove it from the fire and quench it, it is called fire-refined silver. And if it becomes 'back' again and shines and looks beautiful, it is fine silver.'

The test method is similar to cupellation, except that the cupellation method was used by silversmiths and syndics of the guild for refining small quantities, to test the percentage of silver in an alloy. The test procedure is used for refining on a larger scale, for example in the mint, where ingots from the mine were worked for a higher percentage of silver, but it could also have been used in-house by silversmiths to produce a clean piece of silver for making an object. They would have used the refined silver with copper as an alloying element, to achieve the exact silver percentage they required.[46]

Reconstructions

Reconstructions of the selected refining recipes were carried out at the experimental platform at the open-air museum of the Carolingian silver mines in Melle (figs. 21, 22).[47]

The Rijksmuseum metals conservation studio developed a so-called 'historical alloy' for tests on silver conservation. This alloy contains copper as the main alloying element, and traces of bismuth, lead and zinc, which are found in silver from before 1875. After this date the electrolytical refining method came into use; this produces very pure silver with few if any trace elements. As X-ray fluorescence analyses showed that the lead and bismuth content in the historical alloy was slightly higher than that found in historical objects, this alloy was used for the experiments, as it was expected that refining this alloy would give a clear drop in the bismuth level. The full results of this research are presented at length in another publication.[48] The most important experiment, the test procedure mentioned in both books, will be discussed here, as it gave the most interesting results in relation to the silver Vianen used.[49]

Fig. 22
Cupellation furnace used for the experiments by means of the test procedure.

The Test Experiment

For the experiment some changes were made to the Calbus recipe, or a combination was made with the Ercker recipe, as not all the steps could be carried out as prescribed, however the most important steps in the recipe were followed (figs. 23a-d). An earthenware dish was used instead of an iron ring. The only function of the ring – and dish – is to contain the bone ash. The dry bone ash was moistened until it was the consistency of peanut butter. It was then moulded in the scorifier and dried for 24 hours. After drying, a hollow was made in the inside of the bone ash and smoothed with an agate ball (fig. 23a). An oven was used as seen in fig. 22. This is a replica of an eighteenth-century cupellation furnace, which would have worked on the same principles as a seventeenth-century furnace. The furnace was heated using charcoal on top of an earthenware muffle (fig. 23b), and an automatically generated air draught from underneath the furnace (the red rectangle at the bottom of the furnace in fig. 22). The fire could be made 'hotter' or 'colder' by keeping the door shut or by opening the door in front of the tray where the scorifier was placed (fig. 23c).

The historical silver made by the Rijksmuseum was cut into pieces and a calculated amount of lead was added (fig. 23d),[50] after which the test was placed in the oven. After approximately fifteen minutes the silver and lead were molten. The lead can be seen drifting on the silver, rolling around on the surface. After about one hour, all the lead had been absorbed and evaporated from the surface, showing a bright orange molten dome of silver. This is

Figs. 23a-d
Different stages of the test experiments for refining silver.
a) Agate ball in bone ash.
b) Muffle (brick colour) inside the oven.
c) Regulating the temperature.
d) Lead on top of silver before melting.

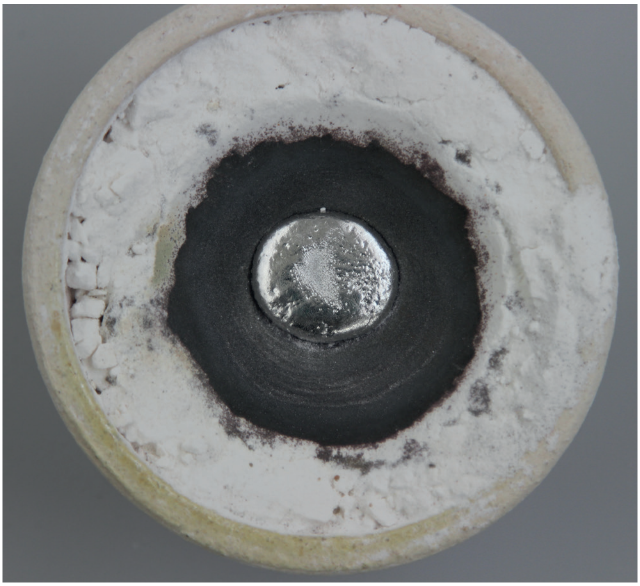

a


b


c

d

Fig. 24
An earthenware test (scorifier), seen from above, filled with bone ash, in the middle the 'bullion', which is the refined silver.



