Trading Values in Early Modern Antwerp

Waarde en waarden in vroegmodern Antwerpen

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BRILL

LEIDEN . BOSTON

2014

Contents / *Inhoud*


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The value of glass and the translation of artisanal knowledge in early modern Antwerp

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Introduction

In his *Descrittione di tutti i Paesi Bassi*, first published in Antwerp in 1568, the Florentine merchant, humanist and cartographer Lodovico Guicciardini (1483-1540) presents Antwerp as a place that, with its gathering of merchants of all nations who mastered a variety of diverse languages, contained the whole world.[1] The many foreign merchants who migrated to Antwerp transformed the city into an urban centre where new goods and new information were traded. For Guicciardini, Antwerp's merchants distinguished themselves through their experience in global trade.[2] Antwerp was also home to a dazzling variety of arts and crafts. Guicciardini singled out for praise the manufacture of and trade in dyes and pigments, especially vermillion ('called *cinabro* in Italian') and the crafts dependent upon them, such as textile and tapestry production, painting, pottery and glassmaking.[3]

Reprinted in several editions and translations throughout the late sixteenth and early seventeenth centuries, Guicciardini's *Descrittione* shaped Antwerp's self-image and fame for at least half a century. It projected a vision of the city as an ever more prosperous, powerful and secure polity, and it emphasised the role of artisans and merchants – both in terms of their production and circulation of goods and of their knowledge of trades and crafts – in the realisation of this vision.[4] An image of the city as a cultural and knowledge hub, primarily established and maintained by communities of artisans and merchants, emerges from Guicciardini's description of Antwerp. He singled out not only the bourse, but also the *panden* of the painters, silversmiths and *tapissiers* as places of note in the city. *Panden* were trading centres for products of material transformation, raw materials that had been skilfully translated into luxury goods such as paintings and tapestries. Another place of significance that Guicciardini mentioned was the glasshouse, 'where all kinds of crystal glasses in the Venetian manner are made by Jacomo Pasquetti of Brescia at great cost and with various privileges of the king and the city'.[5] The 'glasses in the Venetian manner, very beautiful ones and in large quantities', which Guicciardini highlighted as one of the luxury goods manufactured and traded by foreign artisans and merchants in Antwerp, significantly shaped the image of the city (fig. 1). Other places Guicciardini singled out were the printers shops and publishing houses, most famously that of Christoph Plantin (c. 1529-1589).[6] The publication of translations between different languages was a speciality of Antwerp's print and publishing market.[7] Another kind of translation is the process of fixing how-to knowledge (for example, knowledge of how to make luxury goods such as Venetian-style glasses) into words. This translation of artisanal knowledge is the essence of recipes and books of secrets.

Detail fig. 7

1
Southern Netherlands, Glass vessel, c. 1600, *vetro a fili*, Basel, HMB – Historisches Museum Basel (photo: P. Portner).

The study of these recipes and books of secrets is important in order to understand the value of glass in the early modern period. The value of glass did not reside in the cost of the materials, but in the difficult and laborious processes involved in making glass, and above all in the artisanal knowledge of the glassmakers. Moreover, this artisanal knowledge was no longer the product of experience alone. The city, birthplace of the concept of artisanal knowledge, transformed it into the product and process of both experience and reading. It was not only foreign glassmakers that shaped (…) the image of Antwerp; so too did producers, printers and publishers of the books of secrets who packaged the artisanal recipes for sale. As we shall see, in books of secrets the artisanal knowledge involved in the manufacture of glass was embedded in the larger textual frameworks built around metallic transmutation and the alchemical making of gold.

Antwerp was a 'world city' (Antonella Romano and Stéphane Van Damme's term for a 'melting pot' of different cultures of foreign merchants and artisans connecting the city to other parts of the globe).[8] This designation emphasises the importance of Antwerp as a place that accumulated goods and as a node in networks of artisans and merchants that contributed to the aforementioned process of value change. Documenting the shift in the appreciation of glass as an object of alchemical knowledge, and the complementary process of the transformation of artisanal knowledge into the process and product of both making and reading, this chapter shows that Antwerp was a centre of artisanal knowledge translation, and suggests that the concept of artisanal knowledge itself was changed in this translation process.

The change in the value of glass

What was this process of value change? In *Painting and experience in fifteenth-century Italy*, Michael Baxandall famously documented a shift of emphasis in the appreciation of paintings in the Quattrocento. The dichotomy between quality of material and quality of skill was the most consistently and prominently recurring motif in general discussion about painting and sculpture, and this was true whether the discussion was ascetic, deploring public enjoyment of works of art, or affirmative, as in texts of art theory.[9]

While precious pigments become a less prominent factor in the value of a painting, a demand for pictorial skill becomes more so. In the fifteenth century, cultivated beholders expected a good painting to embody skill and understood that they were expected to make discriminations about this skill, and even to do so verbally. In a similar vein, on the basis of a study of Italian majolica in the sixteenth century, the economic historian Richard Goldthwaite has also argued that the Renaissance saw a shift in the attribution of value. His study shows that value was no longer primarily based on the cost of the raw materials, but on the laborious and difficult processes involved in the production of objects – in short, on skill.[10] Majolica was a relatively inexpensive material compared to the previous source material for tableware (silver or even gold for the very rich), yet it was valued for the skill invested in its production. A shift took place from intrinsic value

to design and decoration as important factors in product quality. What mattered was the artists' invention and *ingenium*, not the cost of raw materials.[11] This shift in what constituted value is part of a larger argument in which Goldthwaite – and, more recently, historians of material culture such as Evelyn Welch – have claimed that Renaissance urban centres created the conditions for the accumulation of goods, leading to a new culture of consumption and collecting in which the virtues of magnificence and splendour were redefined to rationalise the acquisitiveness of wealthy merchants.[12] In Giovanni Pontano's (1429-1503) treatise on social virtues of the 1490s, *cristallo* is listed as exemplifying the virtue of splendour. Also, the lightness of majolica could be seen as embodying social virtues. Syson and Thornton have pointed out that the majolica made for Isabella D'Este (1474-1539) was described as being more *sottile*, a term that 'linked the physical quality in objects – that of delicacy or precision – to an acuteness and subtlety of thought of both artist and owner'.[13] Glass and majolica were valued because they were difficult to make, and not just for their aesthetic worth, but as objects of virtue.

