Wenzel Jamnitzer's Centrepiece and the Goldsmith's Secret

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The centrepiece by the sixteenth-century Nuremberg goldsmith Wenzel Jamnitzer (fig. 1) was cleaned and restored for the reopening of the new Rijksmuseum. After forty years on continuous display, this curious and unique object was in dire need of treatment. The silver was tarnished and the lacquer that had been applied in the past had to be removed.[1] Small elements of the silver casts of plants and creatures had been damaged and a method of cleaning these extremely fragile parts had to be devised. The essential treatment presented an opportunity to examine the piece in detail. While this object has been the focus of many publications, it has never been subjected to exhaustive scientific analysis.[2] This was therefore the perfect moment to address the still unanswered questions about the way this piece was made – particularly how the different elements that make up the centrepiece were created and how Jamnitzer managed to produce such incredibly detailed life casts of tiny creatures and plants.

< *Fig. 1*
WENZEL JAMNITZER, *Centrepiece: Merkelsche Tafelaufsatz, Nuremberg*, 1549. Silver, gold, enamel, lacquer and pigments, 99.8 x 46 cm. Amsterdam, Rijksmuseum, inv. no. BK-17040-A. After treatment in 2013.

Fig. 2
NICOLAS DE NEUFCHÂTEL, *Portrait of Wenzel Jamnitzer*, 1562/63. Oil on canvas, 92.5 x. 80 cm. Geneva, Musée d'art et d'histoire, inv. no. 1825-0023.

The Centrepiece

Wenzel Jamnitzer (1507/08-1585) was born in Vienna (fig. 2). He was the son of the goldsmith Hans Jamnitzer, who moved to Nuremberg with his young family and settled there. Wenzel elected to follow in his father's foot-

Fig. 3
ANONYMOUS,
Watercolour, in Three Parts, c. 1548.
Ink, 966 x 499 mm.
Nuremberg, Germanisches Nationalmuseum, P.W. Merkelschen Familienstiftung Bequest, inv. no. HZ. 5360.
Photo: Sebastian Tolle

steps as an 'aurifaber', but did not confine himself to that craft. As well as a goldsmith, he was also a skilled sculptor, artist, printmaker and inventor, and published on various subjects, including perspective. He worked for clients in European court circles and for the wealthy citizens of Nuremberg. In 1549 Nuremberg city council commissioned him to make the present centrepiece for 1,321 guilders – in comparison: the servants were paid one guilder between them to carry the work safely to the town hall when it was ready.[3] The design for this spectacular object has also survived (fig. 3).

Fig. 4
ANONYMOUS,
Leather Case Made for the Centrepiece,
Nuremberg, 1549.
Wood and leather,
109.5 x 53 cm.
Amsterdam,
Rijksmuseum,
inv. no. BK-17040-B.

Fig. 5
ANONYMOUS,
Hand-coloured Engraving of the Centrepiece,
before 1828.
Nuremberg,
Germanisches
Nationalmuseum,
inv. no. K23996.
Photo: Georg Janssen

From 1549 to 1806, the object, packed in its made-to-measure gold-embossed morocco leather case (fig. 4), stood in the *Gehaimen Privilegi Gewölblein* of Nuremberg town hall.[4] When the city was taken by Napoleon's troops in 1806, it found itself in acute financial difficulties. It was decided to sell some valuable items in the city's holdings, including Jamnitzer's masterpiece. The work was acquired at a public sale by the Nuremberg merchant and politician Paul Wolfgang Merkel. The centrepiece could then be seen in his house, where visitors could buy an engraving of it (fig. 5) as a souvenir.[5] In 1880 it was sold to Mayer Carl von Rothschild, a member of the famous Frankfurt banking family. Rothschild had to negotiate long and hard for it, and eventually paid the then astronomical sum of 600,000 Marks.[6] The piece then found its way into the collection of the banker and collector Fritz Mannheimer, who lived in Amsterdam. A significant proportion of Mannheimer's collection, including Jamnitzer's centrepiece, was restituted to the Kingdom of the Netherlands after the Second World War as confiscated art. The object has been part of the Rijksmuseum collection since 1952.

The centrepiece is constructed from twelve different components fastened together with screws, nuts and tie-rods. The base is in the form of a rock overgrown with vegetation: crayfish, bugs and young blue-winged grasshoppers lurk among the sort of plants we might find by the roadside – violets in bud, sweet woodruff, artemisia and hawthorn. Mother Earth stands on the rock. Over her head she holds a garland of flowers woven with rose hips and plantain ears. Above this is a large dish, decorated on the outside with ornaments based on architectural motifs. In the dish there is a large border with etched meanders, inside which is a smaller, round dish decorated with painted fruit and figures, filled in the deeper parts with a black, tar-like substance. Painted silver snakes and lizards between painted silver sprigs and seed-heads alternate around the edge of the dish. The most extraordinary element of the centrepiece is the crowning piece – a bouquet of foliage, hawthorn, lilies-of-the-valley and two long-stemmed aquilegias (columbines) in a small enamelled vase. Between these parts of the centrepiece there are eight small silver shields with lines of Latin verse etched on to them. The poem compares Mother Earth, who bears her load with a willing heart, with a rocky soil that can support a castle.[7]

Sources on Jamnitzer's Methods

We know from written sources that Wenzel Jamnitzer and his brother Albrecht ran a large workshop employing various specialists: from sculptors to chasers, embossers and gilders.[8] This workshop was described in 1547 by Johann Neudörfer, writer, calligrapher and mathematician in Nuremberg and a good friend of the brothers. He was full of praise for their skills:

> They fuse the most beautiful colours of glass, and developed silver etching to a high level; but the tiny creatures, worms, plants and posies they cast in silver and use to decorate silver objects are unequalled. They have honoured me with a pure silver bouquet cast from every imaginable flower and plant, with petals and leaves so subtle and thin that they flutter when one blows on them. But with all this they give all honour to God.[9]

Neudörfer was impressed above all by Jamnitzer's life casts of creatures and plants that he used to decorate his works in gold and silver.

