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ON THE GENESIS OF *THE BLINDING OF SAMSON*: NEW TECHNICAL FINDINGS IN CONTEXT

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ABSTRACT In terms of composition, *The Blinding of Samson* is regarded as Rembrandt's most ambitious history painting of the 1630s. As past technical studies have shown, the creation of this highly dramatic image involved multiple reworkings. This article discusses new findings on the work's genesis, as revealed by micro-X-ray fluorescence analysis (micro-XRF). Rembrandt used underdrawing and underpainting of various colours to work out the composition; he discarded entire figures and he continued reworking the painting even into the final layers of paint. Not only do these findings make clear that Rembrandt used the large format as a testing ground and wrestled with the composition, but they also clarify this painting's relation to other contemporary versions of the subject, allowing conclusions to be drawn about Rembrandt's inclusion of his own and Saskia's facial features in the work.

Introduction

In 1636, Rembrandt devised a dramatic pictorial staging of the blinding of Samson, an incident related in chapter 16 of the Old Testament's Book of Judges. The painting, which is kept at the Städel Museum in Frankfurt, presents the climax of the story: the hero's blinding, set within a dark, cave-like interior (Figure 1). Delilah, who had induced Samson to reveal the secret of his superhuman strength, rushes out of the cave, holding Samson's clipped locks – the source of his power. She glances back at the attack in progress. Samson is writhing on his back, held down by a group of Philistines, one of whom plunges a dagger into his right eye. The unbearable pain finds striking expression in Samson's raised and cramped foot. The episode, illuminated as if by spotlight, is presented on a canvas that measures 219.3 × 305 cm. This gruesome, highly dramatic painting is one of several large-format history paintings that Rembrandt created in the 1630s after his permanent move to Amsterdam. The Rembrandt Research Project (RRP) classified the composition of *The Blinding of Samson* as the most ambitious within that group of works.[1]

Concerning the painting's genesis, past technical investigations have already demonstrated that the composition arrived at its final, highly ambitious state only as a result of numerous alterations and corrections made during the painting process.[2] In the contexts of a restoration carried out in the 1980s, the studies of the RRP and the scholarly cataloguing of the Dutch paintings in the Städel Museum, the painting underwent a series of examinations: photographs were made in normal, raking and ultraviolet (UV) light; infrared reflectography (IRR) and X-ray radiography were performed; microsamples were examined by means of scanning electron microscopy with energy-dispersive X-ray analysis (SEM-EDX); and findings were additionally verified and documented with the microscope.[3]

In early 2021, *The Blinding of Samson* was the subject of a whole new investigation: over the course of a month during the Covid-related closure of the Städel Museum, it was possible to carry out in-gallery micro-XRF scans using the M6 JETSTREAM in order to better understand the genesis of this large painting. Almost the entire surface was captured in a series of 16 overview scans and one detail scan.[4] The subsequent evaluation of the micro-XRF datasets took into account the findings of previous

Figure 1 Rembrandt, *The Blinding of Samson*, 1636, oil on canvas, 219.3 × 305 cm, Städel Museum, Frankfurt am Main, inv. no. 1383. © Städel Museum, Frankfurt am Main.

investigations.[5] By visualising the chemistry of the pigments and filling materials used for ground and paint layers across the painting's whole surface, it was possible to gain deep insights into Rembrandt's process of creating this key work. The discoveries yielded by micro-XRF analysis are the subject of this article.

