

# Appendix: Notes on the Restoration of the Behaim Shields

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BEFORE ENTERING INTO a more detailed description of the work done on three of the Behaim shields, it may be useful to present a few general observations on the group.<sup>1</sup> The seven Behaim shields were X-rayed in the Metropolitan Museum's Objects Conservation Department in 1985. The radiographs revealed that all seven were covered by more than one paint layer and that several had designs in the lower layers quite different from those visible on the uppermost surface. Cleaning tests indicated that the shields 25.26.1, 25.26.3, and 25.26.5 appeared to have the most elaborate and best-preserved underpainting, and from 1990 to 1992 restoration work to recover the earlier painting was carried out.

As different as these seven shields are, they all share several technical features. The cores are of wood, either poplar (*Populus sp.*) or linden (basswood, *Tilia sp.*), which was covered with canvas or animal skin. The exterior surfaces, in turn, were gessoed and painted in the same technique as contemporary panel painting and polychromed sculpture. The area to be painted was coated with several layers of gesso. In one case, shield 25.26.5, crushed glass was applied before the regular gesso layer; this feature is quite unusual. Silver leaf was applied in two different techniques.<sup>2</sup> There is also evidence of the application of raised relief decoration,<sup>3</sup> subsequently lost, on shield 25.26.3. The original painting medium is tempera, and in some cases, especially on silver leaf, resinous glazes were used (shields 25.26.2 and 25.26.5). All postmedieval additions or repaintings were done in oil paint, often of poor quality.

All of the shields were painted twice with the Behaim arms. On shield 25.26.4 the Behaim arms are found on the lowermost paint layer.<sup>4</sup> On shield 25.26.6 the original medieval gesso is apparently preserved, but no original paint layer could be detected.

The five remaining shields with surviving fifteenth-century paint have distinctive individual de-

signs, none of them relating to the Behaim arms. Shield 25.26.2 has not been fully examined, but it seems most unlikely that the Behaim crest would be found in the original painting.<sup>5</sup> Similarly, shield 25.26.7 most likely has an original design below the first Behaim painting.<sup>6</sup> Shields 25.26.5 and 25.26.6 were repainted with completely new designs on top of their original layers before the Behaim arms were later applied. Both of these shields show as part of their intermediate painting small heraldic shields with the *Meerkatze* of the Ketzell family of Nuremberg.<sup>7</sup> On shield 25.26.3, and most likely on shields 25.26.2 and 25.26.7, the Behaim arms were painted directly on top of the original decoration.

That some of the shields were repainted several times proves that they were considered valuable—apparently as memorials—in postmedieval times. It is difficult to determine the age of these various paint layers, but painting style and materials may offer some clues. In the case of the first paintings with the Behaim arms, which were executed by a minor artist working in an old-fashioned Gothic revival style, the dating on the basis of style is difficult. In two of the first Behaim paintings, lead-tin yellow was detected.<sup>8</sup> This pigment ceased to be manufactured about 1750, although old supplies may have been used after this date.

It seems likely that at some point in the seventeenth or eighteenth century this group of seven—or more—shields was assembled and painted with the Behaim arms. The painting materials and style of these first Behaim paintings are compatible. It remains unexplained as to why the Behaim arms in shield 25.26.2 are painted in reverse.

These seven shields may have hung as a group for a considerable time, since they suffered similar damages that necessitated repainting. The second painting of the Behaim arms copies the existing one in a simplified version. Old losses were overpainted, and bronze paint was used instead of silver leaf. The overall quality of these paintings is very poor.

Following the cleaning tests carried out at the Metropolitan Museum in 1924–25—which revealed original paint and decoration, but no medieval Be-

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haim design—test windows were inpainted, followed by a general and generous restoration with bronze paint, dark varnishes, and glazes. These restored surfaces are the ones recorded in the published photographs used from 1925 until 1990.

#### SHIELD 25.26.1

The shield was painted four times: (1) a young woman beside the Gottsmann arms; (2) a foliate border added around the edge of the first layer; (3) the female repainted and the Gottsmann arms replaced with those of the Behaim; and finally (4) a repainting of the previous layer.