the *blick* moment as referred to in the texts. It is said that the word *blick* derives from the Old Dutch verb *blikken* (flickering), or from the Dutch noun *bliksem* or the German verb *blitzen* (lightning), a sudden bright moment.[51]

The result of the test procedure can be seen in fig. 24: an earthenware scorifier, filled with bone ash. In the middle is the bullion, which is the refined silver. Around the bullion the oxides are seen as a dark circle of the oxidized impurities removed from the silver. The yellowish hue at the border of the scorifier derives from the lead (II) oxide – litharge – that formed as a precipitate from the evaporated and oxidized lead fumes. The silver content of the bullion was not 100% but stayed at 98-99 %, while the bismuth content was almost exactly the same as found in the alloy Van Vianen used (fig. 25). After several hammering, annealing and pickling cycles, actions that Adam's silver would have been subjected to when he was making his objects, the percentages stayed nearly the same.[52]

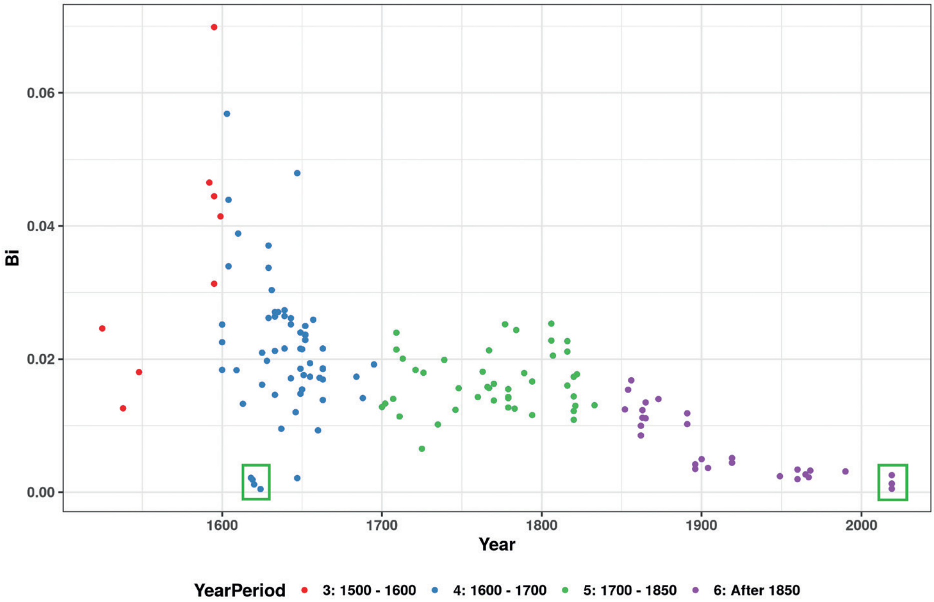


Fig. 25
Bismuth (Bi) mass percentage for silver submitted to the test procedure, measured by means of X-ray fluorescence. The dots in the green rectangle on the left indicate the median of the bismuth content in the silver by Adam van Vianen, the dots in the green rectangle on the right the bismuth content in the silver made according the test procedure. The other dots are silver objects from the Netherlands, made at different periods.

The 'test' silver appeared to be very malleable (fig. 26), and it could be stretched in several hammering rounds. Some cracks appeared around the borders. These borders are susceptible to cracking as they are rather thin, and because of the irregular shape of the bullion.

It is quite possible that Adam van Vianen prepared silver himself according to the prevailing refining recipe in his time, the test procedure. The Mint used this test procedure for preparing the silver, as an instruction in a book for Dutch coin masters

Fig. 26
The test recipe bullion after hammering, annealing and pickling.

dating from 1590 indicates, so he could have also retrieved his silver there.[53] Instead of alloying it with copper as was commonly done, he would have used it in its pure form to facilitate the extreme deformation of the silver.