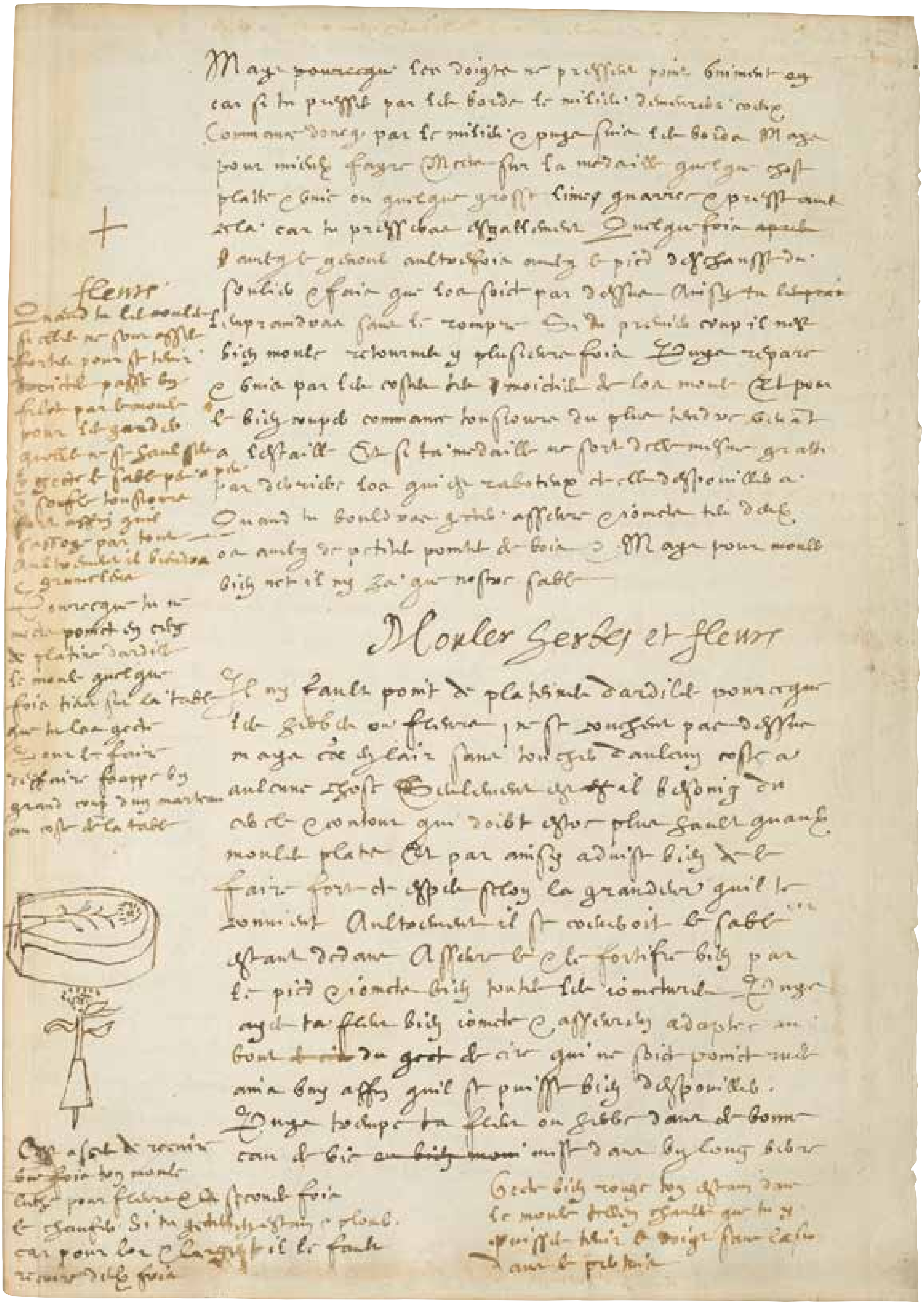
Jamnitzer's work was also known to the great and the good, as we learn from the correspondence between Jamnitzer and Archduke Ferdinand I, the brother of the Holy Roman Emperor Charles V, between 1556 and 1562; although these letters were published and edited selectively, they are very useful to our study.[10] One of the first letters, dated 22 December 1556, is about a special work that Archduke Ferdinand wanted Jamnitzer to make for him. Apparently, the archduke had already gathered together everything that was needed for this commission: 'Many fine objects, namely ores, animals, birds and other associated things...'[11] Ferdinand was insistent that Jamnitzer should visit him in Prague, but Jamnitzer let it be known several times and in the most diplomatic terms that he really did not have the time: he could not leave his many workmen alone in his workshop. In the end he sent his neighbour, the artist, scholar and architect Jacopo Strada, to Prague to work out the details of the commission. Strada was given some small cast animals to take with him. A letter Jamnitzer wrote on 27 March 1559, prior to this visit, contains the most information we have so far about the way he set about making the tiny creatures. 'I have talked to two carvers, but neither was willing to venture on making such tiny creatures … the legs of these tiny creatures would be far too thin and weak.' He suggested that the

archduke should send him 'a few drawings of imitations in order to cast the smallest animals; after all, the small animals could best be made by casting them'. He would then be able to find out which carver could best cast the animals.[12]

It is clear that in this case Jamnitzer did not want to cast the little creatures himself but was seeking someone else to make them. This is remarkable, since, despite the publication of this letter, until now it has always been thought that Jamnitzer made all the little animals himself, and his contemporary Johann Neudörfer stated that Jamnitzer and his brother could cast silver plants and creatures like no one else. We know from other sources that there were a number of artists who could make life casts. In 1550 Hans Lobsinger submitted a list of all his inventions to Nuremberg council in hopes of acquiring a sort of patent for them. He claimed several innovations in goldsmithing and metal casting and also asserted, for instance, that he had made improvements to the press Jamnitzer used to create patterns on gold, silver and other metals. According to the patent application he could also sand-cast silver lizards, otters, snakes and other animals, as well as plants.[13] Another specialist on life casting whose name appears in the literature is Hans Maslitzer. In 1549, the Fugger family – important clients of Jamnitzer's, too – paid twenty-six Augsburg guilders to this goldsmith and metal caster, who also worked in Nuremberg, for the supply of forty silver lizards.[14]

These textual sources provide little information about the precise method Jamnitzer used in making his life casts. What does stand out is that he talks in his letters about someone else who could carve and cast the creatures for him. He also noted that it would definitely be better to make the small creatures by casting them rather than carving a model in wood. By small creatures he probably meant those with a hard exterior, such as an exoskeleton or scales, like insects and lizards. We know that Jamnitzer used wooden models and possibly also woodcarvers who made figures for him, because there is a surviving model for the figure of Mother Earth (fig. 6). Although the possibility that Jamnitzer made it himself cannot be entirely ruled out, various other artists have been suggested as likely makers in the past. The sculptor Johann Gregor van der Schardt was put forward at one time and recently the names of the modeller Lienhart Schacht and the caster Pankraz Labenwolf have been mentioned.[15]

Fig. 6
ANONYMOUS,
Model for Mother Earth, before 1549.
Boxwood,
29 x 18 x 5 cm.
Berlin, Kunstgewerbemuseum,
Staatliche Museen
zu Berlin,
inv. no. K 2930.
Photo © bpk / Kunstgewerbemuseum,
SMB / Saturia Linke



Mays pource que ton doigt ne presseroit point bien net
car si tu presses par les bords le milieu demeurera creux.
Commance donc par le milieu & puys suis les bords. Mays
pour mieulx faire mects sur la medaille quelque chose
platte & unie ou quelque grosse linge quarré & presse avec
cela car tu presseras esgallement. Quelque fois avec
la main le genoul aultre fois avecq le pied des hault du
sable & faire que ce soit par dessus. Ainsy tu l'emprain-
dras sans le rompre. Si du premier coup il n'est
bien moulé retourne y plusieurs fois. Mays repare
& unis par les costés les moitiés de ton moule. Et pour
le bien couper commence tousjours du plus hault de
la taille. Et si ta medaille ne sort d'elle mesme graisse
par derriere ce qui est relevé et elle despouillera.
Quand tu bouldras getter asseche & cimente les [illegible]
ou aultres de petites pointes de bois. Mays pour moule
bien net il n'y a que nostre sable

fleurs
Quand tu les moulles si elles ne sont assez fortes pour se tenir droites passe ung filet par le moule pour les garder qu'elles ne se haulsent à getter le sable par-dessus & couste tousjours qu'il [illegible] par tout aultrement il bouldra grandeur

Pource que tu ne metz point de platine dargille au moule quelque fois tire sur la table pour le bien garder comme le faire reffaire frappe ung grand coup d'ung marteau au coste de la table

Moller herbes et fleurs

Il ny fault point de platine dargille pource que
les herbes ou fleurs ne se rengent par dessus
mays [illegible] sans les couchés daulcun costé a
aulcune chose. Seullement il fault besoing du
cercle & contour qui doibt estre plus hault quand
moule platte. Et par ainsy advise bien de le
faire fort et espés selon la grandeur quil te
convient. Aultrement il se romproit le sable
estant dedans. Asseche le & le fortifie bien par
le pied & cimente bien toutes les commissures. Mays
aye ta fleur bien cimentée & asseurée, adapte au
bout ~~de cire~~ du gect de cire qui ne soit point mal
aisé au moins affin quil se puisse bien despouiller.
Mays trempe ta fleur ou herbe dans de l'eau com-
mune de vie ~~ou bien mesme~~ mise dans ung long [illegible]

Il fault de recuire [illegible] fois ton moule aultrement pour fleurs & la seconde fois le chauffe. Si tu [illegible] plomb car pour les clarifier il le fault recuire deux fois

Gecte bien rouge les estain dans le moule [illegible] qu'il se puisse tenir le doigt sans estre dans le [illegible]

Fig. 7
ANONYMOUS, *Goldsmith's Manuscript*, vicinity of Toulouse, c. 1580. Paris, Bibliothèque nationale de France, ms. Français 640, fol. 145 v: instructions for making a mould to cast a flower.