Similar to majolica, glass imitating precious stones became highly valued in the same period, although the reproductions were made of raw materials far less expensive than the originals. Glass became appreciated for artisanal knowledge rather than skill (as Baxandall has argued). What was artisanal knowledge? Pamela Long has shown that the idea of artisanal knowledge as something that can be possessed, and therefore also protected, patented and traded, first arose in the urban artisanal culture of the late medieval city.[14] This artisanal knowledge, defined as the product of experience, contributed to the rise of early modern science.[15] However, the artisanal knowledge for which glass objects were valued, rather than being solely the product of experience gained in the workshop, was actually that of both experience and reading.[16] This transformation of artisanal knowledge was made possible in a city like Antwerp where scholarly cultures (characterised by learning through reading) and artisanal cultures (in which learning by doing was the standard) were brought together. The emergence of places where these two cultures confronted each other – some, like the printer's shop, are highlighted in Guicciardini's description of Antwerp – is an essential aspect of the emergence of Antwerpas a centre of cultural translation in the early modern period.

What was alchemy?

In early modern Antwerp, glass became valued as an object of artisanal-turned-alchemical knowledge. This raises the question: what was alchemy? In the early modern period alchemy represented a diverse field.[17] Metallic transmutation of base metals into more noble ones, especially the making of gold, is probably the most ready association with alchemy. However, not only was there considerable divergence of opinion about how to make the Philosophers' Stone to bring about metallic transmutation, the making of gold was merely one aspect of early modern alchemy. A second sub-field was medical alchemy. Made a key part of alchemy by John of Rupescissa in the fourteenth century, the importance of chemically produced or

enhanced medical preparations expanded hugely following the writings of Paracelsus in the sixteenth century. A third sub-field of early modern alchemy was chemical manufacture. Early modern artisanal workshops adopted chemical methods to make all kinds of goods and materials: pigments, dyes, alloys, perfumes, etcetera. 'The entire range of ideas and practices dealing with the production and manipulation of material substances and their properties – whether the making of gold and silver, or the making of medicines, dyes, pigments, acids, glass, salts and so forth' was referred to as alchemy in the early modern period.[18] In short, far from being limited to the making of gold, alchemy was the practice and theory of material transformation.

Two clarifications are in order to this definition of the scope of early modern alchemy and the identity of alchemists. First, the simple use of chemical methods and techniques to produce goods and materials did not make an artisan an alchemist. Artisans and alchemists were differentiated. It is important to keep in mind that while alchemy (and its language) was often based on laboratory practices, one of the distinguishing characteristics of alchemical knowledge is that it was the product of writing and reading, and not only the outcome of experience in alchemical laboratories. Glassmakers in early modern Antwerp were not alchemists. There is no evidence that they were interested in making gold or that they read up on alchemy. However, consumers appreciated glass as an object of alchemical knowledge. This appreciation was mediated through the reading of recipes and books of secrets, which, as we shall see, were produced in high numbers on the Antwerp publishing market.

A second clarification of the definition of early modern alchemy concerns the division between three sub-fields: metallic transmutation, medical alchemy, and chemical manufacture. It was possible for an early modern alchemist to be involved in one or two of these fields, but it was not necessary to be involved in all three to be called an alchemist. For example, Paracelsus (1493-1541) gave the field of medical alchemy a boost, but he did not dabble in the making of gold. Given that these three fields are separate domains of alchemy it is remarkable that (as we shall see) language belonging to the field of transmutation was used to describe the processes of glassmaking.

Trading jewels and glass

In Antwerp, glassmakers and painters belonged to the guild of St. Luke. However, *a la façon de Venise* glassmaking was in the hands of the Italian community of artisans and merchants who operated outside the guilds. They set up their ovens and shops in Antwerp and brought with them Italian glassmakers who possessed the know-how to make a kind of colourless glass. This glass was known as *cristallo* to denote that it was as clear as rock crystal, and its invention was attributed to Angelo Barovier (c. 1400-1460) in Venice, named 'master Angelo expert in the alchemy of crystal' in 1460.[19] After several unsuccessful attempts to establish glass ovens for the production of *façon de Venise* glass in Antwerp in the 1530s, the city of Antwerp in 1542 awarded a considerable sum of money to the Italian

2
Filippo Gridolfi (attr.), Glass vessel, c. 1600, serpentine glass, Antwerp, Museum Vleeshuis (photo: Museum Vleeshuis).

Giovanni Cornachini to establish Antwerp's first workshop producing the highly sought after *cristallo* mirrors, for which Murano had gained worldwide fame. When in 1558 Jacomo Pasquetti, an Italian merchant from Brescia, acquired from the Venetian Jacomo di Francesco the patent to produce crystalline glass in Antwerp, this was the true beginning of a flourishing period for Antwerp's *façon de Venise* glass industry. Although in 1592 Pasquetti's successor, Ambrogio Mongardo (d. 1596), complained that many of his highly skilled workers had been secretly solicited to go to London and Middelburg, the manufacture and trade of glass continued to thrive well into the seventeenth century. During the directorship of Sara Vinckx, Mongardo's widow, who later remarried the Italian Filippo Gridolphi, the Antwerp glass industry reached new heights (fig. 2). During this period the building where the glass ovens were in operation, the *Gelaesenhuys* at the Meir, was enlarged to make room for additional Italian master-glassblowers, bringing their number up to eight.[20]

The guilds' collective trademarks were an important visual manifestation of quality control. However, as Bert de Munck has recently argued, the marks did not guarantee that a product was made by a skilled artisan. The trademarks only referred to the quality of raw materials used and as such only vouched for the artisan's honesty, not for his superior skill.[21] Interestingly, no collective trademarks were used on majolica and ceramics, possibly because the raw materials were less expensive and other factors (especially design) were considered more important. At the time of the establishment of the guild of silver- and goldsmiths, explicit rules about the origin of the alloy (silver) were formulated. In contrast, the request to the city authorities to establish a guild of diamond cutters in 1582 gave no mention to the skills involved beyond very vague phrases such as that diamonds were to be 'well and carefully cut'.[22] Since guilds could not vouch for the skills of their masters, guild-based masters defined the value of the raw materials as the most important factor in the consumers' appreciation of a produced object. This was an obvious choice given that the wealth of cities depended upon the availability of raw materials. Fitting this picture of value attribution in relation to the guilds, *a la façon de Venise* glass was produced outside the guild structures and not primarily valued for its raw materials.