Genesis of *The Blinding of Samson*

The preparation of the pictorial ground

As is common for many of Rembrandt's works from 1632 onwards,[6] the canvas support of *The Blinding of Samson* was prepared with a double-layered ground in which a red priming is followed by a grey one.[7] The first ochre-based red ground layer is visible in the iron distribution, but only in areas where the overlying grey ground was thinly applied. Microchemical analysis of samples taken from the painting in 1980 detected a red ochre with a small admixture of lead white.[8] The second ground layer, in grey, contains mainly lead white.[9] Interesting traces of the working process are found in the lead-Lβ distribution of the micro-XRF scans,[10] which shows that the second ground layer was applied in three horizontal sections, each consisting of vertically oriented brushstrokes. These broad, slightly curved brushstrokes are visible across the whole surface (Figure 2). Since those in the upper section curve in a direction opposite the others, it stands to reason that the large canvas was rotated by 180 degrees to apply that area.[11] The three sections of ground range from about 65 to 75 cm in height. Where the sections border one another, 'claw'-shaped structures are visible in the lead distribution (Figure 2, arrows). These may be liquid run marks, which could indicate that the canvas was grounded while in an upright position. Both the unusual form of these run marks and the lack of grooves left behind by brush bristles could suggest that the grey ground layer was applied with a priming knife or similar tool.[12] This ground layer may subsequently have been smoothed using a priming knife, as recommended in contemporary manuscripts, since the edges of the run marks, which had already dried, show a higher lead intensity than their centre (Figure 2, arrows).[13]

Creating the composition

The underdrawing

The coloured underpainting of various areas of the painting has been much discussed by past authors.[14] These local underpaintings served to establish the basic compositional arrangement by either toning or omitting certain areas. Light areas of the composition were underlaid with