There is one remarkable difference between the refined silver retrieved with the test procedure and the silver Van Vianen used: Van Vianen's silver contains slightly more copper (approximately 1.5%, instead of the 0.3% of the refined silver). The copper percentage in Van Vianen's silver is not as high as was common for other contemporary silversmiths though (approximately 6-7%). As we have seen, it was common practice to alloy the refined silver with copper to the required guild standard. Lazarus Ercker's recipe does specifically mention the possibility of adding copper after refining so that the silversmith will not have a higher silver content than is necessary for the assay.[54]

An explanation for the slightly higher copper content in Adam van Vianen's silver than in our reproductions could be that in the end the test procedure silver was too soft and therefore vulnerable, the reason why Van Vianen might have purposely alloyed this silver with a small amount of copper, making the silver sturdier and more resilient to wear and tear.[55] As yet, Adam van Vianen is the only silversmith known to have used this very pure silver, according to the Rijksmuseum database of Dutch silver. Could his long career as a quality master and the vicinity of the main mint of the Netherlands have given him the opportunity to experiment with materials more easily? Or might he have been driven by another incentive, alchemy, motivating him to experiment with the purest metals, as is quite convincingly posited as a field in which Adam van Vianen was interested by Jessica Whittle in this Bulletin.[56]

Conclusion

This research provided further insight into Adam van Vianen's work processes and helped to unravel the myths surrounding his extraordinary ewer. It shows that the ewer is truly unsurpassed in many respects. X-radiography examination proved that the ewer is indeed made out of one piece of silver, with a very small, unavoidable solder seam in the handle. As far as we know, he was the first silversmith to set himself the challenge of making a ewer out of one piece of silver. A brother with connections in the highest circles at different courts, where the latest innovations in material, techniques and trends were studied, could have given Adam an added incentive to develop his skills. This object can therefore be seen as a technical tour de force in silversmithing. The very pure silver alloy he used adds to its singularity, as Van Vianen seems to be the only Dutch Renaissance silversmith who used this pure silver to create his raised objects. Working in Utrecht as a quality controller for the guild, and living near the mint, surely contributed to his knowledge of metallurgy. He must have been aware that very pure silver is more malleable, and therefore the best material to meet his needs. The reconstructions based on contemporary sources showed that it is possible to obtain this very malleable silver alloy with unusually low levels of impurities. It is not clear whether he made the alloy himself or if he retrieved ingots from the mint.

This close study of Adam van Vianen's magnificent ewer shows that a combination of extraordinary artistic and technical skills created the momentum for Adam van Vianen to break away from traditional methods and perfect his skills.

ABSTRACT

The magnificent gilded silver ewer Adam van Vianen made in 1614 to commemorate his brother Paulus van Vianen who had died the previous year in Prague, is the pinnacle of the *kwabstijl,* and of Dutch silversmithing in general. The execution of the raising and embossing is exceptional and had never seen before. Von Sandrart specifically stated in his book that Adam made the whole object out of one piece of silver. It is quite possible that Adam van Vianen applied himself to a quest that many sculptors undertook in the Renaissance: making an object under the most challenging circumstances in their area of expertise. A ewer traditionally consists of a body, foot, handle and a lid with a hinge, which are soldered or screwed together. Adam van Vianen, however, integrated all these separate parts into one dynamic, swirling form, and the absence of clearly separated parts seems to confirm that the ewer is made out of a single piece. To determine once and for all whether the ewer is made out of one piece of silver sheet, an expert team researched the ewer with the aid of X-radiography and formulated a theory as to the way the ewer's handle was constructed. The research also covered the alloy in Adam van Vianen's ewer and other objects by his hand in the Rijksmuseum's collection, and outlined the background of available knowledge on silversmithing in the Netherlands in the seventeenth century, and the products available at that time. Finally, reconstructions of silver refining were carried out using two contemporary sources: *Bergbuchlein und Probierbuchlein* by Calbus of Freiberg (and unknown authors), Leipzig 1524, and Lazarus Ercker's *Beschreibung: Allerfürnemisten Mineralischen Ertzt, und Bergwercks arten …* Prague 1574. The complete alloy research in the Rijksmuseum laboratories showed that the alloy was very different from alloys used by other Dutch silversmiths in the same period. A surprising outcome that could very well be connected to the demands Adam van Vianen made on his material.