The shift of value from cost of material to skill and knowledge is evident in the location of glassmaking activities. From the fifteenth century onwards, gems and jewellery circulated through merchant-banking networks as both collectibles and collateral.[23] The collections of merchant-banker families (such as the Medici family) grew out of their desire to possess material treasures, which could be put to economic use if circumstance demanded.[24] Obviously, for merchant-bankers, the primary attraction of jewellery and gems (but also of silverware, for example) was the material they were made of. They were valued first and foremost for the cost of the material. By the second half of the sixteenth century the Medici were still interested in jewellery and precious stones – the decoration of the Cappella Medicei in the church of San Lorenzo with precious stones is perhaps the best-known and most representative project illustrating this interest (fig. 3) – but remarkably they had also acquired an interest in the

3
Matteo Nigetti & Bernardo Buontalenti, *Cappella dei Principe,* seventeenth century, marble inlaid with colored marbles and semi-precious stone, Florence, Church of San Lorenzo (photo: Kunsthistorisches Institut in Florenz – Max-Planck-Institut).

imitation of precious stones in glass, a material whose manipulation required skill but that was much less costly than the originals.[25]

Medicean glassmaking began in 1569 upon the arrival of the Venetian glassmaker Bortolo alli Tre Mori, whom the Medici had lured away from Murano, the most important centre of glass production at the time. The attraction was *cristallo* glass. Francesco I de' Medici (1541-1587) not only established the *Studiolo* (in which the grand duke was pictured as an alchemist next to other depictions of the invention and manufacture of glass; fig. 4) but also the *Casino di San Marco* built by Bernardo Buontalenti (1531-1608), in which he housed the court workshops, including those dedicated to glassmaking as well as those which produced the famous Medici porcelain.[26] In these workshops, under the direction of Niccolo Sisti, *cristallo* glass was made, as well as all sorts of coloured glass in imitation of precious stones. In 1598 Antonio de' Medici (1576-1621), son of Francesco I, came to live and work in the *Casino*, and three years later Antonio Neri (1576-1614) began his work in the *Casino* under the direction of Niccoló Landi.[27] Antonio de' Medici acted as Neri's patron, so it comes as no surprise that Neri's *L' arte vetraria*, the first printed book on glassmaking, is dedicated to him.

In Antwerp, too, merchant-bankers turned to glass. In the early seventeenth century the Portuguese Ximenes family of merchant bankers,

which had resided in Antwerp for several generations, developed a commercial interest in glassmaking.[28] As was typical for a merchant-banker, Emmanuel Ximenez (1564-1632) possessed a significant quantity of jewellery (his only other possession that came close to matching it in numbers was – again, typically – silverware).[29] But it was not only the cost of the material that determined Ximenez's interest in accumulation. As one of the Portuguese families residing in Antwerp and leading the trade in jewellery,[30] Ximenez's house at the Meir also contained an alchemy and distillation chamber in the attic. This was a place where merchants and artisans, especially the local Italian glass community and the Portuguese experts in jewellery, met to discuss and judge the newest advances in glass imitations of precious stones.[31] Next to Antonio de' Medici, Emmanuel Ximenez was Neri's most important patron. Neri was Ximenez's guest in Antwerp for eight years, and Neri wrote *L'arte vetraria* partly based on his experience in Antwerp's glass ovens directed by Filippo Gridolphi.[32] In this book, Neri mentions that 'many Portuguese gentlemen well practised in appraising jewels' admired chalcedony glass made according to a recipe first tried in Antwerp.[33] For Ximenez, the value of these glass imitations lay in the knowledge and skills needed to produce them.[34] Looking for innovation, Ximenez took an intellectual interest in the glass objects in which he traded.

Glass as an object of alchemical knowledge

What were the knowledge and skills that accorded value to glass made in imitation of precious stones? Approaching the making of glass from the production side, this included knowledge of materials and processes of transmuting raw and purified materials into glass. Some of the apparatus, materials and processes were common to alchemy and glassmaking, and it is to common materials and processes that historians arguing for the alchemy of glass have mostly referred.[35]

Writings about glass offer a clearer glimpse of the nature of the knowledge for which consumers – not artisanal producers – valued glass. In the writings discussed below, glass was considered an object of alchemical knowledge because of analogies between concepts and operations involved in the production of glass in imitation of precious stones and those set down on paper for the making of the Philosophers' Stone (the key ingredient to turn a base metal into gold). The imitation of precious stones is about glass as a result of chemical manufacture; the making of the Philosophers' Stone is about metallic transmutation. As we have seen above, both were areas of early modern alchemy, but they were quite distinct. There was no inherently necessary connection between chemical manufacture and metallic transmutation.

The construction of the analogy between the imitation of precious stones and the making of the Philosophers' Stone is not unique to writings connected to Antwerp. Already in the late fourteenth century the *Sedacina totius artis alchimie* by the Carmelite monk Guillaume Sedacer (d. 1382) drew an analogy between the craft processes of glassmaking and alchemy as transmutation.[36] Catalonia, where Sedacer spent most of his life when

4
Giovanni Maria Butteri, ***The glass workshop*, 1570-1575,** oil on board, 147 x 86 cm, Florence, Palazzo Vecchio (photo: S.S.P.S.A.E e per il Polo Museale della città di Firenze – Gabinetto Fotografico).

he was not in Montpellier, was a centre of glassmaking. This said, the glass recipes which we find in the *Sedacina* were probably derived from widely circulating collections of recipes, of which the most famous ones mentioning glass are likely the *Mappae clavicula* (ninth to twelfth century) and the *De diversarum artium schedula*, a twelfth-century collection attributed to the monk Theophilus. Whatever the source of these recipes, Sedacer thought that the alchemist should follow the same procedures for the making of glass and the Philosophers' Stone.