The written sources do, though, make it clear that Wenzel Jamnitzer and his brother Albrecht (possibly in collaboration with Hans Lobsinger) were engaged in technical innovation and that he had a workshop with specialists in different fields. Wenzel appears to have acted primarily as the supervisor of the execution of his designs. The sources do not tell us incontrovertibly whether he made the life casts of plants and animals himself, but it makes sense to assume that he must have known all about these techniques in detail. And the written sources, finally, do not give any precise information about the more technical aspects of Jamnitzer's goldsmithing practice: we learn little or nothing about his raw materials such as the composition of his silver alloys and mould materials, his tools or the specific plants and animals he used for his life casts. Happily, the scientific analyses undertaken by the Rijksmuseum were able to shed new light on these matters.

Experiments in Making Life Casts from Aquilegias

A life cast is made by catching a small creature or picking a plant that is then embedded in a moulding material, such as plaster. The mould is fired in a kiln so that the organic material is calcined. Any residue is carefully shaken out of the mould and the cavity is filled with molten silver. Once it is cool, the mould is removed to release the silver cast. This old technique was recently investigated in depth by Pamela Smith and Tonny Beentjes,[16] who used a late-sixteenth-century manuscript from the vicinity of Toulouse as a guide for their experiments.[17] This manuscript of recipes for casting plants and animals from life is illustrated with drawings explaining such things as how a lizard had to be embedded in the mould. The recipe for the mould material was also described (fig. 7). This research, which concentrated chiefly on casting animals, showed among other things that they were cast in a mould with two halves. This made the mould easier to clean before the silver was poured in (sometimes fragments of bone that had not completely calcined were left behind), and meant that the mould could be re-used – convenient if a number of creatures had to be cast. The individual lizards and snakes on Jamnitzer's centrepiece appear to have been cast in this way: there is a seam down the length of the bodies (fig. 8).

Fig. 8
Unpainted lizard removed from the hill of plants below Mother Earth: a seam is visible just above the red line.

Detailed experimental studies into casting fragile plants and flowers had never been carried out before. The recent cleaning presented the chance to conduct an extensive study of the life casts. These casts are very fragile – the posy of flowers on top of the centrepiece a case in point (fig. 9) – so it was not possible to try out potential cleaning methods on the elements themselves: tiny pieces could break off at the slightest touch. This meant an intermediate step was essential. It was decided to make new life casts of plants and investigate the best way to clean those. The contemporary written sources provide little to go on. Plants like these also present an extra degree of technical difficulty. It is not possible to use vents when casting because they are very difficult to put in and remove with such a fragile cast. The air present in the mould cavity after the vegetable matter has been calcined can prevent the silver from completely filling the mould. The thin leaves of the plants present another problem: if the silver is cast very thinly there is a risk of cold shut, where the metal flows out so thinly that it cools too quickly and solidifies before the mould is filled. How, then, in the sixteenth century, could someone make an aquilegia, a delicate plant with such fine petals?

The first experiments used vacuum casting. In this modern technique – which, of course, did not exist in the sixteenth century – the mould is subjected to a vacuum during casting so that the silver is sucked with some force into the mould. This almost completely eliminates the problem of air in the mould preventing the silver from flowing. A number of different plants of the kind on the centrepiece were prepared for casting in silver. A wax sprue was melted on to the stem of the plant, after which more branches were melted on to a main wax sprue. The 'tree' thus created was then embedded in a special casting medium, fired and cast.[18] The initial results were satisfactory. Because there was already a certain natural path ('tree structure'), most branching plants could be effectively cast. The metal could run through a wide access point to increasingly thinner parts. It was able to flow freely without encountering many obstructions on the way. We expected to be able to make a cast of an aquilegia using this sophisticated technique for the detailed casting of small objects. The aquilegias, however, all failed. The silver did not flow fully into their petals, indicating cold shut (fig. 10).

Fig. 10
Detail of the centre of the vacuum-cast aquilegia, after cleaning in vitriol, in which the stamens and pistils can be seen and the petals were only partially filled.

< *Fig. 9*
Posy of flowers removed from the top of the centrepiece: lilies-of-the-valley, hawthorn and aquilegias can be identified.

It was therefore decided to go back to the recipe described in the above-mentioned sixteenth-century French manuscript in the hope that it would be possible to cast a complete aquilegia using this old method.[19] A test series was made with Tonny Beentjes's assistance. The embedding material was a mixture of crushed old roof tiles and plaster to which iron filings or iron oxide were added. The plants, with sprues on the stems and branches, and without vents, were placed in the kiln and fired to about 700 degrees. The aquilegia's spurs were removed because they did not seem to be present on Jamnitzer's casts, or in any event were smaller than in the modern aquilegias being used for the test. Lastly, the petals were plumped up with butter, since the manuscript states that making the petals thicker would facilitate casting; thicker petals leave a larger space in the mould after calcining, which means that silver can flow in for longer without cooling off. Jamnitzer proved to have placed the sprues on the flower in the same way we had done four hundred and sixty years later: that is on the spurs (figs. 11, 12). Without these extra sprues the flower could not fill with silver because the stem at the base of the bloom is too thin to allow all the silver to flow through quickly.

Fig. 11
Sprues on the spurs of the aquilegia to be reproduced.

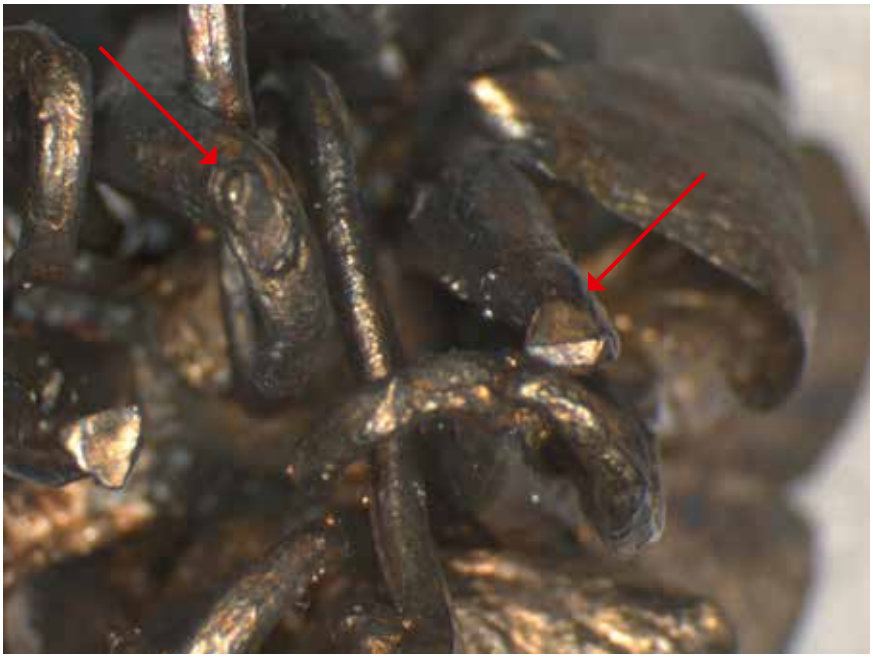


Fig. 12
Back of the silver aquilegia from Jamnitzer's posy: there are traces of where the sprues were cut off.

Fig. 13
An aquilegia cast according to the method given in the French manuscript (left), and the aquilegia taken from the centrepiece (right): the petals and spurs of the aquilegia on the left are much coarser and incompletely cast.

This time the casts of the aquilegias were more complete than those made with the vacuum machine (fig. 13), but some of the petals were still not fully cast. The texture of the elements was also coarser. This might have been caused by plumping up the petals with butter, but could also have had to do with the nature of the mould material. One test casting by Beentjes of an aquilegia with stem and petals according to the French method was extraordinarily successful (fig. 14). Here again the petals were not complete, but the other parts were virtually fully cast.

So, is the method in the French manuscript the technique Jamnitzer used to cast the aquilegias? Not entirely. Further investigation has revealed that Jamnitzer set about it in a slightly different way. For instance, grains of

Fig. 14
Aquilegias cast by Tonny Beentjes according to the method given in the French manuscript, unfinished (sprues still present).

sand were found cast into the silver of the base (fig. 15). The French manuscript does not mention sand. Electron microscope examination showed that there were also particles that appeared to be baked on the surface of the hill of vegetation on which Mother Earth stands.[20] These particles contain aluminium, silicon and potassium. This led us to suspect that there may have been feldspar (silicates) or clay on the surface, a discovery that set us on a different track: might there have been other recipes for making silver casts from life, using other materials?