NOTES

* With thanks to Robert van Langh, Dirk Jan Biemond, Frits Scholten, Florian Téreygeol, the metal conservation team at the Rijksmuseum, Daan Brouwer, Tonny Beentjes and Hiroshi Suzuki.

1 Johan ter Molen, *Van Vianen. Een Utrechtse familie van zilversmeden met een internationale faam*, Leiden 1984 (diss. Leiden University), part 1, pp. 29-30.

2 The term *kwab* has been in use since the late nineteenth century. Before that, this style did not have a name and the ornaments were referred to as grotesque forms (or *snakerijen* in Dutch), see Reinier Baarsen and Ine Castelijns van Beek, *Kwab: Ornament as Art in the Age of Rembrandt,* Amsterdam (Rijksmuseum) 2018.

3 Ter Molen 1984 (note 1), part 1, p. 49.

4 See G. Brinkhuis, 'Het Utrechts Zilversmeden geslacht van Vianen', *Jaarboek Oud Utrecht* (1974), pp. 198-214, esp. p. 202.

5 Ter Molen 1984 (note 1), part 1, pp. 17-34.

6 Ibid., part 1, p. 19.

7 Theresia M. Duyvené de Wit-Klinkhamer, 'Een vermaarde zilveren beker', *Netherlands Yearbook for History of Art/Nederlands Kunsthistorisch Jaarboek* 17 (1966), p. 96.

8 'Die Stadt Amsterdam hat zu seiner Gedächtniss ein Giesskandel mit dem Deckel ohngefehr 1 1/2 Spannen hoch aus einem Stück Silber getrieben färtigen lassen, worauf alles in Groteschen oder Schnackerey, wie sie solches nennen, gebildet; wird für ein wunder-seltsames Stuck gehalten', J. von Sandrart, *Teutsche Academie der Edlen Bau-, Bild- und Mahlerey-Künste*, Nuremberg 1675, p. 223.

9 The distinctly higher percentage of silver was noticed in earlier research by Louise van den Bergh-Hoogterp into silver from Adam van Vianen's *Ewer with Scenes Depicting the legend of Marcus Curtius*, 1619, now in the Metropolitan Museum of Art, New York, inv. no. 2018.194a, b, see Louise van den Bergh-Hoogterp, 'Een schenkkan van Adam Van Vianen nader bekeken', *De Stavelij* 14 (1999), no. 1, pp. 4-9. Art dealers Jacob Roosjens and Emiel and Esther Aardewerk also mentioned the unusual composition of the alloy to Joosje van Bennekom on various occasions.

10 Symposium *Kwab: New Discoveries*, 13-14 September 2018, Rijksmuseum, Amsterdam.

11 X-ray system: baltograph generator XSD225 with X-ray tube TSD225/0 and control unit LSI.

Focal spot size 1mm (640W) and 5.5 mm (3000W). Water cooling unit WCU3000. Image made with CR: Image plates (IP's) with a Duerr HD-CR 35 NDT CR-scanner, 95kV; 6,7 mA resolution 25-1—µm. Augmenting the pictures, the life-time view setting was used for the final evaluation of the object.

12 The authors, Tonny Beentjes, lecturer in metal conservation at the Conservation and Restoration of Cultural Heritage programme at the University of Amsterdam, and Daan Brouwer, metal conservator and silversmith, were present.

13 Louise van den Bergh-Hoogterp visually observed a similar technique on Adam van Vianen's *Ewer with Scenes Depicting the Legend of Marcus Curtius* which is not gilded and has a much clearer seam on the inside of the handle, see Van den Bergh-Hoogterp 1999 (note 9). It is interesting to note here that, inspired by this research into Van Vianen's technique, the silversmith Daan Brouwer hammered a silver ewer (*Hephaistos*, 2020) with body and handle made using the same method as described in this article.