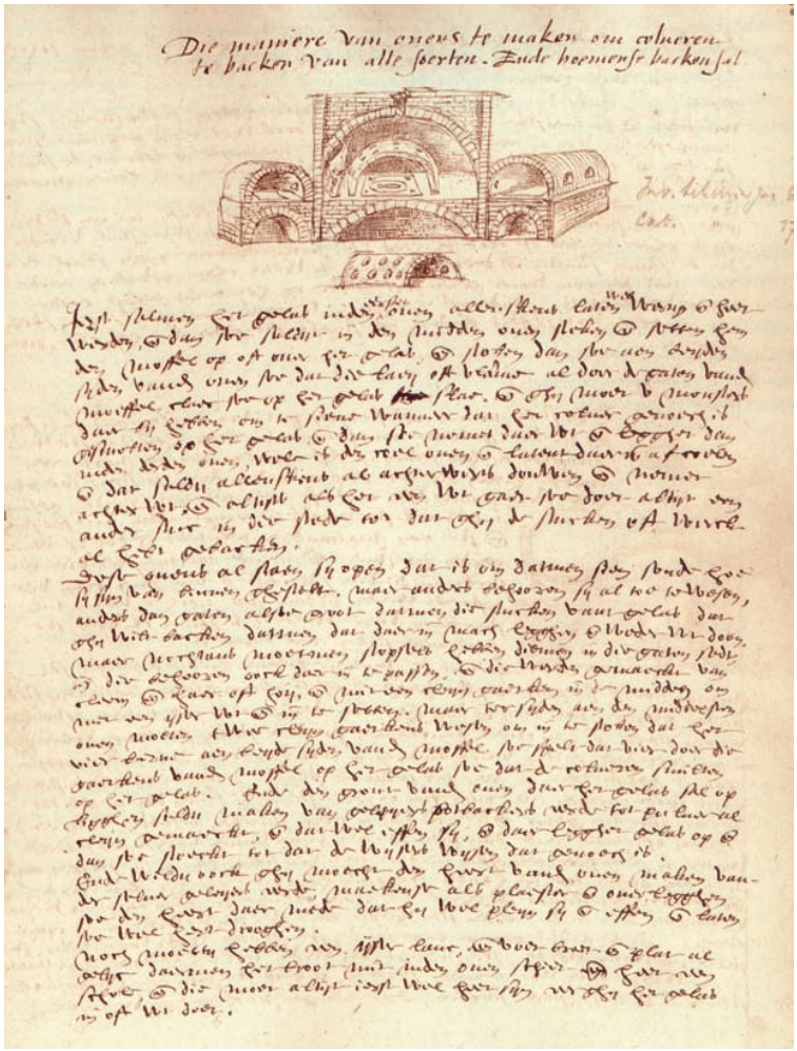
Sedacer was not the first to think of the artificial production of precious stones in the context of alchemy. The nucleus of manuscripts from the fourteenth century that make up the pseudo-Lullian corpus (texts on alchemy attributed to Raymond Lull [c. 1232-c. 1315]) also shows this particular emphasis on the artificial production of precious stones.[37] In this corpus the *ars lapidifica* (the art of making precious stones) is closely associated with the alchemical art of transmutation. The making of precious stones and of the Philosophers' Stone requires following the same procedures, according to pseudo-Lull. However, there is an important difference between pseudo-Lull and Sedacer. Pseudo-Lull stated that the described operations for the making of precious stones are based on the natural philosophical theory of precious stones as 'watery substances'. Pseudo-Lull dissolved different sorts of metal in so-called water (in fact, diverse liquids) to create different kinds of precious stones. These theoretically inspired operations are entirely different in nature from the craft-like recipes for the production of glass and glass imitations of precious stones found in the *Sedacina*.[38]

After mentioning that glass is transparent and that it is receptive to all colours, Sedacer lists several recipes for glass and glass recipients of different colours, all starting with a mixture of white sand and plant or wood ashes, and all of which are made into glass by procedures involving heating and cooling in the furnace.[39] These are followed by two recipes for the manufacture of lead glass, one of which is directly geared towards the artificial production of precious stones. From these precious stones, Sedacer maintains, the Philosophers' Stone is derived. The introduction of the section on glass explicitly states that the 'convertible stone' (that is, glass; it is convertible because it can take on all colours) is the basis of the Philosophers' Stone, 'because the way, the means and the procedure are the same for both'.[40] The recipes to make glass are followed by several recipes for the Philosophers' Stone using the same materials and processes that Sedacer describes for the making of glass imitations of precious stones. In short, the *Sedacina* constructs an analogy between the processes of one art of fire (glassmaking) and alchemy as transmutation. While the recipes for the manufacture of glass are similar to those found in earlier collections, their transfer to the field of alchemical transmutation is Sedacer's.

There are other examples of the alchemy of glass being practiced in a variety of places in the period leading up to the seventeenth century.[41] However, Antwerp, home to one of the more significant glass industries in Europe, was an important locus for the construction of the analogy between glass and the Philosophers' Stone. Two examples of writings connected to Antwerp are discussed in the following sections.

Stained glass

The first example comes from a mid-sixteenth-century manuscript which contains recipes on 'Die maniere van ovens te maken om colueren te backen van alle soorten. Ende hoemense backen sal' ('The ways to make ovens for baking colours of all sorts and how to bake them').[42] It dates to a period in which techniques for colouring locally produced glass (in the context of making stained-glass windows) changed. Pot-metal glass (glass coloured throughout) and flashed glass (the application of a thin, coloured layer on a much thicker, colourless glass substrate) was replaced by painting glass with silver stain and enamels. These fashionable techniques for colouring glass are the focus of the glass recipes in this manuscript. Next to a drawing of a three-chambered furnace it gives details on how the glassmaker should proceed with the firing process (fig. 5).[43] In the first kiln the glass is to be heated slowly until it reaches the required temperature. Next the glass is transferred to the second kiln. Here the flames are to surround the glass



5
Anonymous, ***The ways to make ovens for baking colours of all sorts and how to bake them***, **c. 1550**, Ms. 64, fol. 33, Antwerp, Museum Plantin-Moretus, Prentenkabinet (photo: Museum Plantin-Moretus).

6
Anonymous, *The ways to make ovens for baking colours of all sorts and how to bake them*, c. 1550 (detail), MS 64, fol. 34. Antwerp, Museum Plantin-Moretus / Prentenkabinet. Museum Plantin-Moretus, Prentenkabinet (photo: Museum Plantin-Moretus).

from all sides through the holes of the muffle. This is to allow the glass paints to melt onto the glass. Glass painters use a special paint for outlines and shadows made of glass particles suspended in a liquid binder. During firing, the glass particles in the paint melt and merge with the glass surface to create a range of brown-black tones. When the glass is sufficiently vitrified, it is removed and placed in the third kiln. The purpose of this third kiln is to anneal the glass.

The manuscript also contains a recipe for the production of silver stain. Silver stain is applied to uncoloured glass to produce a lemon yellow to orange-brown effect and to give light blue glass a green hue. The recipe in the manuscript concerns the precipitation of silver in order to produce a silver salt or a mixture of silver salts by means of a combination of acids. The accompanying drawing (fig. 6) shows vessels used for 'distilling' acid 'water', which is subsequently used to produce the silver salt. After a series of distilling and heating operations a black residue remains, which the author of the manuscript describes as 'gold'.[44] In other words, the procedure for making silver stain glass is described in terms borrowed from alchemical transmutation (or the making of gold).