The wood core, identified as poplar, is covered on the back with leather and on the front with coarse linen, which is thickly covered with several layers of gesso. In the first (original) painting, silver leaf was attached to the white bole in the water-gilding technique and was burnished to a high gloss. The design was incised on the gesso ground before the application of silver leaf. The paint, which consists of very finely ground pigments in tempera, probably egg tempera, was then applied most carefully and skillfully. All the paint is opaque and hides the underlying silver leaf entirely. There is no trace of colored glazes, which are often found on silver leaf. It is remarkable how well this original paint adheres to the polished surface of the silver leaf, proof of an exacting technique. Silver leaf oxidizes, becoming black upon exposure to air; therefore it has to be sealed with varnish. Traces of the original yellowed varnish were found. The pigments of this first painting consist of copper green, azurite, lead-tin yellow, lead-tin white, and vermilion. The good state of preservation of this original paint layer is due not only to its fine technique but also to its protecting layers of overpaint.

The first restoration of some damage in the green dress of the woman appears to have occurred early on, as the restorer took great pains to fill the losses carefully and to match the green paint.

In the second painting, the shield was covered with a thick varnish, which in the course of time had turned dark brown. This coating greatly facilitated the removal of later overpaint from the original. A decorative border of foliage was added, finely executed in green and ocher glazes and outlined in black. Unfortunately, this border was very badly preserved, with only a small section visible on the dexter at the *bouche* (Figure 45).

In the third painting, only the female figure was retained, while the size and position of the shield and crest were altered in order to introduce the Behaim arms. The thick varnish of the second layer, which must have darkened by then, was removed from the dress of the woman in order to be able to follow the design of the original more easily. Indeed, the repainting of the dress followed the outline of the original quite faithfully, but it was painted in a uniform green without details. The pigment—copper green—of this second repainting is almost identical with the original pigment of the green dress, but it is much more coarsely ground.

In the original the woman presses the folds of her long skirt against her body with her left hand. When repainted, the hand position was retained, but as there were no folds, her gesture had lost its purpose. Similarly, in the original, the woman rests her right hand on the foliage, but in the repainting, the foliage was omitted. Since the hand was repainted in the same position, it appears to dangle aimlessly in front of her.

Because of the brown varnish, the painter of the third paint layer was not distracted by the bold design of the Gottsmann arms. First he covered the areas to be occupied by the eagle, helmet, and the dexter side of the Behaim crest with silver leaf in the oil-gilding technique. Then the silver leaf was glazed and the Behaim crest was painted with rather coarsely ground pigments in an oil medium. The background was painted dark brown. The execution was rather poor.

Before the shield was again repainted it suffered considerable damage. The edges and ridges were bumped and abraded and paint was lost. The lower left corner especially has considerable losses, probably due to water damage. The canvas became detached from the wood; it buckled and the gesso fell off.

In the fourth painting none of the losses was filled, but the artist simply painted over damaged areas, which resulted in a most unattractive surface. This lack of craftsmanship is indicative for the painting manner of this repainting of the Behaim arms.

This repainting of the Behaim layer is essentially a copy of the previous one, but in a poorer version. It seems that the painter could not resist uncovering the first face of the woman. The second layer was removed and the original, which was slightly damaged, was repainted in a more contemporary manner. The woman's scarf was altered, and she was now dressed in dark blue.

In the two older paint layers, the lady and crest were “floating” on the shield. In this latest version, the painter introduced a floor on which the woman stood. The foreground was painted light brown and the lady and crest cast hazy shadows on it, the light source coming from the upper left. As another new feature, the painter introduced a black margin. For the eagle, helmet, and Behaim crest the painter used bronze paint. The painting medium was oil mixed with varnish.

During the restoration of 1924, Stanley Rowland cleaned and removed a large area in the upper half of the shield, down to the original silver leaf. This area was subsequently retouched and a thick varnish covered the entire surface.

It was the good fortune of the present restorers that Rowland made his cleaning tests in areas that had no original paint. He left us the excitement of removing layer upon layer, as in archaeological fieldwork, and indeed we found a very well-preserved medieval treasure that had not been seen in centuries.