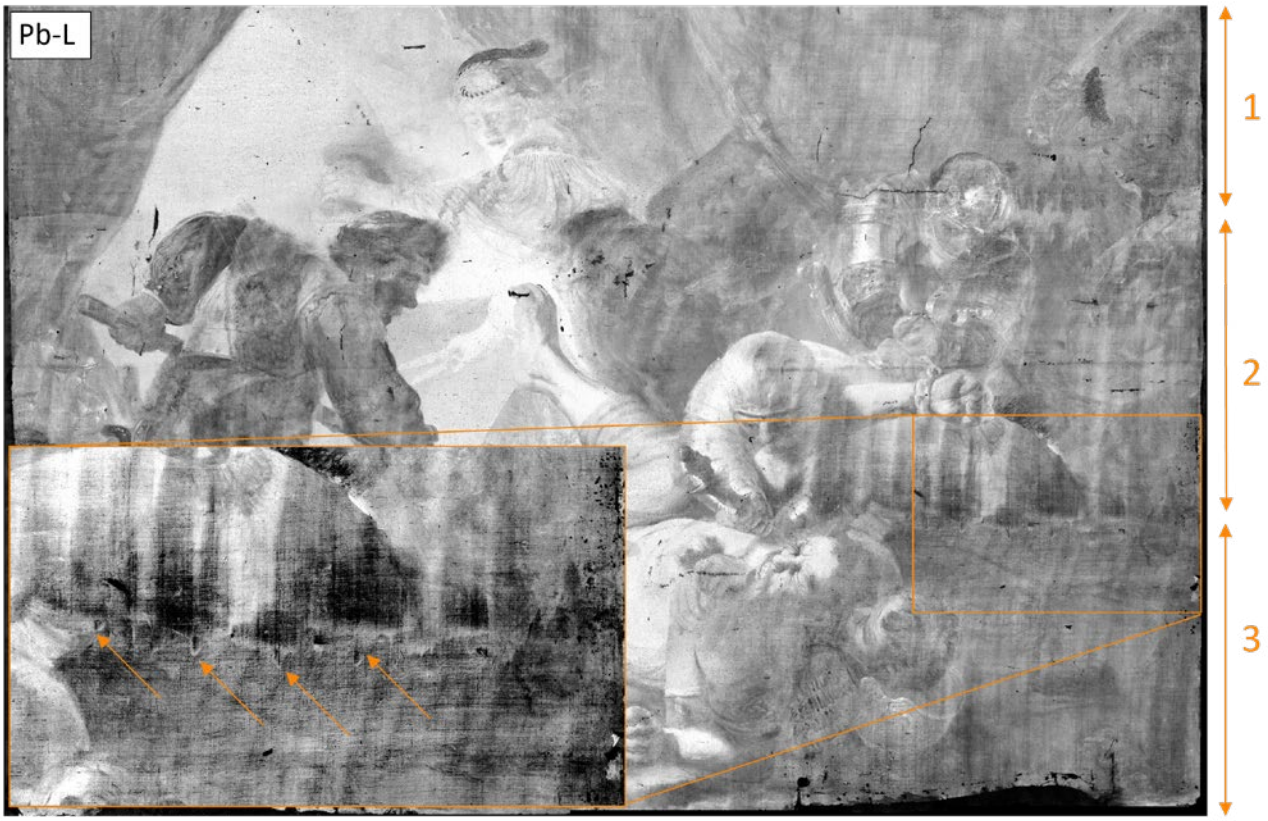

Figure 2 Micro-XRF Pb-L distribution showing traces of the application of the second ground layer. The layer was applied in three sections (see 1–3). The character of some of the application traces (see arrows) suggests the use of a priming knife to apply and smooth the second ground layer. © Städel Museum, Frankfurt am Main (image: Mareike Gerken).

rapid applications of lead white and are thus visible in X-radiographs. Parts of the light-toned passages of underpainting were incorporated into the final image, as for example in the proper left hand of Delilah.[15] The dark areas of the composition were established with a red-brown, iron-containing underpainting that was detected in all the samples taken in 1980.[16] This same red-brown underpaint is visible in the iron distribution of the micro-XRF analysis, but only in abraded or peripheral areas such as Samson's foot.

Micro-XRF analysis has made it possible to identify further details located below the surface that testify to Rembrandt's complex search for the right composition of *The Blinding of Samson*. The new findings include a hitherto unknown underdrawing executed with paint applied with a brush. Two different line colours are detectable in this underdrawing stage: a vermilion red (Figure 3: VIS, red) and a pure white that contains lead white (Figure 3: VIS, blue). To a limited extent, these two were applied in mixture with one another, visible in single areas as light red lines that shimmer through the covering abraded paint. It remains an open question as to whether the brush underdrawing lies beneath the coloured underpaintings, but there are some indications that this is the case. On the one hand, its composition sometimes deviates significantly from the final composition; on the other hand, some of the pictorial elements that were indicated in the underdrawing were, in part, omitted from the locally applied coloured underpaintings. The underdrawing is not visible across the entire surface in the micro-XRF scans; in fact, detection is mainly limited to dark areas of the painting. It is therefore unclear whether an underdrawing was used throughout the composition and, if so, whether the elemental signals originating from the underdrawing are being attenuated by covering paint layers containing lead white in light areas of the painting. Nevertheless, the detectable underdrawn lines provide a wealth of new information, some of which only become apparent when studied in the context of all alterations.

We begin with the lines of lead white that lie beneath the soldier's shield at the right edge of the painting (Figure 3: Pb-L, a). They do not correspond to what is visible on the surface and instead are reminiscent of drapery folds, revealing that the shield was not originally planned. Furthermore, the area above the shield contains a spider-like pattern of underdrawing lines that was abandoned in the final composition (Figure 3: Pb-L, b). In order to clarify what those lines indicate, we can turn to a detail of the soldier who is binding Samson's upraised arm with a chain: the red undrawn lines beneath that soldier's proper left hand were applied in a comparable spider-like configuration (Figure 3: Hg-L, a). As executed in paint, the hand was shifted only slightly downward and to the right. The white underdrawn lines above the other soldier's shield could therefore also indicate a hand, which in this case was abandoned as a result of compositional changes. This would mean that the soldier's raised right hand, holding a sabre, was established at a later stage. That hand and the pommel and blade of

Figure 3 Mapping of the underdrawing lines identified (VIS) and detail micro-XRF distribution images of mercury (Hg-L) and lead (Pb-L) from the upper right background. In some areas of the painting, white and red underdrawing lines can be visualised (see arrows), that reveal compositional changes. © Städel Museum, Frankfurt am Main (images: Mareike Gerken).

the sabre were underdrawn in brush using both lead white and vermilion (Figure 3: Hg-L, b).