Perhaps another recipe might be more appropriate. There is also a German source about life casting: *Ars Vitraria*.[21] The book is primarily concerned with glassmaking, but it includes a chapter on casting small silver creatures and plants. The sections on casting from life have been studied previously.[22] It is, admittedly, a book that was published more than a century after Jamnitzer made his masterpiece, but the text is based on older sources. Johannes Kunckel, the seventeenth-century German chemist who compiled the work, noted his own findings. The chapter of the *Ars Vitraria* devoted to casting plants includes the following recipe, which can be summed up thus: a material referred to as 'spat' has to be pulverized and held in a pot over a fire until the water has disappeared. One part of this burnt 'spat' is then mixed with one part 'federweiss'. The plant – possibly moistened with brandy – is then placed in an outer mould of yellow clay mixed with fine sand and wool. The mixture of 'spat' and 'federweiss' is poured into this, and the whole thing is then shaken gently so that the medium flows all around the plant. The form is then placed on 'old' coals – this may mean coals that are still hot – and the silver is poured into the hot mould. Kunckel ends by noting that adding bismuth to the silver before it is melted makes the metal thinner so that it flows better.[23]

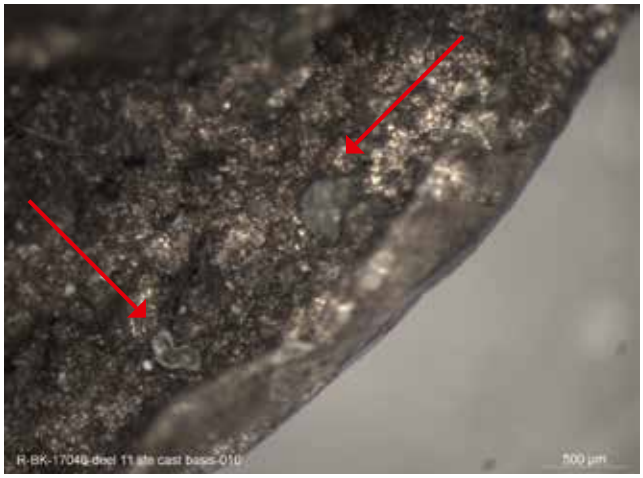


Fig. 15
Base of the centrepiece with life casts: around the edge there are grains of sand in the silver.

Precisely what 'spat' and 'federweiss' mean is not clear. The interpretation of old names for materials is tricky: they can often refer to more than one thing. 'Federweiss' may be a talc or asbestos-like powder.[24] In the first version of Kunckel (1679), 'spat' in any event means something other than plaster, since the author uses the word for plaster elsewhere in the book and explains how to use it when one wants to cast silver.[25] 'Spat' may mean feldspar (*Feldspat* in German), which is a silicate such as granite. Potters use feldspar to lower the firing temperature of earthenware.[26] Given that particles resembling clay have been found on the cast silver of Jamnitzer's centrepiece, it would certainly be interesting to investigate further whether there actually was a technique in Nuremberg for casting with clay-like materials.[27] There was certainly a long tradition in the city of casting bronze sculptures in clay moulds.[28]

A significant advantage is that a mould made of clay and feldspar can be fired to a much higher temperature than a mould made of plaster and crushed brick. Plaster, after all, crumbles at temperatures above 700 degrees and the mould becomes unusable. A mould that can withstand higher temperatures can keep the silver liquid for longer, increasing the chance that it will flow

throughout the mould: this could prevent cold shut. How the life cast could then be removed from this 'ceramic' shell remains the question. It is possible that quenching it in water would cause the shell to shatter. New experiments to test this recipe with clay are planned.

The investigation into the casting of the aquilegia also revealed that the sixteenth-century aquilegia used for the life casts on the centrepiece looks different from the ones we know today. Jamnitzer's aquilegia appears to have more petals and looks fuller. This proves to be a double-flowered variety: instead of the usual five spurs and five petals it has ten of each. In a sixteenth-century botanical manuscript from the region where Jamnitzer worked (fig. 16) there is an aquilegia that looks very like the type Jamnitzer cast; it is labelled *Aquilegia multiplex*.[29] These variants were usually cultivars: mutations like this seldom survive in the wild. His use of this type of aquilegia, which fills with silver more readily because it has more petals, may go some way towards explaining the success of Jamnitzer's life casts. It is also possible, however, that Jamnitzer modified his aquilegias himself to create the right effect. The petals of his aquilegia are very short and look as though they have been trimmed. He could thus ensure that the metal did not have as far to flow, increasing the chance of a successful, complete cast.

Fig. 16
Detail of *Aquilegia multiplex* from *Liber picturatus*, sixteenth century. Watercolour. Krakow, Jagiellonian Library, ms. A25, p. 30.

Composition of the Silver

Various measurements were also carried out on the silver itself (see table 1).[30] Around 1511 a decree was issued in Nuremberg prohibiting the use of less than 14 lot silver (875 parts silver, 125 parts copper).[31] The analysis showed that the silver (Ag) Wenzel Jamnitzer used for his life casts was well above that standard (930 parts silver), which also made the life casts more expensive. The female figure also meets the standard (880 parts silver). The measurements show that a small amount of bismuth might have been added, as Kunckel's book advocated this metal as a suitable material to make the silver flow better. One can think of two reasons why Jamnitzer preferred to cast silver that had a higher purity than the minimum standard: purer silver is better for casting and does not tarnish as quickly. Jamnitzer was undoubtedly aware of both properties.

Plants and Animals on the Centrepiece

There are many other species of plants and animals on the centrepiece besides the aquilegia, and they have been identified by biologists at the University of

TABLE 1 The average composition of different components of the centrepiece (percentages)

	Ag	Au	Bi	Cu	Ni	Pb	Zn
Life casts (n=22)	93.8±2.3	0.14±0.10	0.65±0.15	4.58±1.93	0.23±0.14	0.34±0.26	0.01±0.02
Cast statue (n=12)	88.8±6.9	0.26±0.26	0.54±0.10	5.44±1.40	0.27±0.04	1.04±1.25	0
Solder (n=5)	82.5±10.6	0.09±0.05	0.53±0.11	14.5±9.44	0.30±0.08	0.40±0.07	1.47±1.21
Silver plate (n=5)	89.8±1.5	0.13±0.08	0.60±0.07	7.63±1.38	0.28±0.02	0.76±0.50	0.05±0.04

TABLE 2 Plants on the Centrepiece

Species	Found on component
Parsley (*Umbelliferae*)	A
Sweet woodruff (*Galium odoratum*)	A
Primrose (*Primula vulgaris*)	A
Violet (bud, *Viola species*)	A
Box (*Buxus sempervirens*)	A
Mugwort (*Artemisia vulgaris*)	A, B, C, D
Common hawthorn (*Crataegus monogyna*)	A, B, D, E
Common grape vine (resembles hawthorn, *Vitis vinifera*)	A, D
Monkshood (*Aconitum napellus*)	B
Lady's thumb (*Polygonum persicaria*)	B
Common sow thistle (*Sonchus oleraceus*)	B
Goldenrod (*Solidago virgaurea*)	B
Hemp antimony (*Eupatorium cannabinum*)	B, D
Celery (*Apium graveolens*)	B, E
Meadow saxifrage (*Saxifraga granulata*)	C
Ragwort (*Senecio jacobea*)	C
Common comfrey (*Symphytum officinale*)	C
Rose, possibly shrub rose (bud, *Rosa gallica officinalis*)	C
Common wormwood (*Artemisia absinthium*)	C, D
Broadleaf plantain (*Plantago major*)	C, D, E
Cow parsley (*Anthriscus sylvestris*)	C, E
Rough hawksbeard (*Crepis biennis*)	D
Aquilegia (*Aquilegia vulgaris*)	E
Lily-of-the-Valley (*Convullaria majalis*)	E
Betony (*Stachys officinalis*)	E
Tansy (*Tanacetum vulgare*)	E
Great mullein (*Verbascum thapsus*)	E
Ploughman's spikenard (*Inula conyza*)	E

A = silver hill with plants, low
B = silver hill with plants, high
C = garland above Mother Earth's head
D = dish
E = bouquet at the top

Fig. 17
Painted silver sprig taken from the dish in the centrepiece during restoration: different species are combined in a single sprig.