The varnish was removed with solvents. All paint layers were removed with scalpels under low magnification, and minor losses within the painting were filled and retouched. An area on the lower left part of the dress was partly reconstructed along original incisions. Dry pigments in PVA were applied in little dots to distinguish the retouching from the original. The surface was thinly coated with damar and bleached beeswax.

It should be noted as well that on the back of the shield St. Christopher and the Christ child are painted directly onto the leather with very coarsely ground pigments. The consistency is so crumbly and the brown overpaint adheres to it so firmly that it was not possible to remove overpaint from the original.

#### SHIELD 25.26.3

Prior to the restoration of 1991, the shield displayed the arms of Behaim von Schwarzbach (Figure 3). In the lower sinister corner a small shield with the Volckamer arms was also visible. The border was decorated with wavy lines painted in silver and black. This border decoration is also found on shields 25.26.2 and 25.26.6 (Figures 2 and 6). On shield 25.26.2, which still awaits restoration, initial cleaning tests revealed an original decoration of curving cloud-bands executed on burnished silver

leaf with tempera paint and colored glazes. The painter who first added the Behaim arms to this shield repeated the design, though simplified, and introduced it on shields 25.26.3 and 25.26.6. In the subsequent repainting of the Behaim arms, the existing design was simply repeated.

The cleaning tests performed at the Museum in 1925 had already revealed a segment of the border with Gothic letters. The X-ray from 1985 was reassuring as to the fact that a completely different painting was hidden underneath the Behaim layer. It was decided to have the shield fully restored; this work was completed in January/February 1991.

The shield most likely consists of one piece of wood covered on both sides with skin. The front of the shield is coated with gray gesso and painted with tempera paint. The skin has lifted from the support in low-lying areas on the dexter side, resulting in extensive paint loss.

The four corners of the border as well as the four corners of the central design and the center section were once covered with applications. They could have been cut out from paper or vellum but most likely they were pressed brocade (*Pressbrokat* in German), applications that were quite common on late-medieval South German sculptures and panel paintings. Constructed of putty mixtures containing wax and resin or gesso, they were pressed into molds. Usually metal leaf was pressed together with the paste into the mold, easing the removal and coating the relief decoration at the same time. The edges were trimmed—the sharp contours of the losses on the shield echo the outlines of the applications. On this shield they were applied with a wax/resin adhesive, of which traces of brown residue remain. The painting of the shield followed after the applications were in place, judging from the sharply contoured losses in the paint layer. The appearance of these applications, apart from their general outlines, cannot be determined. The metal leaf on pressed brocade was usually coated with colored resinous glazes, but no traces of such glazes could be observed on this shield.

The painting of the border consists of pale yellow Gothic letters on a light brown ground. Yellow stripes frame the border accentuated by black and white lines. The middle of each side is composed of a simple design with blue lines enhanced with white and black lines and white fleurs-de-lys. The central decoration depicts a panther standing upright on its hind legs, surrounded by swirls of colorful foliage. White, yellow, green, red, blue, and black were painted on a light brown background. The back of

the shield, now covered with two modern layers of brown oil paint, was not explored as to its original appearance.

The original paint layer was covered directly with the Behaim arms; no traces of intermittent paintings were found. In the first painting of the Behaim arms the background of the central panel was coated with thick, coarse green paint. The border consisted of a brown wavy pattern on a silver-leaf ground. The eagle, helmet, and crest were also painted on silver leaf. Black was used to outline the design. The style and quality of this painting correspond to the first Behaim painting on the other shields.

Crude materials and poor craftsmanship characterize the second Behaim painting. Thick brown and black oil paint filled the background. In some areas painted red several different shades were found. Bronze paint was applied on the coat of arms and the border. This layer corresponded fully to the second painting of the Behaim arms on the other shields. Restorations followed the second Behaim painting. Losses were filled with putty and the shield was inpainted with black and brown colors and bronze paint. These restorations appear to have been the work of Stanley Rowland at the Metropolitan Museum.