Unless one was familiar with the refining process of quartation (separating gold and silver) and the gold that was left behind in this process as a residue of black powder, it must have been surprising that something

black was described as gold, although less so if we understand the visual effects of the application of silver stain. The silver stain powder (the 'gold') was mixed with clay or ochre and painted on the glass. After firing, the binding layer was removed so that the transparent yellow became visible. For example, the yellow colouring in a detail of the *Virgin and Child with Maarten van Nieuwenhove* by Hans Memling (fig. 7), the roundel that depicts a sowing hand, is achieved with silver stain.[45] The blue in the roundel comes from blue enamel. Enamel glass paint is a brightly coloured glass that melts at a lower temperature than the window glass to which it is applied. Enamel paints were increasingly used from the sixteenth century in combination with colourless glass. The low-melting coloured glass is obtained by the use of high amounts of fluxing agents such as lead oxide. During firing, the glass powder transforms into a thin, homogenous layer of glass that colours the glass pane in transmitted light. The Antwerp manuscript contains recipes for blue, purple and green enamel with the use of gum water as a binding agent. For blue enamel, for instance, the use of *saffre* (derived from cobalt) is prescribed as a colouring agent. Most likely the green colour in the roundel in the Memling would have been produced by a combination of blue enamel and silver stain. Thus, in reference to the produced visual colour effect, the product of silver stain is described as the golden outcome of alchemical transmutation in this mid-sixteenth-century Antwerp manuscript.

7
Hans Memling, *Virgin and Child with Maarten van Nieuwenhove*, 1487 (detail of left panel), oil on panel, 44.7 x 33.5 cm, Bruges, Memling Museum, inv. No: O.SJ178.I (photo: Musea Brugge / Lukas – Art in Flanders vzw, photo Hugo Maertens).

Books of secrets

Who were the readers of these glass recipes? The context in which they appear tells us that they were not written for experts. Although they reveal familiarity with the newest workshop practices of stained-glass window makers, the intended audience was not these 'professionals'. The coloured glass recipes are part of a miscellaneous collection of recipes, written partly in Latin, partly in Dutch, that were owned by the Antwerp apothecary Peeter van Coudenberghe (1517-1599), famous for his garden, and a friend of Plantin.[46] While the recipes in Latin are mostly diverse in nature (dealing with cooking, medicine, alchemy and the making of glass and colours), the Dutch part, which is also longer, contains recipes which are mostly of art technological origin: the making of colours in different media, inks, mirror construction and glassmaking. The recipes on 'Die maniere van ovens te maken om colueren te backen van alle soorten. Ende hoemense backen sal' ('The ways to make ovens for baking colours of all sorts and how to bake them') are the last in the Dutch part of the manuscript.

In its entirety the collection of manuscript recipes in the Museum Plantin-Moretus is very similar in content to the *Tbouc van wondre* (1513) and other books of secrets published in Antwerp in this period. These books of secrets partly derived their content from local crafts, and were partly based on translations of books of secrets published in languages other than Dutch. The titles of such publications make it clear what to expect – that is, a continuous stream of wonders and secrets, some of which had their origin in art technological recipes: *Tbouc van wondre* (The book of wonders, 1513); *Dat boeck der secreten Alberti Magni een prince onder alle den*

Philosophen (The book of secrets by Albertus Magnus the prince among all the philosophers, 1544); *Een nieuwe tractaet, genaemt dat Batement van recepten* (A new treatise, called the house of recipes, 1546); *Dat playsant Hofken van Recepten* (The pleasant garden of recipes, 1548); and translations of the books of secrets by Alessandro Piemontese (pseudonym of Girolamo Ruscelli [1500-1566]), *De Secreten* (The secrets, 1561), and Giovanbattista della Porta (1535-1615), *Magia oft de wonderlicke wercken der naturen* (Magic or the wonderful works of nature, 1566). Books of secrets also contained recipes from alchemical sources and shaded the descriptions of artisanal processes alchemically. One example is the *Secreet-Boeck* (The book of secrets, 1609) of Carel Baten (c. 1540-c. 1617), a well-educated, much-travelled and prolifically published physician who moved from the Southern Netherlands first to Dordrecht and later to Amsterdam.[47] Not only did Baten borrow recipes from alchemists, his description of the secrets of glass also contains references to alchemical authorities such as Geber.[48] Books of secrets point to a vernacular alchemical knowledge culture, colouring the description of art technological processes and the appreciation of artisanal knowledge in the Netherlands.[49]

The flood of publications on the Antwerp market is thus partly connected to the emergence of the 'professor of secrets' in Italian cities in the sixteenth century.[50] This figure made his living by selling 'secrets' on the piazza and at court and by publishing 'books of secrets'. Often such secrets were based on artisanal recipes, which were previously collected in recipe books.[51] The manufacture of *cristallo* glass products, such as mirrors, was a typical part of the repertoire of professors of secrets. One example is the Venetian Jew, Maggino, who was involved in several enterprises, including the manufacture of glass, and moved from court to court selling his secrets.[52] Together with another Jewish professor of secrets, Abraham Colourni, he successfully offered his glassmaking secrets to Friedrich I (1557-1608), duke of Württemberg in Stuttgart, clothing his petitions in the rhetoric of alchemy and secrecy. However, while courts provided high-status clients for professors of secrets, the books of secrets coming off the presses in Venice and elsewhere reached a much wider public. The authors of books of secrets functioned as 'brokers' and 'go-betweens' whose important role in early modern knowledge networks has recently been emphasised in several studies. As go-betweens they transferred artisanal recipes to wider audiences, and in this process of translation from recipe to secret, they also transformed artisanal knowledge.[53]

In Antwerp the authorship and readership of books of secrets has been associated with membership of the chambers of rhetoric.[54] Arjan van Dixhoorn has argued that chambers of rhetoric were institutional centres of vernacular learning where artisans, artists and merchants learned how to speak and write.[55] Knowledge was a key concern of the chambers of rhetoric, and much emphasis was placed on the practical utility of the *consten* (arts) in an urban environment.[56] The chambers of rhetoric also offered members access to wider networks of knowledge exchange in which teachers, printers and publishers, engravers and painters played an important role. The chambers of rhetoric were not only important in the public festive culture. Through the exchange of manuscripts, through

personal contact and increasingly through printing, the members of the chambers of rhetoric shaped a vernacular knowledge culture in the Netherlands. Books of secrets were one genre of writing in the rhetoricians' print culture. However, this does not exclude wealthy collectors as readers of such books of secrets. As I have shown elsewhere, those who could afford the purchase of an art cabinet read such books alongside Della Porta's optical secrets.[57]

Antonio Neri's chalcedony glass

The second example of a writing connected to Antwerp, Neri's *L'arte vetraria*, published in Florence in 1612, is also packaged as a book of secrets. This is hinted at in the opening words with which Neri dedicates his book to Antonio de' Medici: 'Having spent years of my youth labouring around the glassmaking craft, and having experimented with many fine and marvellous effects, I have now committed these findings to print with the greatest clarity I am capable of, and published them to the world in order to help and delight my fellow artisans'.[58] However, the inclusion of such an important figure at the Florentine court indicates that the intended audience of Neri's book was probably more exclusive than that of some books of secrets, including the Museum Plantin-Moretus manuscript, coming off the Antwerp presses.