14 Edgar Lein, *Ars aeraria: die Kunst des Bronzegiessens und die Bedeutung von Bronze in der florentinischen Renaissance*, Mainz am Rein 2004.

15 Irving Lavin, 'Ex Uno Lapide: The Renaissance Sculptor's Tour de Force', in Matthias Winner et al. (eds.), *Il cortile delle statue. Der Statuenhof des Belvedere im Vatikan*, Mainz 1998, pp. 190-210. Frits Scholten made us aware of the publications dealing with the subject of 'ex uno lapide'.

16 Giorgio Vasari, *Le vite de più eccellenti pittori, scultori e architettori*, 1568. English edition: *Lives of the Most Eminent Painters, Sculptors and Architects* (transl. J. Foster), vol. 5, London 1864, p. 66.

17 Quoted in Lein 2004 (note 14), p. 129.

18 Michael Cole, *Cellini and the Principles of Sculpture,* Cambridge 2002, p. 49.

19 Ibid., p. 49.

20 Benvenuto Cellini and C.R. Ashbee, *Benevenuto Cellini: The Treatises of Benvenuto Cellini on Goldsmithing and Sculpture*, New York 1967, p. 56.

21 The famous *Saliera*, which Cellini made in 1543 for King Francis I of France, was given to Archduke Ferdinand II in 1570. It subsequently came into the possession of the Holy Roman Emperor Rudolph II in 1605. The ornaments Paulus van Vianen made three years later for a jasper jug, made by Misseroni in Milan in 1590, seem to have been inspired by this large salt cellar. The reclining figures at the base of the two objects are noticeably similar (the ones by Cellini were inspired by Michelangelo). Paulus must have studied the object thoroughly, which gave him the incentive to aim for a similar technical tour de force.

22 Liesel Gentelli, *Analysis of 16th to 19th Century Silver Coin*s, Albany (diss. University of Western Australia) 2017, pp. 43-46, see https://doi.org/10.4225/23/59f2938acef6a. Silver from Austria was processed via the Saigerhutten process (lead added to refine), the silver from South America via the patio process (mercury added to refine).

23 'Was dann dem Erzherzog gefällig sein werde, wolle er mit allem Fleisse machen. Das Silber, welches ihm durch den Münzmeister in Joachimsthal hätte zugesendet werden sollen, sei ihm noch nicht zugekommen. Nach Empfang desselben werde er das Werk sofort unter die händ nehmen', letter from Jamnitzer to Ferdinand I, 24 April 1559, *Jahrbuch der Kunsthistorischen Sammlungen des Allerhöchsten Kaiserhauses* 11 (1890), p. CLXXXII, see https://digi.ub.uni-heidelberg.de/diglit/jbksak1890/0537.

24 Ter Molen 1984 (note 1), p. 30. See also Het Utrechts Archief, *Insinuatie van protest ...,* 9 February 1628, 34-4, inv. no. U016a001. In this deed Van Vianen's last address, where he died (*sterfhuis*) was recorded as Oudegracht, corner of Zakkendragerssteeg, near the Jansbrug. For more information on Adam van Vianen's activities, see P.W. van der Meulen, *Costumen, usantien, policien ende styl van procederen, der Stadt, jurisdictie ende vryheid van Utrecht*, Utrecht 1709, p. 26. In this work, a case involving the brewer Van Vianen was used as an example of laws specific to Utrecht. Summarizing, it states that in the years running up to 1613 Adam was in conflict with a fellow brewer, Cornelis van Meerevelt, and claimed 147 guilders because Cornelis had delivered beer to a certain Griepman, which was in breach of the regulations of the Brewers' Guild. In 1787 there was still a brewery on the site where Adam lived for much of his life (Zakkendragerssteeg, on the corner of Oudegracht), see the notarial deed of the sale by Margaretha Constantia Rulland of the house, breweries, ground, cellar and safe, named 't Hart on the Zakkendragerssteeg/Oudegracht in 1787, Het Utrechts Archief, 34-4, inv. no. U 24 2a 019 HV.

25 Many thanks to Janjaap Luijt, historical researcher in Utrecht, who verified the locations pinpointed, and made some helpful suggestions about the location of the guild.