During the restoration of 1991 all postmedieval additions were removed, mostly with scalpels. A few small round holes, which had obviously served to hold the shield's handles or straps, were uncovered. Damages in the surface were inpainted, but larger losses in the design were not retouched. The areas of the lost applications were kept darker, based on the brown residues of original adhesive.

## SHIELD 25.26.5

This shield had the most blistered and unattractive surface and the most complex series of paint layers of all seven shields. It was therefore the most challenging of the shields. The shield was painted five times with three totally different designs: (1, the earliest) a plant with a bandscroll inscribed with three W's; (2) a *mi-parti* design incorporating the letters AGVF and stripes; (3) as an addition to the second layer, two small shields of arms; (4) the Behaim arms; and (5) a repainting of the previous layer.

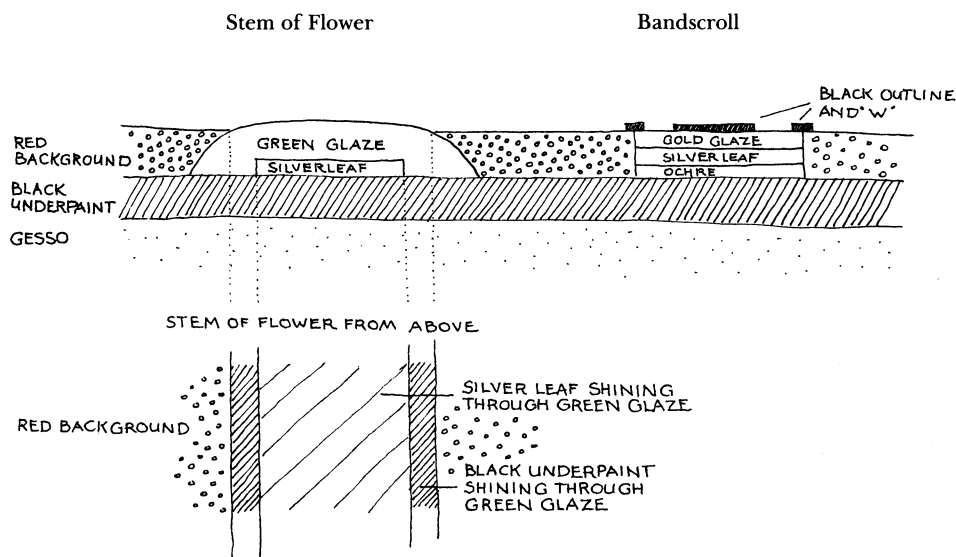
The linden wood core is covered with several layers of animal skin, only the top layer having been cut to the shape of the shield. The leather on the

front of the shield is coated overall with crushed glass, bound most likely with hide glue. Clear glass and green and blue particles have been found. The particles vary in size from tiny grains to pieces as large as 2 millimeters. Medieval sculptures and panel paintings occasionally have a coarse stone-dust ground for a first coating before the smooth gesso layers were applied. However, this is the only case we have ever encountered of crushed glass. The glass improved the adherence of gesso to the skin, but it may also have served as general reinforcement. Several layers of gesso were applied, thick enough to cover the glass so that the surface could be sanded to a smooth surface. The ridges on the shield seem to be entirely modeled in gesso.

It seems best to describe the complex layers of the shield from the earliest to the latest, opposite from the sequence of their discovery. The design of the first painting uses the middle ridge of the shield as the dividing line between sinister and dexter sides. In the restoration of 1991, only a small area of the sinister side was uncovered, but cleaning tests showed that the entire shield was first coated with a thick layer of finely ground black paint. On the sinister side, the black appears as an outline for the stems and leaves of a plant, visible through yellow and green glazes. In a rather unusual technique, the design was painted first and the red background last, giving the design a cut-out quality. A precise outline of the design must first have been drawn on the black paint. Then the leaves and stems of the plant were coated accurately with oil, onto which silver leaf was attached. The silver leaf and its black outline were then coated with green and yellowish-green glazes. The background was painted over in red, giving the stems and leaves great depth and luminosity (Drawing 1). For the flowers, opaque pigments were chosen: a gritty blue (azurite) and a light yellow (lead-tin yellow). The bandscroll that extends across the stems was first painted ocher, then covered with silver leaf in the above-mentioned oil-gilding technique. The silver leaf was then coated with a yellow glaze to resemble gold. Letters, triangular spacers, and cross hatchings were painted with black. Only the outlines of the flowers and the bandscroll have been enhanced with a thin, wavy brushstroke.