The painting's most extensive compositional change is found in the upper right background where the mercury distribution, which is attributable solely to the red pigment vermilion, shows linear indications of a soldier's head that was not executed in paint. The head, tilted downward and to the left, in three-quarter profile, was sketched with economical but skilful strokes of the brush (Figure 3: Hg-L, c). The nose and the helmet with unfastened strap are clearly visible. An oval form to the right of the discarded head may have been related to a shield strapped to the soldier's back or to a pauldron covering his shoulder. That oval form in particular suggests that the abandonment of the background figure was connected with the major compositional changes carried out on the sabre-wielding soldier at the right. Those changes make clear that the much-admired arrangement of the soldiers along a steep diagonal took its final form only in the course of the working process. While that aspect of the composition does appear to have been at least intimated in the initial design, it achieved full dramatic effect only after the soldier's head located in the now-dark background had been discarded. Since all three soldiers arranged along the diagonal contain at least some lines underdrawn with vermilion, and since the figure of the sabre-wielding soldier at the far right was modified in

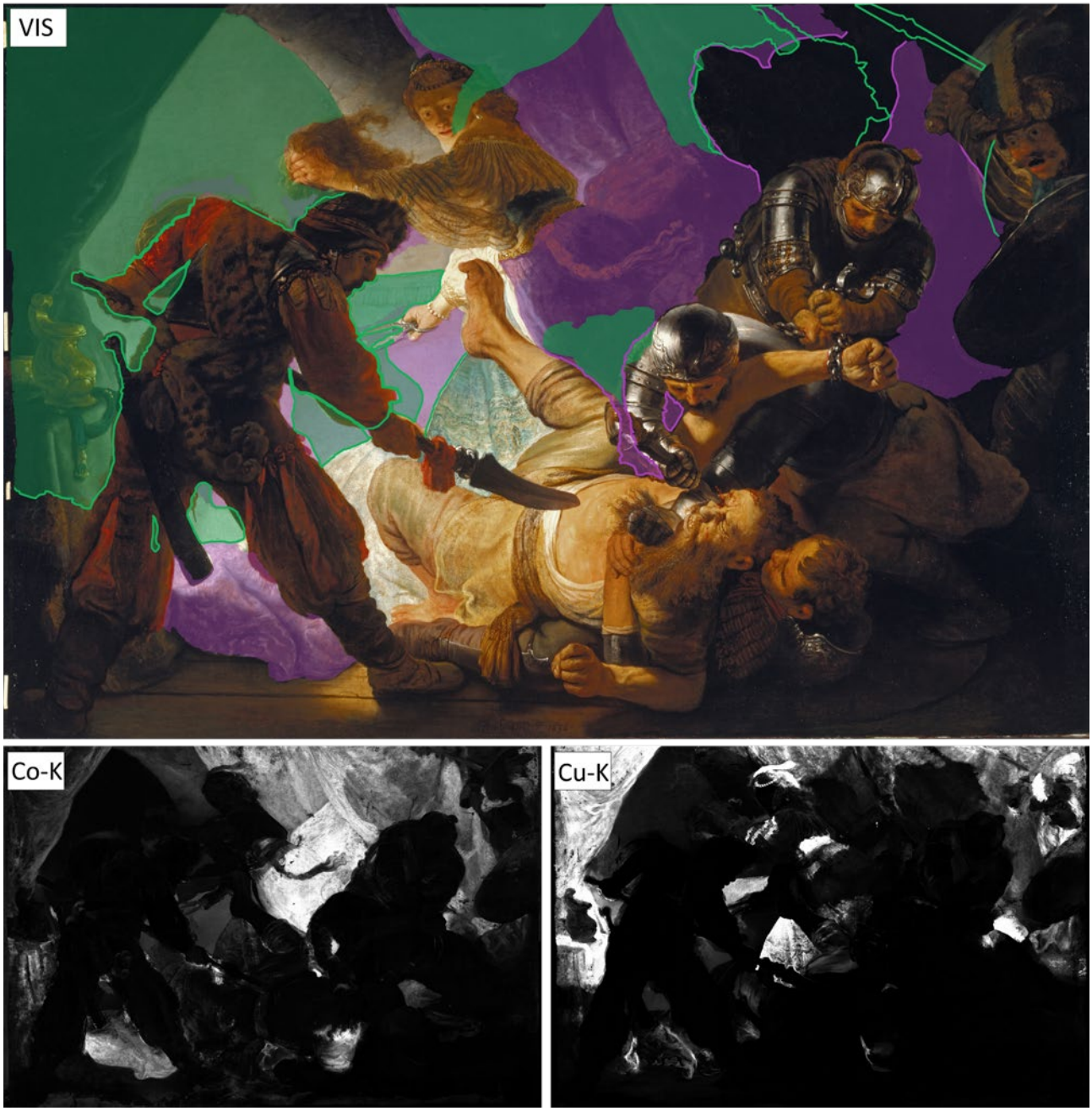

Figure 4 Mapping of the two blue underpaintings (VIS) and micro-XRF elemental distribution images of cobalt (Co-K) and copper (Cu-K). In addition to the light-toned and brown underpaintings, the detected blue underpaintings with smalt (Co-K) and a copper blue (Cu-K) also played an important part in establishing the composition. © Städel Museum, Frankfurt am Main (images: Mareike Gerken).

order to extend the diagonal all the way to the upper right, the head once in the background must have belonged to a fifth soldier that was never executed in paint.

The underpainting

In addition to the aforementioned light and dark underpainting,[17] blue pigments also appear to have played a role in the initial colour layout and the process of working out the composition (Figure 4: VIS). A smalt underpainting is detectable particularly in the upper right background area (Figure 4: Co-K). In some places there also appears to be an underpainting containing a copper-based pigment; it registers as strong signals emitted through the craquelure in several limited areas. Those passages of underpaint may be connected with the initial execution in colour, but they, too, do not always match the internal divisions of the final composition (Figure 4: Cu-K).

The broad underpainting with smalt established a space that initially lay between Samson's right knee and the soldier with the dagger,[18] but it also left in reserve – as did the copper-based underpainting – the later-discarded soldier's head in the background (Figure 4: VIS, purple). An interesting feature in the copper distribution is an elongated reserve area, not far from the discarded soldier, that runs diagonally towards the upper left (Figure 4: VIS, green). A similar form located a few decimetres further to