26 'Placaaet, soo opten cours vanden Gelde, als Opte Politie ende Discipline vande Munte, Muntsslach, mitsgaders van de wissele ende Wisselaers, 19 december 1603', Jan Janssen (publ.), *Nederlantsche munt-boek: Vervatende de voornaemste placcaten ende ordonnantien sedert den jaere 1580 tot in den loopende Jare*, Amsterdam 1645, p. 36.

27 'XVI third part "Ordonnantiën Keyser Karel op de Goud & Zilversmeden 13 april 1551", Interpretation 1648', J. van de Water (ed.), *Groot placaatboek vervattende alle de placaten, ordonnantiën en edicten der edele mogende heeren Staten 's lands van Utrecht: Mitsgaders van de ed. Groot Achtb. Heeren Borgemeesteren en Vroedschap der Stad Utrecht tot het jaar 1728 ingesloten*, Utrecht 1729, unpaged.

28 H.E. van Gelder, 'De Daalder in de Nederlandse Geïllustreerde Muntboeken', *Jaarboek voor Munt- en Penningkunde* 74 (1987), pp. 21-81, esp. p. 48.

29 *Muntplakkaat 1502* and *Muntplakkaat 1551,* in W.C. Meers, *Proeve eenen Geschiedenis van het bankwezen in Nederland, in de tijd der Republiek*, Rotterdam 1838, p. 22.

30 Els Vercouteren, 'De geldwisselaars in Brabant (1430-1506): een bijdrage tot de economische geschiedenis van de Zuidelijke Nederlanden', *BMGM Low Countries Historical Review* 100 (1985), no. 1, pp. 3-25. Money exchangers could travel around as independent workers, or work at a bank in a city.

31 *Muntplakkaat 1606* in Meers 1838 (note 29), p. 23.

32 The silver alloy was often determined by scraping a small amount of silver from places that would not leave visible marks. The silver was then analyzed by cupellation or potentiometric silver titration. Because these are both destructive methods, it is more difficult to find suitable locations for sampling, fewer samples can be taken, and there is a chance that the samples are not representative. The possibilities for XRF research were researched for their usability.

32 Exhibition *KWAB. Dutch Design in the Age of Rembrandt*, 30 June-16 September 2018, Rijksmuseum, Amsterdam.

33 Six objects by Adam van Vianen were measured. It was only possible to measure the objects with a silver surface. A cup dating from 1625 (BK-16093) was also measured, but the remnants of gilding interfered, so comparable data could not be obtained.

34 The ewer (BK-1976-75) could be measured on the back of the inner cup.

35 Olympus handheld Delta calibrated with a silver standard set from the Ashmolean Museum, Oxford, with many different ranges in impurities. Measuring time 30 seconds, 40KV. This database was started to see whether some groupings could be seen by XRF, although the data are not as precise as the other (destructive) analytical techniques commonly used for silver analysis (ICP-MS, potentiometric). At the moment, all the silver data are being reworked by Gerben Mooiweer, statistician at the Rijks Universiteit Wageningen, in an R driven database, which offers more analytical possibilities, such as PCA. The first results of a Partial Least Squares (PLS) regression analysis showed that the group of heavily worked objects made by Adam van Vianen differs significantly from his contemporaries' work in more than one element. However, more data would always be desirable.

36 Aaron Shugar and Jennifer Mass, *Handheld XRF for Art and Archaeology*, Leuven 2012.

37 Two objects by Paulus van Vianen were also measured.

38 1 penning = 24 grain and 1 grain = 3,742/000; 11 penning and 8 grain (with remedy 3 the lower border becomes 5 grain) = 934/000 parts of silver.

39 Hiroshi Suzuki, a silversmith known for his extensively worked objects, for example, had great difficulty making extreme shapes in silver, as the silver would crack. By experimenting with different grades of silver, he came to the conclusion that for his type of work, which is comparable to Adam's ewer in terms of the extreme manipulation of the material, fine silver worked best. (Correspondence with Hiroshi Suzuki, February 2019).