Although it was very tempting to expose this extraordinarily beautiful design, the most sophisticated painting of the shield's many layers, it was decided not to remove the second and third layers. However, with some cleaning tests and the help of X-ray photographs, an approximate reconstruction

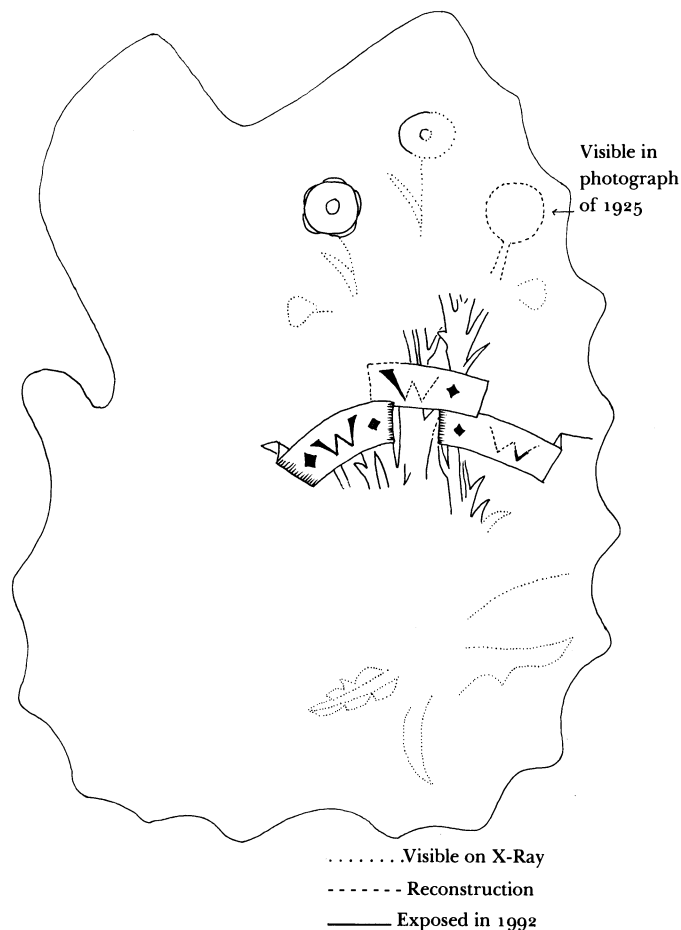
## CROSS SECTION OF FIRST PAINT LAYER



Drawing 1. Cross section of the first paint layer found on shield 25.26.5 (drawings by the authors)

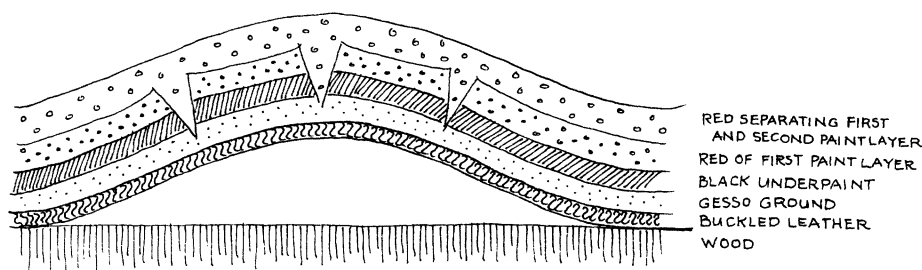
of the design could be made (Drawing 2). It is a plant with three large stems that are thick and thorny. At their lower end are large serrated leaves. The leaves growing from the stems are lancet shaped. Each stem carries a round blue flower with a yellow center. The left and probably also the right flower have an additional bud.<sup>9</sup> The bandscroll, which has black hatchings to indicate the shadow formed when it bends, is wrapped twice around the stems of the plant and folds back on either end. Between spacers on each of the three forward-bent loops is a simple "W" in "antiqua" style. This symmetrical design of flowers, leaves, and banderole is evenly spread over the sinister side of the shield, the banderole just touching the central ridge and the outer sinister edge of the shield.