Amsterdam. Damage to the casts meant this was by no means always easy, particularly in the case of the plants and flowers. Most of the cast plants proved to be wild varieties and garden herbs (see table 2).

The native species include monkshood, aquilegia and small vine leaves (around the dish). We are more likely to encounter plants like the shrub rose and box in a monastery garden. Interestingly, the casters sometimes combined parts of plants that do not belong together, creating a non-existent imaginary plant (fig. 17).[32] We have already seen that Jamnitzer probably trimmed the petals of the aquilegia: he evidently had no scruples about

manipulating nature when it suited him, in order to achieve the best aesthetic effect.

The insects – all of which are found on the rock that forms the base – proved to be young (juvenile) specimens that were probably caught in May and June. They include the blue-winged grasshopper (*Oedipoda caerulescens*, figs. 18a-b) and a firebug (*Pyrrhocoris apterus*, figs. 19a-b). The little lizards and snakes on the centrepiece are likewise young animals – the grass snake (*Natrix natrix*) and the viviparous or common lizard (*Zootoca vivipara*). These are the most obvious species to use in life casting. Grass snakes frequently lay their eggs in the same place (somewhere warm, such as a dunghill) and often share their environment with man. The eggs all hatch at the same time in June, so the innumerable young are easy to collect.[33] The common lizard also lives near humans and is often found in the same habitat as the grass snake. After they are born, the young of the common lizard can be found basking together, so they are easy to catch. It is quite possible that Jamnitzer and other goldsmiths employed the local children to catch the creatures, because they were most likely to know where to find them.[34] Jamnitzer's principal reason for choosing juvenile creatures would surely have been that they are more decorative and refined than adult specimens and in proportion to the other silver components of the centrepiece.

Painting

The silver life casts of the plants and creatures around the dish and on the edge of the foot of the centrepiece were painted. The paint has become very dark in many places, but the original intense colour can sometimes still be made out. The pigment appears to have retained its colour on the underside of the border of the dish better than elsewhere, probably because these parts have never been covered in dust. The different colours have previously been analysed and the paint proves to be built up with a rosin varnish.[35] The pigments are those current at the time, including verdigris (green), vermillion (red) and azurite (blue). These pigments are also mentioned in recipes in a chapter on painting silver in the French manuscript.

< *Fig. 18a*
Oedipoda caerulescens, blue-winged grasshopper.
Photo: André den Ouden

< *Fig. 18b*
Grasshopper on the hill of plants beneath Mother Earth.
Photo: Blickwinkel / Alamy Stock Photo

> *Fig. 19a*
Zootoca vivipara, viviparous or common lizard, adult and juveniles.

> *Fig. 19b*
Juvenile lizard on the dish in the centrepiece.

Reptile expert I.A. Janssen established that the painting on the lizards and snakes corresponds with the patterns found on the living creatures.[36] This could also mean that the paint has remained essentially unchanged since it was applied.

The Female Figure

The figure of Mother Earth has also been examined in detail. The x-radiograph (fig. 20) shows that the statuette is built up from different parts. The hands, arms, head, trunk and lower body were cast separately and then soldered together. All the parts are hollow, except for the hands. Making a hollow cast of a statue uses less metal, which is certainly worthwhile in the case of silver. Casting the arms, the hands and the upper body separately meant that their positions could be varied. The arms of the wooden model for the figure were certainly in a different position. The pose of the model may in the end have proved unusable so that the arms and hands had to be cast separately (or sawn off and re-soldered) to get them in the right place. It could also have been normal practice in a workshop to have one standard casting pattern for a torso to which various arms, legs and heads could be added to create objects in different positions.[37] This last option appears to be the most likely, since the woman's hands have small pins to ensure a good soldered connection to the arms, and the arms and the body have connecting cuffs. This points to a predetermined working method.

It came as a surprise to discover that the female figure had been reinforced at the feet and base with long rolls of silver sheet. This point was probably thought to be too thin to bear the weight of the heavy dish and so it was strengthened to be on the safe side; the total weight of the centrepiece is 11.26 kilos and the dish and flowers probably account for about two-thirds of this, 7 or 8 kilos.

Fig. 20
X-radiograph of the figure of Mother Earth, taken with GE equipment with ERESCO image intensifier GE 200kV 1,7mA: rolled silver sheet visible as reinforcement in the feet.

Fig. 21
Repeat pattern under the dish.

Fig. 22
Ornamental border of the dish (fig. 21): the arrow indicates a casting bubble.

Patterns

We learn from Hans Lobsinger's patent request, mentioned earlier, that Jamnitzer owned a press or roller that could impress patterns in metal. Going by the many repeating patterns in the silver in the centrepiece on the base of the dish (fig. 21), it might be assumed that such a press or die was used here. When these patterns were examined under a microscope, however, it was seen that they were not pressed, but cast in separate parts, a more expensive method. It was possible to establish this by looking at casting flaws and casting bubbles (fig. 22), typical characteristics by which a cast can be recognized. Casting flaws are caused when an area inside the mould is damaged, perhaps because the mould has taken a hard knock. This can loosen a fragment of sand or clay, which will be visible on the cast. Casting flaws like this can be seen in a number of places. Casting bubbles occur when air is trapped in a mould cavity while the piece is being cast. These small air bubbles are eventually filled with metal during casting and can be seen on the cast later. Air bubbles usually occur with casting, so we can assume that the patterns used in constructing the dish were made in wax – the accepted technique for precise modelling – and then cast in silver.

Dedication

The occasion for which the centrepiece was made is unknown. A cartouche, a round silver shield with a decorative surround of etched arabesques filled with black wax, has been screwed to the underside of the base, but it appears to be unworked: there is no dedication (fig. 23). It has until now been assumed, on the basis of this 'empty' plaque that the city of Nuremberg's original intention was, in accordance with custom, to present the costly centrepiece as a gift to a highly placed guest visiting the city. It has been suggested, for instance, that it might have been made for Charles V, but was never presented

Fig. 23
The cartouche underneath the centrepiece, diam. 9 cm.

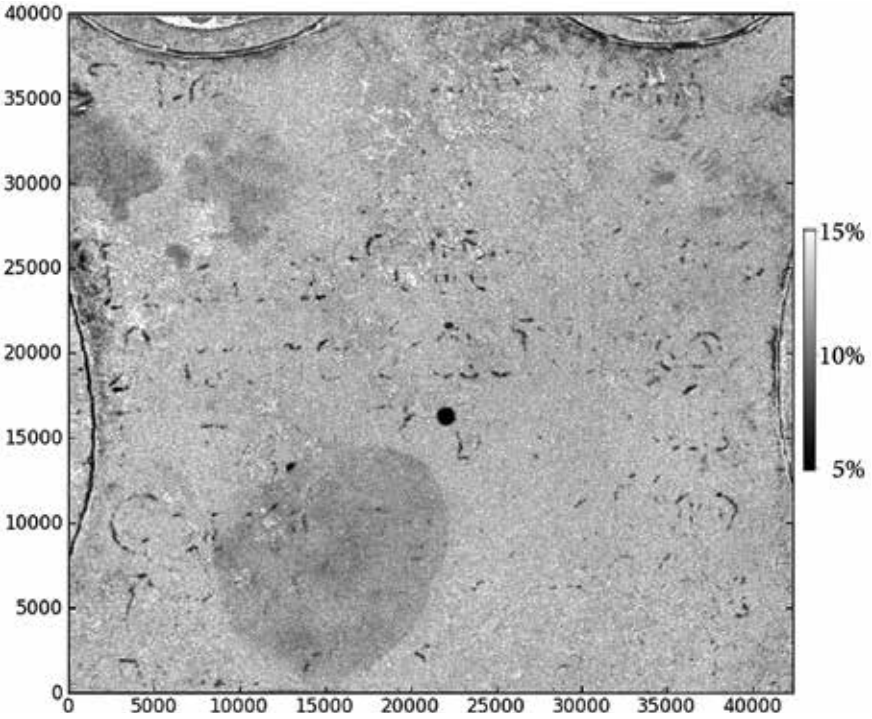


Fig. 24
AGLAE scan of the surface of cartouche (fig. 23), approx. 4 x 4 cm: outlines of letters are visible.

because, contrary to expectations, after his visit to Nuremberg in 1541 the emperor never came to the city again. It was also thought that his son and heir Philip II was the intended recipient because he was going to make a tour of Germany, but in the end he did not go to Nuremberg either.[38]

Further investigation has now revealed that there actually was lettering on the plaque. Like smaller cartouches on the centrepiece, it originally had an etched inscription that was subsequently removed. After this discovery in the Rijksmuseum's conservation workshop, a research institute associated with the Louvre used a special analytical technique in an attempt to recover the lettering (fig. 24).[39] This was not a complete success, but some individual letters were identified (fig. 25). It is to be hoped that other techniques will be developed in the future that will make it possible to recover the whole inscription.