40 English ed. (transl. Annelies Sisco and Cyril Smith), *Bergbuchlein und Probierbuchlein: a translation from the German of the Bergbüchlein, a sixteenth-century book on mining geology*, New York 1949, p. 159.

41 English ed. (transl. Annelies Sisco and Cyril Smith), *Treatise on Ores and Assaying*, Illinois 1951. Dutch ed. (transl. J.E.C.): *Het Proefboek van Lazarus Ercker of defselfs verhandeling over de mineraalen en metaalen*, The Hague (Ottho en Pieter van Thol) 1745.

42 Willem van Laer, B. Dubbe (introduction), *Weg-wyzer voor aankomende goud en zilver-smeden*, Lochem 1967 (original ed., Amsterdam 1721).
43 Sisco and Smith 1949 (note 40), p. 112.
44 1 mark in Dutch weight system of Troy pounds: approx. 250 grams, see https://www.goudenzilverweging.nl/gsd_tg (consulted 16 March 2020).
45 The blick moment is well known among metallurgists and silversmiths and it is described in many metallurgical recipes. It describes an important visual moment in the furnace, when the silver is molten, and is so hot it starts to roll around with lead oxides (litharge) floating on top of the molten silver. The blick moment occurs when the litharge or impurities are completely absorbed by the bone ash and the silver looks completely 'clear', like an orange dome.
46 It is interesting to note that the *Probierbuchlein* also has a chapter on 'How assay weights are made in the Netherlands', showing that there was interaction between Germany and Holland on silversmith topics as early as the sixteenth century.
47 The platform is run by Dr Florian Téreygeol, see https://www.mines-argent.com/.
48 J. van Bennekom, E. van Bork and F. Téreygeol, 'Explorative Studies in 16th Century Silver Refining Recipes', *Journal of Archaeological Science: Reports* 36 (2021), 102775.
49 The tests were carried out over the course of three days, in a cupellation furnace large enough for the larger earthenware dish. An earthenware muffle was used, and charcoal of high quality was used to heat the furnace. Each test lasted approximately 60 minutes.
50 The recipe of Calbus of Freiberg does not explicitly mention the addition of lead for refinement. However, during the experimental stage it became clear that the silver alloy could only be refined by adding lead, as this is essential in the refining process. Lazarus Ercker does mention, though, that one should add lead when the silver is low grade, in a later recipe in the book, see Sisco and Smith 1949 (note 40), p. 78, §43 'How to refine silver containing different amounts of copper'.
51 Pieter van Veen and Nicoline van der Sijs, *Etymologisch woordenboek: de herkomst van onze woorden*, Utrecht/Antwerp 1997 (2nd edition).
52 Recipe derived from Willem van Laer (note 42), p. 106: 1 l water, 6.8 gr 'wynsteen' (tartaric acid), 13.4 gr 'zout' (salt), heated in a copper container. During the tests it seemed as if the copper from the container also dissolved slightly and was deposited on the surface of the silver. Another recipe in an earlier Dutch book gives more or less the same ingredients: '4 stoop regenwater' (rainwater), '2 merk wijnsteenroer' (tartaric acid) 'goed gestampt 1 merck grof zout' (well-ground salt) in a copper dish, in Herman Jansz Muller, *Tresoir van de maten van gewichten van coorn, lande, van de elle ende natte mate* …, Amsterdam 1590, p. 52.
53 Muller 1590 (note 52), pp. 47-52, which contains instructions for the mint master on how to refine the silver. The instructions are not extensive, but look similar to Ercker's and Freiberg's more elaborate test recipes.
54 Ercker's recipe 'How to refine cupelled silver and how to make correctly the tests used in the process' has some remarks at the end that are included in our annex, because they did not directly involve the refining procedure. One of these remarks considers the adding of refined copper ('half a lot or a quintlein') so the silver will not become overrefined.
55 William D. Callister jr. and David G. Rethwish, *Materials Science and Engineering, an Introduction,* New York 2009 (8th edition), pp. 93-94.
56 Jessica Whittle, 'Chaos & Creation: Adam van Vianen's Gilt Ewer', pp. 196-215 in this volume of *The Rijksmuseum Bulletin*.

Detail of fig. 1, p. 196