Neri draws the same analogy between the chemical manufacture of glass and transmutation, again supported by visual effect. The *Arte vetraria* consists of seven books, of which only the first is devoted to the making of *cristallo* (colourless) glass. The other six books discuss several recipes for coloured glass. Neri's book on glass is partly based on recipe collections for glass circulating in numerous manuscripts, such as the Montpellier manuscript *Ricette per far vetri colorati e smalti d'ogni sorte havute in Murano* (1536) and various other anonymous collections circulating in Florence.[59] However, book 2 on the production of chalcedony glass (fig. 8) and book 5 on the imitation of gemstones and jewels show especially interesting variations with respect to earlier written sources and are related to Neri's own experience, including that gained in the glass workshops of Antwerp.

Neri is best known for his book on glassmaking, but recent investigations of his manuscripts and correspondence with Ximenez have shown that his interests embraced a much wider scope of alchemical activities.[60] Neri's widely circulated but incomprehensible recipe for the Philosophers' Stone – the *Donum Dei* – shows that he was interested in the transmutation of metals and the making of gold. However, Neri's *Discorso sopra la chimica* defined chemistry as:

> a much more universal art, which in some ways also embraces medicine (or at least it comes very close in assisting) (…) It is an art, which resolves and reduces all 'mixed bodies' into their primary elements, it searches out their nature and separates the pure from the impure and it makes use of the pure to perfect these bodies and even to transform one body into another.[61]

8
Venice, Stemmed bowl, c. 1510, chalcedony glass, 17.5 x 27.2 cm, Berlin, Künstgewerbemuseum (photo: Staatliche Museen zu Berlin SPK).

Chimica (chemistry) is then for Neri much wider in scope than what he defined as 'alchemy', which pertains only to the transmutation of metals. *Chimica* embraced medicine. Just as substantial as Neri's and Ximenez's shared interest in glassmaking was their interest in the chemical preparation of pharmaceuticals, a practice central to Paracelsus's medical doctrines. To illustrate this with just one example: in a letter dated 21 February 1608, Neri, then in Antwerp, tells a friend that he prepared medicines by means of chemical operations, curing sickness in accordance with Paracelsian doctrine, and this 'to the great astonishment of Antwerp'.[62]

It should be clear that the recipes, packaged as secrets in the collections and books mentioned above, played no role in the learning of a trade. Artisanal recipes might have played a role in standardisation processes in large-scale workshops;[63] or indeed may have transmitted information on the crafts to people outside the walls of the workshop; they might even have promoted epistemic values typical of artisanal culture;[64] but they were not used for the transmission of knowledge of processes, techniques and materials between a master and his apprentices. Communication in the artist's workshop was dominated by the human voice. Oral transmission was the standard. So was learning by doing – not by reading. Against this

background the most striking novelty about Neri is that he read. In *L'arte vetraria*, Neri identified Isaac Hollandus as the source of some recipes for the making of artificial gemstones.[65] Hollandus was a post-Paracelsian, probably fictive character to whom numerous manuscripts, in Dutch and translated, were attributed, and whose reputation reached mythic proportions at the time, sometimes even as an alleged predecessor and source of Paracelsus.[66] Although Hollandus's writings circulated in the Florentine circles of Antonio de' Medici, it is more likely, given the consequence he was accorded in Antwerp, that it was there that Hollandus became so important to Neri.[67] For example, in the enigmatic *Physicae et theologicae conclusiones* (1621), in which Otto van Veen (1556-1629) referred to the Paracelsian *tria prima* of sulphur, salt and mercury (the basic elements of the universe and of man) to prove the threefold nature and divinity of man, Van Veen singled out Isaac Hollandus as his most important authority on alchemy.[68]

Beyond single recipes for the making of artificial gemstones, reading the *Opera Mineralia* by Isaac Hollandus would have reinforced for Neri the similarities between glass and minerals, which he notes in the preface of *L'arte vetraria*: glass was made by art imitating the processes of nature, while the formation of minerals was likened to the processes of glassmaking. In fact, it is in the context of the imitation of precious stones, discussed in book 5 of *Arte vetraria*, that the connection between alchemy and glass is made most apparent:

> There are many who attribute the invention of glass, and perhaps with some reason, to the alchemists; wanting to imitate jewels, they discovered glass. This may not be too far from the truth; as I show clearly in Book 5 of the present work, methods of imitating all the jewels, in which I describe the vitrification of stones, that in and of themselves could never be melted or fused.[69]

Reading Isaac Hollandus confronted Neri with recipes for making glass imitations of precious stones as well as with a natural philosophy of vitrification for understanding minerals.

The making of glass imitations of precious stones falls within the scope of the art of alchemy (Neri's *chimica*), which included chemical manufacture. However, for Neri, glass was not an object of alchemical knowledge just because it was chemically manufactured. Glass was also more properly alchemical (in Neri's sense of alchemy as the transmutation of metals) because of analogies between glass and the product of alchemical transmutation. The definition of glass as an object of alchemical knowledge is most clearly evident in the chalcedony glasses whose production held pride of place in *L'arte vetreria*. They were also the likely reason behind Neri's move from Florence to Ximenez's house in Antwerp. *Calcedonio* was glass imitating not only chalcedony, but also other precious stones such as agates and oriental jaspers.[70] It was produced by a technique based on the superimposing and fusion of layers of molten glass, and it resulted in a translucent white, grey or reddish-brown ground with swirls of other colours mixed in a random pattern throughout. Numerous recipes

for chalcedony glass were circulating in manuscripts at this time; Neri lists no fewer than three for the making of chalcedony glass – which in 'beauty and allure of colours even surpassed the exceptional beauty of oriental agate' – one of which he claims to have tried when he was a guest in Ximenez's house in Antwerp in January 1609.[71]

The way in which Neri and Ximenez describe the visual appearance of chalcedony glass hints at its connotations with alchemical transmutation. Chalcedony glass is *dichroistic*. This refers to the varied response of chalcedony glass to transmitted and reflected light. In reflected light the glass will show a variegated swirl of colours, while in transmitted light it appears, in Neri's words, 'red as fire' – indeed, it displays a fiery orangey-red or yellow colour.[72] Like the anonymous author of the Museum Plantin-Moretus manuscript, and drawing upon a similar analogy between the manufacture of glass and alchemical transmutation, Neri suggests that the colour of the glass is identical to that of the Philosophers' Stone. For Neri, chalcedony glass was the alchemist's gold.