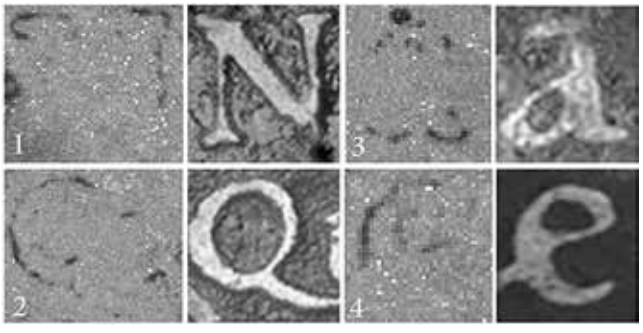


Fig. 25
Letters that could be identified from the scan (fig. 24).

The investigation brought to light many new facts about the centrepiece, particularly technical aspects. To start with, it was established on the basis of old documents that Jamnitzer did not always make all his life casts himself and sometimes employed other people to do it for him. The silver insects, snakes and lizards on the centrepiece have been identified, and it has emerged that almost all of the casts were of juveniles; Jamnitzer and his assistants adjusted the shape of the animals to show them at their best. The plants were also young. There are two possible reasons for this. The plants would be fresher and the creatures would be easier to catch. The small creatures looked more elegant when incorporated in the decoration and presented opportunities for a high degree of refinement. Parts of different plants were combined to create new imaginary plants. Jamnitzer was fortunate in that there was a variety of aquilegia growing in the region that lent itself perfectly – with a little modification – to casting. It appears that this variety no longer exists; the centrepiece is consequently also of importance in terms of botanical history. The flower that was used was modified somewhat, though – plumped up with butter or something similar – to ensure the success of the casting. It was also found that a mould made with a clay-like substance with feldspar was used for the life casts of plants in this centrepiece. The silver plants and flowers around the dish were painted. The paint used for this was a rosin/oil varnish with the usual pigments for the time. Biologists have confirmed that the painting was true to life.

The female figure proved to be composed of a number of parts, and it appears that the final pose was not decided until a later stage. The discovery that the fine patterns on elements of the centrepiece were all cast, not pressed, was an important one. It proved yet again that Jamnitzer and his assistants had achieved perfect mastery of the casting technique.

Perhaps the most interesting find of this technical and scientific investigation is that the dedication cartouche on the underside of the centrepiece, which had always been assumed to be empty, had in fact borne an inscription put on in Wenzel Jamnitzer's time. It may be possible to decipher this lettering in full in the future, and then the mystery of the intended recipient of this extraordinary centrepiece can be solved.

ABSTRACT

This article focuses on the 'Merkelsche Tafelaufsatz', a large centrepiece made by the Nuremberg-based Wenzel Jamnitzer in 1549. The piece is known for its numerous life casts of small creatures and flowers – real plants and animals placed in a mould with material that was heated, causing the original to be calcined. The void thus created was then filled with silver. Earlier research based on a contemporary French treatise on the subject illustrates how these life casts, especially the animals, could have been made. This article focuses on the casting of the flowers. An experiment recreating the intricate aquilegia in the crowning piece shed light on the casting method the goldsmith and his workshop used to achieve the delicate petals and fragile pistils and stamens. The plants and animals on the centrepiece are identified, and other techniques involved in creating the centrepiece as a whole, are described and examined. The cast ornaments, the paint on some of the life casts and the reinforcement of the main figure are discussed. The article concludes by demonstrating that the dedication cartouche, always thought to have been left empty, must have borne an inscription as some of the letters from it have been reconstructed with analytical techniques.

NOTES

* Thanks are owed to Tonny Beentjes, Dirk Jan Biemond, Robert van Langh, Sara Creange, Tamar Davidowitz, Ellen van Bork and Arie Pappot. This project could not have succeeded without them.

1 The display case, like many of them in the past, was not air-tight and the lacquer had a limited life, which meant that the silver tarnished over time.

2 The first long articles began to appear in the nineteenth century, and in the nineteen-seventies Klaus Pechstein published a very painstaking study of the object. Ten years later, the Germanisches Nationalmuseum in Nuremberg, where Wenzel Jamnitzer was active, devoted a whole exhibition to the goldsmith and his working environment. The last major exhibition that featured work by Jamnitzer was in 2007, likewise in Nuremberg. In addition to these publications, there are many sources dating from Wenzel Jamnitzer's own time that contribute to our knowledge of Jamnitzer, the man and his workshop. See among others *Die Nürnbergischen Künstler geschildert nach ihrem Leben und ihren Werken*, Heft Wenzel Jamnitzer, Nuremberg 1828, pp. 2-24; M. Frankenburger, 'Beiträge zur Geschichte Wenzel Jamnitzers und seiner Familie', *Studien zur Deutschen Kunstgeschichte* 30 (1901), pp. 1-95; Rudolf Bergau, 'Der Merkel'sche Tafelaufsatz von Wenzel Jamnitzer', *Zeitschrift für Bildende Kunst* 13 (1878), pp. 246-48; Klaus Pechstein, 'Der Merkelsche Tafelaufsatz von Wenzel Jamnitzer', *Mitteilungen der Vereinigung für Geschichte der Stadt Nürnberg*, Nuremberg 1974, pp. 90-121; Klaus Pechstein, Ralf Schürer and Martin Angerer, *Wenzel Jamnitzer und die Nürnberger Goldschmiedekunst 1500-1700*, Munich 1985. For Jamnitzer's correspondence see among others D. Schönherr, 'Wenzel Jamnitzers Arbeiten für Erzherzog Ferdinand', *Mittheilungen des Instituts für Österreichische Geschichtsforschungen* 9 (1888), pp. 289-326; there are also letters in archives in Saxony (C. Gurlitt Aus den sächsichen Archiven I: 'Wenzel Jamnitzer und der kursächsische Hof', *Kunstgewerbeblatt* 1 (1885), pp. 51-53) and the archives of Emperor Rudolph II (R. Beer, 'Acten, Regesten und Inventare aus dem Archiv General zu Simancas', *Jahrbuch der kunsthistorischen Sammlungen des Allerhöchsten Kaiserhauses* 12 (1891), pp. XCI-CCI; Sven Hauschke, 'Goldschmiede als Hersteller wissenschaftlicher Instrumente und Geräte' in Karin Tebbe (ed.), *Nürnberger Goldschmiedekunst. Band II: Goldglanz und Silberstrahl*, Nuremberg 2007, note 28; a manuscript in the Victoria and Albert Museum, London, National Art Library, MS 1601-1893, fol. 74v, is being edited by Sven Hauske, but does not contain much of technical interest.

3 U. Timann, 'Goldschmiedearbeiten als diplomatische Geschenke', in Herman Maue et al., *Quasi Centrum Europae: Europa Kauft in Nürnberg 1400-1800*, Nuremberg 2002, pp. 217-39, esp. p. 219. Archive records also show that Jamnitzer's wife received twelve thaler and his servants were paid one guilder for carrying the finished work to the town hall.