On the dexter side, cleaning tests yielded only red paint, and X-rays revealed nothing that would suggest that this side had additional designs. A thin, light yellow varnish separates the original paint layer from the second. There was no apparent accumulation of dirt, suggesting that the second layer was painted not long after the first was finished. However, the first painting had suffered some damage before it was repainted. Possibly the shield became wet and the leather separated in some areas from the wood, with the result that the surface buckled and the paint cracked. The raised edges of the cupped paint exposed the black paint and gesso below. The paint of the second layer filled these



Drawing 2. Reconstruction of the original design on shield 25.26.5

### CROSS SECTION OF BUCKLED LEATHER AND CUPPED PAINT OF FIRST PAINT LAYER



Drawing 3. Cross section demonstrating the damage to the first paint layer on shield 25.26.5

gaps and collected more thickly in the depth of the cups (Drawing 3). In some areas, the original paint must have flaked off and was carefully filled in with gesso before the shield was repainted.

The second painting of the shield consisted of a completely different design (Figure 35, minus the too-small inshields). The first layer, including the new fills, was painted over in red, close in color to the red background of the original but consisting of much coarser pigments. The painter of the second layer ignored the vertical division given by the shape of the shield and moved the center line toward the sinister side, in the exact middle of the shield. This way the shield is divided in approximately equal halves. For his elaborate Gothic letters the painter needed more space and did not hesitate to paint them over ridges. In this respect, the second painter paid little attention to the shape of the shield.

The sinister side was painted with four vertical stripes of roughly equal width, consisting of a green stripe between two white ones and a red one on the outer edge. The white stripes are thickly applied in opaque paint, the vertical brushmarks of a stiff bristle brush still being visible. The green stripe consists of two very dark green layers of a rather transparent green, while the red consists of two layers of dark red glazes.

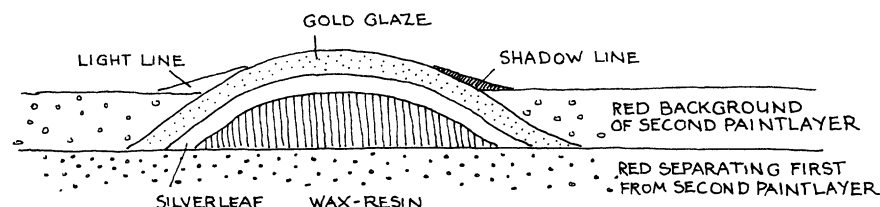
The dexter side shows four elaborately intertwined Gothic letters arranged vertically, reading down as *AGVF*. These letters were painted in a technique similar to the stems and leaves of the first painting that this painter had covered up. The letters were painted onto the red background with a thick mixture, most likely a wax resin, and these slightly elevated ridges were covered with silver leaf,

which was coated with yellow glaze. The background was once again painted red. Finally the letters were modeled with light and dark outlines, giving the impression that they are lit from the upper left. Most of the silver leaf has been abraded, but it is still preserved under the outlines.

The third paint layer consists of the two small shields bearing the Ketzel and Koler arms that were superimposed on top of the second layer. The shields are at an angle to each other and shown in different perspectives. The light source comes again from the upper left, with both the Ketzel *Meerkatze* and the Koler ring casting shadows to the lower right. Since the Ketzel shield awkwardly cuts off the letter "G" underneath, some additional curves conforming to the curvature of the shield and some scrolls and flourishes were added. Over the white stripes crisscross hatchings were painted in white. Along the middle ridge and the edge of the dexter side traces of green color over silver leaf were found—possibly the remains of a decoration containing leaves.