The difference between Neri's chalcedony glass and stained-glass windows is one of audience. Only the knowledgeable community that read books of secrets would have understood glass as an object of alchemical knowledge. Within this larger community, there were graduations of interest and acquisition abilities. Neri's chalcedony glasses catered to a very exclusive audience. The most marked difference between Neri's *L'arte vetreria* and the collections of recipes that preceded it (including a collection such as that brought together in the Museum-Plantin Moretus manuscript) is its naming of people – not only of recent authorities, even if they are as elusive as the non-existent Isaac Hollandus, but also of patrons (e.g. Antonio de' Medici). A wider audience would have valued Neri's glass for its association with alchemical knowledge, but the object itself, the *calcedonio* glass, was marketed as the Philosophers' Stone fit for a prince – or the elite strata of merchants, artists, and patricians in Antwerp to which Ximenez belonged.

Conclusion

Guicciardini's *Descrittione* underscores that luxury glass was one of the artistic goods that formed the basis of Antwerp's fame as a centre of the circulation of goods, knowledge and cultural translation. This chapter documents a shift in the value of glass as evidence for Antwerp's rise to a centre of the translation of artisanal knowledge. Already emerging from Guicciardini's description of Antwerp was the city's role as host to a number of places of exchange between artisanal and bookish cultures. The numerous printer's shops found in the city are just one example of such places. Antwerp was also home to institutions, like the chambers of rhetoric, offering similar possibilities of exchange. These places and institutions, supported by Antwerp's communities of merchants, artists and artisans, made the city a centre of artisanal knowledge translation. Recipes and books of secrets produced and consumed in the city fixed artisanal knowledge in words. The emerging appreciation of glass as an object of alchemical knowledge illustrates a more general process in which the

artisanal knowledge in recipes and books of secrets was alchemically tinged. This translation of artisanal knowledge also transformed the concept of artisanal knowledge as it became the product of experience and reading. Antwerp, as a 'world city' and melting pot of artisanal and scholarly cultures, created the conditions for the value shift of glass and the transformation of artisanal knowledge.

Notes

1 Guicciardini 1612, 88. My discussion of Guicciardini is based on Göttler 2013.
2 Guicciardini 1612, 91-93.
3 'Cinabro in Italiaens ghenoemt', Guicciardini 1612, 92.
4 See A. van Dixhoorn, 'Guicciardini's *Descrittione di tutti i Paesi Bassi*: The virtues of Antwerp, the prosperity of Belgica and free trade utopian imperialism', in this volume.
5 Guicciardini 1612, 89: 'daer allerley cristalyne glasen op de Veneetsche maniere ghemaeckt worden/ door Jacob Pasquet van Bresien/ met grooten cost/ ende met verscheyden privilegien van den Koninck ende van de stadt'.
6 Guicciardini 1612, 92: 'glasen op 't Veneetsch/ seer schoone ende met groote menichten'.
7 See the contribution by Hubert Meeus in this volume. For one example of Antwerp as a hub for the translation of knowledge of nature, see Lopez-Terrada & Pardo-Tomas 2012.
8 Romano & Van Damme 2009.
9 Baxandall 1988, 16.
10 Goldthwaite 1989.
11 De Munck 2011, 112.
12 Goldthwaite 1993, 176-242. For corrections to Goldthwaite, see especially the introduction to O'Malley & Welch 2007, 1-8, and Blondé 2007. See also Welch 2005.
13 Syson & Thornton 2001, 208.
14 Long 2001, 88-96.
15 The literature is too large to list. See recently: Smith 2004.
16 Damm *et al.* 2012 contains several papers on the reading practices of engineers of all sorts next to those of visual artists.
17 For an accessible introduction to the history of alchemy and the source of my definition of alchemy, see Principe 2013. See also Newman & Principe 1998.
18 Principe 2013, 85.
19 For the establishment and history of the Antwerp glass industry, see Veeckman & Dumortier 2002, as well as other papers in this volume discussing archaeological and archival evidence. The production of *cristallo* glass was based on the use of coastal plant ashes and on the controlled addition of manganese oxide, the decolourising agent that neutralised the greenish tint in the glass. This resulted in a clearer glass than forest glass, for which wood ashes were used in more densely forested regions such as Bohemia. Venice imported coastal plant ashes from the Levant. See also Baar 1938.
20 El-Dekmak-Denissen 1988, 17.
21 De Munck 2012.
22 De Munck 2011, 107. Quoted from the 1582 statutes of the guild in Schlugleit 1935, 13.
23 For the circulation of jewels and gems in merchant-banking networks, see Clark 2011, which includes several notes on Lorenzo de' Medici.
24 Hooper-Greenhill 1992, 47-53.
25 For the Medici' interest in *pietre dure*, see Butters 2000.
26 On the *Studiolo*, its iconographical program and alchemy, see Conticelli 2002. For Medici porcelain, see Alinari 2009 and Cora & Fanfani 1986.
27 On Antonio de' Medici and the *Casino*, see Covoni 1892.
28 For Ximenez's interest in glassmaking, see Dupré 2010, 58-69. Emmanuel Ximenez, his life in global trade, his possessions and epistemic interests are discussed in Dupré & Göttler s.a.
29 Listed in the inventory of Ximenez's house at the Meir at the time of the death of his wife, Isabella da Veiga, in 1617. The inventory is partly transcribed in Duverger 1984-2004, vol. 2, 400-461. For a full transcription and English translation, see Dupré & Göttler s.a.
30 Kockelbergh *et al.* 1992, 49-53. See also Schlugleit 1935.
31 For Ximenez's alchemical laboratory, see Dupré 2010, 58.
32 For Gridolfi's glassworks, see Denissen 1985a; Denissen 1985b; El-Dekmak-Denissen 1988; Génard 1883; Hudig 1923.
33 Neri 1612, 48: 'molti Signori Portughesi pratichi di gioie l'ammirarondo dicendo'.
34 About the demand for Venetian glass and the qualities which consumers sought in Renaissance glass, see McCray *et al.* 1999, 66-95.
35 For the term 'alchemy of glass', see Beretta 2009.
36 Barthélemey 2002 contains a transcription and French translation of this alchemical treatise. See also Barthélemy 1995.
37 Pereira 1990. For the pseudo-Lullian corpus, see Pereira 1989, the focus on the production of precious stones on page 9.
38 In the same period, or slightly later in the 15th century, the same type of craft recipes found in the *Sedacina* was also notably introduced in the lapidary compiled by the historian Jean d'Outremont in Liège. See Cannella 2006.
39 Barthélemey 2002, vol. 2, 164.
40 Barthélemey 2002, vol. 2, 164: 'quia illius et istius est una via et unus modus et unus processus'.
41 Beretta 2009.
42 Museum Plantin-Moretus (Antwerp), MS no. 64, 33r-35r. Transcription of the manuscript in Caen 2009, 394-399.
43 Caen 2009, 288-289.
44 'Den nempt noch een ander teijlken ende ghietet clear vanden ander in dat teylken, ende soo wasschet allenskens af tot dat ghy swert allene hebt, ende hout het wit allene, dat is het silver ende het swart is het gout'. Transcribed in Caen 2009, 399.
45 For glass paints, see Caen 2009, 251-260.
46 The manuscript is transcribed, described and discussed in Vandamme 1974. I thank Marlise Rijks for pointing my attention to Van Coudenberghe's ownership of the manuscript. 'P. Koldenbergij' is written on the binding of the manuscript. For Van Coudenberghe, see Egmond 2010, 17-20.
47 For Baten, see Cook 2007, 138.
48 Baten 1609, 172-177.
49 For a vernacular alchemical knowledge culture in the Netherlands, see Van Gijsen 2004 and Van Gijsen 2008.
50 On the 'professor of secrets', see Eamon 1994, esp. ch. 4, 135, and more recently Eamon 2010. The name derives from *Piazza universale* of Tommasso Garzoni (1549-1589).
51 On recipes and secrets, see Leong & Rankin 2011.
52 On Maggino and Colorni, see Jütte 2012, 675-676. See also Jütte's full study on Jews, science and secrets, Jütte 2011.
53 For go-betweens, see Schaffer *et al.* 2009,