4 U. Timann, 'Zur Handwerksgeschichte der Nürnberger Goldschmiede', in Tebbe 2007 (note 2), pp. 34-36. The reason why the object stayed in the town hall for so long and was not, as was customary with town council commissions, presented as a gift to a visiting ruler, is explored later in this essay.

5 Hand-coloured 1 florin 12 krone, black and white 86 krone; Friedrich Mayer, *Nürnberg und seine Merkwürdigkeite: Ein Wegweiser für Fremde*, Nuremberg 1849. The Wilder brothers are named as the engravers in Bergau's 1878 article (note 2).

6 P. Glanville, 'Mayer Carl von Rothschild: Collector or Patriot', 2004, online article on Rothschild archive: www.rothschildarchive.org/materials/ar2004mayercarl.pdf (consulted 20 November 2017).

7 The full text of the poem reads: 'I Celebrato laudibus Deum O grata mens Mortalitum II Divina sunt quecunque fert Foecunda Tellus munera II Sed nos ministri spiritus Tuemur haec divinitus 1 Cur mole mollis foemina Heic tot gravata fructuum Aut quae Dearum sim rogas 2 Sum terra Mater Omnium Onusta caro pondere Nascentium ex me fructuum 3 Non vitibus graves botri Nec sunt molesti pendulis Foetus virentes frondibus 4 Moles jocunda scilicet Quam corda foeta sustinet Leviter feruntque leniter 5 Sic fulcra saxeo solo Subnixa gestat Robusta magnam Regiam.' (Sing the Lord's praises, oh grateful spirit of the mortals. Whatever the fertile earth brings forth are divine gifts. We, servants of the spirit, wonder at this divine nature. You ask why I, a frail woman, bear such a heavy burden of fruit, or which goddess I am. I am the earth, the mother of all things, laden with the precious burden of the fruit I have brought forth. The vines are as little troubled by the full grape as the verdant twigs of the fruit that hang from them.

It is pleasant to bear a load with a cheerful mind: that burden becomes light. Just as the rocky foundation, supported by the ground below, carries the great castle.)

8 For the earliest description of Wenzel Jamnitzer's workshop see Eitelberger von Edelberg and W. Braumüller, 'J. Neudörfer, Nachrichten von den vornehmsten Künstlern und Werkleuten, 1547, von G.W.K. Lochner', *Quellenschriften für Kunstgeschichte und Kunsttechnik des Mittelalters und der Renaissance* X, Vienna 1875, pp. 126-27. Later authors usually follow this text, see e.g. Johann Gabriel Doppelmayer, 'Historische Nachricht vond den Nürnbergischen Mathematicis und Künstlern' in Karl-Heinz Manegold and Wilhelm Treue (eds.), *Documenta Technica*, Hildesheim 1972, pp. 205-06.

9 Von Edelberg and Braumüller 1875 (note 8): (note 8): 'Sie schmelzen die schönsten Farben von Glas, und haben das Silberätzen am höchsten gebracht, was sie aber von Thierlein, Würmlein, Kräutern und Schnecken von Silber giessen, und die Silberne Gefässe damit zieren, das ist vorhin nicht erhöret worden. Wie sie mich dann mit einer ganzen silbernen Schnecken [posy of flowers], von allerlei Blümlein und Kräutlein gegossen, verehret haben, welche Blättlein und Kräutlein also subtil und dünn sind, dass sie auch ein Anblasen wehig macht, aber in dem allen geben sie Gott allein die Ehre.'

10 Schönherr 1888 (note 2), pp. 298-305; D. Schönherr, 'Urkunden und Regesten aus dem K.K. Statthalterei-Archiv in Innsbruck', *Jahrbuch der Kunsthistorische Sammlungen des Allerhöchsten Kaiserhauses* II (1890), pp. LXXXIV-CCXLI. The first article is a summary of the archive records that are reproduced more fully in the second document. The letters that are quoted differ in small details between one document and the other and it is not clear what is an original sentence in a letter and what is an edited text. The original letters would have to be studied again to be certain of their wording.

11 Schönherr 1890 (note 10), pp. CLXVIII-CLXIX: 'Viele schöne Sache, nämlich Stiefe (Ertze), Thiere, Vögel und andere darzu gehörige Dingen beisammen habe.' E. Mulzer, 'Das Jamnitzerhaus in Nürnberg und der Goldschmied Wenzel Jamnitzer', *Mitteilungen des Vereins für Geschichte der Stadt Nürnberg* 61 (1974), pp. 48-89, esp. p. 63.

12 Schönherr 1888 (note 2), p. 301; correspondence from Wenzel Jamnitzer to Archduke Ferdinand, 27 March 1559. The editor both quotes and described what is in Jamnitzer's letter: 'So habe ich mit zwei Bildschnitzen gesprochen; aber keiner wolle es unternehmen so kleine Thierlein zu machen … es würden die beinlein an den kleinen dirlein so gar dir [thin] und schwach. Sein Rath gehe nun dahin, der Erzherzog möge ihm etliche fissirung von kunderfeden [counterfeiting] zusenden, um die kleinsten Thiere zo schmelzen; denn es kinnen die kleinen dierlein nit besser zuwegengebracht werden dann geschmelzt. Dabei könnte er auch erfahren, welcher Bildschnitzer die Thiere am besten schmelze'.

13 'item er kun auch edexen, ottern, schlangen und andere tier, auch gewex als von silber in sand giessen.' A. Bartelmess, 'Hans Lobsinger und seine Erfindungen', *Mitteilungen des Vereins für Geschichte der Stadt Nürenberg* 52 (1963/64), pp. 256-64, esp. p. 262. The word 'ottern' is probably a misinterpretation of the text since an otter is a large animal with much soft tissue, which would make it very difficult to model.

14 N. Lieb, *Die Fugger und die Kunst im Zeitalter der hohen Renaissance*, Munich 1958, p. 85. The lizards mentioned in this payment, from the same year as the centrepice, are not likely to be the lizards in the centrepiece as it has only twelfe.

15 Pechstein et al. 1985 (note 2), p. 408. Van der Schardt probably worked with Jamnitzer on the monumental 3.5-metre-high-fountain celebrating the union of the Holy Roman Empire with the House of Habsburg that was made for Emperor Maximilian II in 1568. Going by the style, other artists are also possible candidates, among them the Nuremberg bronze casters Georg Labenwolf and Lienhart Schacht. The latter two worked together on figures for a fountain (1576-82), that are highly reminiscent of the Mother Earth in the centrepiece in the width of the female figure, the folds of the robe, and the cuirass with the prominent round breastplate, see S. Hauschke, 'Es Muss nicht immer Gold und Silber sein – Messingguss und Eisenschnitt aus Nuremberg', in Hermann Maué and Christine Kupper, *Quasi Centrum Europae Europa Kauft in Nürenberg 1400 1800*, exh. cat. Nuremberg (Germanisches Nationalmuseum) 2002, pp. 241-71. True, the fountain is of a later date than the centrepiece, but there are so many similarities in the style of the figures that it would appear to be a reasonable assumption. Not much is known about Lienhart Schacht's working life. In another article, the design for Jamnitzer's *Daphne*, which was made in the 1570-75 period, is

likewise attributed to the workshop of Labenwolf and Schacht, see M. Bimbinet-Privat and A. Kugel, 'La Daphné d'argent et de corail par Wenzel Jamnitzer au Musée National de la Renaissance', *La Revue du Louvre et des musées de France* 57 (2007), no. 4, pp. 62-74, esp. pp. 66-67.

16 P.H. Smith, 'Making and Knowing in a Sixteenth-century Goldsmith's Workshop', in Lissa Roberts, Simon Schaffer and Peter Dear (eds.), *The Mindful Hand: Inquiry and Invention between the Late Renaissance and Early Industrialization*, Amsterdam 2007, pp. 20-37; T.P.C. Beentjes and P.H. Smith, 'Moyen de faire de gect pour petite lezardes', *Stavelij Jaarboek* (2009), pp. 15-18; T.P.C. Beentjes and P.H. Smith, 'Sixteenth-century Life-casting Techniques: Experimental Reconstructions Based on a Preserved Manuscript', in David Saunders et al., *Renaissance Workshop: The Materials and Techniques of Renaissance Art*, London 2013, pp. 144-51.