The surface of the shield was in bad condition when the fourth layer was painted. It was abraded and scratched and paint had flaked off. The surface seems to have been dark brown, judging from layers of varnish and dirt that obscured the design of the third painting. This suggests, perhaps, that considerable time had passed between the painting of the Ketzel and Koler arms and the painting of the Behaim arms. It was easy for the painter to start a totally new design without being disturbed by the existing one. He painted the Behaim arms directly over losses of paint and gesso onto a buckled surface. There is no evidence of fills from this period.

## CROSS SECTION OF LETTERS IN SECOND PAINT LAYER



Drawing 4. Cross section of letters in the second paint layer on shield 25.26.5

The paint of this layer was opaque, beginning with the green background color, which consisted of coarsely ground pigments containing copper green, azurite, lead-tin yellow, and lead white. The foliage was painted white, and the helmet, eagle, and sinister side of the Behaim shield once again was oil gilded with silver leaf and covered with glazes. The execution, however, was quite poor.

The fifth and final painting was essentially a repaint of the fourth, but with less care and poorer materials. Instead of silver leaf, bronze paint was used. The painting medium was oil, probably mixed with varnish. It was this fifth painting, much darkened with time, that Bashford Dean saw in 1923 (Figure 27).

In the restoration of 1924, Stanley Rowland set out to clean the surface and explore the lower paint layers. On the sinister side he discovered the original layer, uncovering the blue flower with the yellow center (Figure 30). But it was decided to preserve the Behaim arms, so this area was covered up; all losses were filled with gesso, which was incised with a crackle pattern to match the surface of the rest of the shield, and all missing paint was retouched to blend in with the fifth painting.

The X-rays taken before the restoration offered a confusing array of images (Figure 31). Cleaning tests were not much more enlightening, because of the partial removal of various paint layers in the previous restoration. Therefore, a methodical removal of layer upon layer using a scalpel under low magnification was necessary. Eventually, the second and third layers were exposed. On the sinister side, where the paint could easily be repainted, several small "windows" were opened to expose the under-

lying original layer. Photographs and samples were taken. The windows were later retouched; the retouching consists of little dots to distinguish it from the original. Gouache and dry pigments in PVA were used. A thin coat of damar with bleached beeswax was used as protective coating.

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## NOTES

1. Edmund Dandridge of the Museum's Department of Objects Conservation took the X-rays of the shields.
2. In the water-gilding technique the ground is prepared with bole, the metal leaf is attached with thin glue, and the leaf is

polished with an agate to high gloss. In the oil-gilding technique the leaf adheres to an oil-coated surface and dries in a crinkly surface. A variation is mordant gilding, in which the leaf adheres to a slightly raised, sticky surface, usually a mixture of resin and wax; on the second paint layer of shield 25.26.5, the letters *AGVF* were painted in this technique.

3. Raised relief decorations, also known as pressed brocades, were used to decorate medieval and Renaissance panel paintings and sculptures. A wax-resin mixture or fiber-gesso mixture is pressed into a mold and, after drying, is cut to the needed size and glued onto the gesso. These decorations are usually coated with metal leaf. On shield 25.26.3, in the original paint layer, the corner quatrefoils and panther in the center were most likely decorated in this technique.

4. Large losses in the first Behaim painting can be seen in the X-ray. There are a confusing number of paint layers belonging to the two Behaim paintings and to the restoration of 1925. No trace was found of any underlying layers of 15th-century paint

or gesso as on the other shields. This suggests that the exterior of the shield may have been scraped down to the leather before it was painted with the Behaim arms, or that the shield dates to a later period as an addition to the Behaim group.

5. A small shield visible in X-ray below the eagle has not been uncovered. Unfortunately, the lower part of the shield is a restoration.

6. The margin, which was examined more closely, has been repainted at least four times.

7. The pigments in both are azurite, lead-tin yellow, and lead white.

8. Lead-tin yellow was found, mixed with copper green, in the green background of shield 25.26.5 and in the green dress of the woman in shield 25.26.1.

9. The flower, still visible in the photographs of 1925 (Figure 30), must have been removed by the restorers at that time. Only traces of that flower remain today (Figure 34).