Burke 2005 and Cook & Dupré 2012, 6.

54 De Munck & Van Dixhoorn s.a.

55 Van Dixhoorn 2009.

56 Vandommele 2011, 137-294, esp. 265.

57 Dupré 2010, 71-76.

58 Neri 1612, 2: 'Havendo faticato molti anni della gioventù mia, circa l'Arte Vetraria, & havendo sperimentato in essa molti effetti veri, & maravigliosi, hò di essi compilato un trattato, con quella maggior chiarezza che per me si è potuto, & affine di publicarlo al mondo per giovare, & dilettare per quanto per me si portrà l'intendenti di tal professione'. English translation from Engle 2003-2007, vol. 1, 2.

59 Moretti & Toninato 2001.

60 For the correspondence (Biblioteca Nazionale Centrale di Firenze, Ms. II. I. 391, containing Ximenez's letters to Neri; Ms. Palat. 867, IX, ff. 88v-98r), see Grazzini 1983-1984, 147-265; Dupré & Göttler s.a.; Galluzzi 1982; Neri 1612, 13-19; and see Engle 2008 on the Glasgow manuscripts. Pieter Boer and Paul Engle have published a very useful annotated bibliography of Neri's manuscripts: Boer & Engle 2010.

61 Grazzini 2012, 420: 'un Arte, molto più universale, la quale in certo modo abbraccia La Medicina, o almeno se gl'accosta molto da vicino per aiutarla (...) Essere un Arte, la quale risolvendo, e riducendo tutti i Corpi Misti, ne suoi primi Elementi, va rintracciando la natura di essi, e separando il puro dall'impuro, e di quello si serve a perfezionare i medesimi Corpi, et anco a tramutare un Corpo in un altro'. English translation from Grazzini 2012, 435-436.

62 Biblioteca Nazionale Marciana Venezia, Ms. Ital., IV. 60 [5097], no. 5, fol. 389r. Quoted in Zecchin 1987, 157.

63 Wallert 2012.

64 Smith 2004b.

65 Neri 1612, 70: 'Above all is this wonderful invention. A new way practiced by me, with the doctrine taken from Isaac Hollandus, in which paste jewels of so much grace, beauty and perfection are made, they seem nearly impossible to describe, and hard to believe'. English translation from Engle 2003-2007, vol. 3, 2. Also see Neri 1612, 79: 'I took this method from the writings of Isaac Hollandus while I was in Flanders'.

66 For Isaac Hollandus's identity, see Van Gijsen 2010.

67 One of manuscripts related to Antonio de' Medici's alchemical activities contains a recipe attributed to Isaac Hollandus, for 'acqua paradisi'; see Lawrence J. Schönberg Collection 448, University of Pennsylvania, 166r.

68 Dekoninck s.a. See also Halleux & Bernès 1995. For Rubens and alchemy, see Göttler 2012.

69 Neri 1612, 'Al curioso lettore': 'Vogliono molti, & forse con qualche ragione; che l'invention del vetro sia stata trovata dalli Alchimisti: che volendo loro imitare le gioie, trovassero il vetro, cosa forse non molto lontana dal vero; poiche come mostro io chiaro nel Quinto Libro della presente Opera, il modo di imitare tutte le gioie, nel qual modo si vede la vetrificatione delle pietre, che per loro stesse giamai fonderebbono, ne vetrificherebbono'. English translation from Engle 2003-2007, vol. 1, 5.

70 For chalcedony glass, see McCray *et al.* 1995 and Hills 1999, 118-122.

71 Neri mentions that he made chalcedony glass according to the first recipe in Florence at the *Casino* under the direction of Niccolo Landi in 1601; the second recipe allowed him to make chalcedony glass in Flanders, and according to Neri was admired by Grand Duke Ferdinando de' Medici; and Neri demonstrated the third recipe in Antwerp in January 1609: 'With this powder, I made a chalcedony glass in a glass furnace in Antwerp that was then run by a most courteous gentleman, Mr. Filippo Gridolfi'. Neri 1612, 48 (English translation from Engle 2003-2007, vol. 2, 23). He adds that he presented two pieces of chalcedony glass made according to this technique to the prince of Orange.

72 Neri 1612, 41. English translation from Engle 2003-2007, vol. 2, 12.

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