17 Anonymous, goldsmith's manuscript, late sixteenth century. Paris, Bibliothèque nationale de France, ms. Français 640, first referred to in Pamela Smith's article (note 16).

18 With thanks the vacuum casting works De Viking, Amsterdam. The firing programme was: heating the mould to 290 degrees for three hours (material calcined); then two hours at 450 degrees; then three hours at 720 degrees, after which it was cooled to 650 degrees, which is the final casting temperature of the mould.

19 P.H. Smith and T.P.C. Beentjes, 'Nature and Art, Making and Knowing: Reconstructing Sixteenth-Century Life-Casting Techniques', *Renaissance Quarterly* 63 (2010), pp. 128-79. A later annotation on the manuscript indicated that fired clay was reused.

20 With thanks to Ineke Joosten, Cultural Heritage Agency of the Netherlands (RCE), for analysing the samples with the SEM.

21 J. Kunckel, *Ars Vitraria experimentalis oder vollkommene Glasmacherkunst* (*Documenta technica: Darstellungen und Quellen zur Technikgeschichte, Reihe 2 Quellenschriften zur Technikgeschichte)*, Olms 1992 [1679], pp. 405-07. Based on Venetian sources by Antonio Neri, who died in 1612.

22 E. Lein, 'Wie man allerhand Insecta, als Spinnen, Fliegen, Käfer, Eydexen, Frösche und auch ander zart Laubwerck scharff abgiessen solle, als wann sie natürlich also gewachsen wären', in Heike Richter Petersberg (ed.), *Das Modell in der bildenden Kunst des Mittelalters und der Neuzeit*, Imhof 2006, pp. 103-19. The title of the article translates as 'How one should accurately cast all sorts of insects such as spiders, flies, beetles, lizards, frogs and also other delicate foliage as if they had grown thus in nature'.

23 Kunckel 1679 (note 21), pp. 406-07: 'Zur verbeserrung der Fließeigenschaften des Metalls soll dem Silber, welches zum Guss verwendet wird, Wismut beigemengt werden, und die Form, in die das Metall eingegossen wird, recht heiss sein.' (To improve the flow properties of the metal, bismuth should be added to the silver used for casting, and the mould in which the metal is cast should be very hot.)

24 For a possible explanation of the term 'alumen plumosum', see Beentjes and Smith 2009 (note 16), p. 147.

25 Kunckel 1679 (note 21), pp. 414-15.

26 E-mail conversation with Lou Jacobs, Leiden University, Laboratory for Ceramics Studies, 30 May 2012: 'Spat could refer to feldspar. Federweiss could indicate talc (a magnesium silicate). The mould may have been made by mixing these materials. If one part of very fine clay is mixed in, heating will cause consolidation while at the same time the embedded organic material is combusted. 1000 degrees seems to me to be a good temperature for this. The silver can be poured straight into the hot mould.'

27 Bartelmess 1963/64 (note 13), pp. 256-64.

28 R. van Langh, *Technical Studies of Renaissance Bronzes*, Amsterdam 2013, chapter VII: 'Innovations in the Casting Technology of 16th-Century European Bronze Sculptures'.

29 J. De Koning et al, *Drawn after Nature: The Complete Botanical Watercolours of the 16th Century*, Zeist 2008, p. 255. Reproduced in it is the manuscript with 1400 watercolours by Ferdinand Bauer, *Libri Picturati* A18-30, southern part of the Low Countries, sixteenth century. Krakow, Jagiellonian Library.

30 ARTAX XRF, authors' measurements, tungsten tube, Ni-filter 12 microns, collimator 0.650 mm, 50 kV 498 mA, measured for 60 seconds, in air. Counts normalized. A new analysis will be carried out in the future; it will be corrected with PYMCA. The life casts have a thick, fine layer of silver, the measurements with the XRF would therefore not be wholly representative of the material as a whole, because the XRF only penetrates to about 10 microns – the fine silver layer on one of the life-cast leaves was already 10-15 microns thick.

31 'Dessgleichen, das sy auch das wercksilber laut dess gesetz under 14 lott nit arbeiten und damit betrug und geferlikait desshalb verhüt werde, sollen die geschworenen maister das-

selb wercksilber nit allein aus dem poden, sonndern auch am corpus zimlicher weise bestechen.' (Furthermore, in order to prevent fraud and avoid danger, the sworn masters may not, by law, use any working silver below 14 lot and they must remove [?] this working silver properly, not only out of the bottom [of the mould], but also from the body.) E. Steingräber, *Der Goldschmied: Vom alten handwerk der Gold- und Silberarbeiter*, Munich 1966, pp. 76-77. 16 lot is pure silver, 15 lot is 937 parts silver to 1,000 parts, and 14 lot is 875 parts to 1,000 parts. U. Timann, 'Zur Handwerkgeschichte der Nürnberger Goldschmiede' in Tebbe 2007 (note 2), pp. 34-36.

32 The plants and flowers were identified by Sam Segal (Still Life Studies), letter dated 29 March 2010; the insects by Ben Brugge, entomologist at the University of Amsterdam; the reptiles by I. Janssen, herpetologist, RAVON, University of Amsterdam/ZMA.

33 For the significance of the grass snake in Dutch and other cultures see H.R.J. Lenders and I.A. Janssen, 'The Grass Snake and the Basilisk: From Pre-Christian Protective House God to the Antichrist', *Environment and History* 20 (2014), pp. 319-46.

34 I.A. Janssen, 'Een zéér exclusieve én eeuwenoude determinatie', *Schubben en Slijm. RAVON Nieuwsbrief voor en door vrijwilligers* 7 (2011), p. 5.

35 For details of the manuscript and information about paint on the life casts on Jamnitzer's centrepiece see T. Davidowitz et al., 'Identifying 16th-Century Paints on Silver Using a Contemporary Manuscript', in S. Eyb-Green et al., *The Artist's Process Technology and Interpretation. Proceedings of the 4th symposium of the Art Technological Source Research Working Group*, London 2012, pp. 72-79.

36 Janssen 2011 (note 34).

37 See research undertaken by the Victoria and Albert Museum: http://www.vam.ac.uk/blog/tales-archives/making-silver-sculpture-victorian-home (accessed 1 December 2017). Although these patterns were used in a Victorian workshop, the method would have been no different in preceding centuries; working this way saved time and money.

38 Pechstein 1974 (note 2), pp. 98-99: 'Welche Widmungsinschrift war wohl für die große, leergebliebene Kartusche auf der Unterseite der Kredenz vorgesehen, und sollte diese nicht den Anlaß der Űbergabenfasthalten. Karl v. erscheint einleuchtend als Adressat dieses Jamnitzerschen Tafelaufsatzes, des Huldigungsgeschenkes des Rates. Wem anders als ihm hätte der Rat ein solches Meisterwerk der Kunst wie der Kaum verteckten politschen Berechnung verehren können'. (What dedication inscription might have been intended for the large, empty cartouche on the underside of the centrepiece and would the occasion for the presentation not have been recorded on it? Charles v would seem to be the self-evident recipient of this centrepiece by Jamnitzer, as a gift from the council. To whom else could the council have dedicated such an artistic masterpiece as the scarcely veiled political calculation?). Pechstein et al. 1985 (note 2), p. 22: 'Ursprünglich war dieses aufwendige werk … als Geschenk für einem Besuch für Kaiser Karl v oder seiner Sohn und möglichen Nachfolger König Philipp II von Spanien bestimmt, die aber die Stadt nach 1549 nicht mehr besuchen sollten.' (The costly work … was originally intended as a gift for a visit by Emperor Charles v or his son and possible successor King Philip II of Spain, who however never visited the city after 1549.)

39 Joosje van Bennekom et al., 'The Merkel Centerpiece by Wenzel Jamnitzer: Proving the Existence of a Previously Unknown Inscription Using the Aglae Pixe Mapping System', *Art Matters: International Journal for Technical Art History* 6 (2014), pp. 1-10.