the right, above the sabre of the soldier at the right edge, is clearly identifiable. Comparison of different element distributions of the micro-XRF scan shows that a spear was originally indicated here and was later overpainted with an iron- and manganese-containing earth pigment, applied rapidly with jagged brushstrokes (Figure 5). A whole series of such compositional changes has already been described in the literature: for example, the arrow-filled quiver formerly strapped to the back of the halberdier in the left foreground,[19] which also shows up clearly in the Pb-Lβ distribution, and the original indications of clothing in the area of Samson's chest, which is bare in the finished painting.[20] Likewise, the initial layout of the light blue background has already been extensively discussed thanks to its visibility in the X-radiographs.[21] The light blue area foresaw, among other things, a much slimmer left arm for the halberdier. The adjustment and refinement of this part of the background appears to have occurred little by little in the course of the painting process. With regard, again, to the halberdier in the left foreground, the first paint layer of the light blue background paint executed with a copper blue extends beneath almost the whole left contour of the finished figure. The figure's right contour in some places conforms precisely to the underpainting, but in other places not at all (Figure 4: VIS, green). In this area, the original reworkings executed in the final paint layers can be localised by the presence of lead white and smalt,[22] which cover the parts of the light background that either were not initially established in blue or were heavily reworked (Figure 4: VIS, purple). The aforementioned lead white-containing underpainting in light-toned areas of the painting was changed in ways that have not been noted previously. The Pb-Lβ distribution reveals that the light underpainting extended well into the bottom of the curtain at the painting's left edge, occupying what is now the bottom quarter of the curtain and establishing a hard edge that does not exist in the finished work. In addition, pictorial elements were indicated in the light underpainting by leaving certain parts in reserve. As can be seen when comparing the X-radiograph with the mercury distribution of the micro-XRF analysis, the position of Delilah's eyes, for example, was left in reserve but then slightly shifted during the painting process.

The painting process

Where applied over a dark underpainting, the painting's bright or light-toned colours have been applied opaquely and with a strong impasto such as in the skin of Samson's right leg and the right hand of the halberdier. In contrast, areas of the composition that lie on top of a bright underpainting, including Delilah's skin and the light areas of the background, were executed in thin layers of paint that incorporate the lead white underpainting into the finished representation. Certain details, such as the curls in the

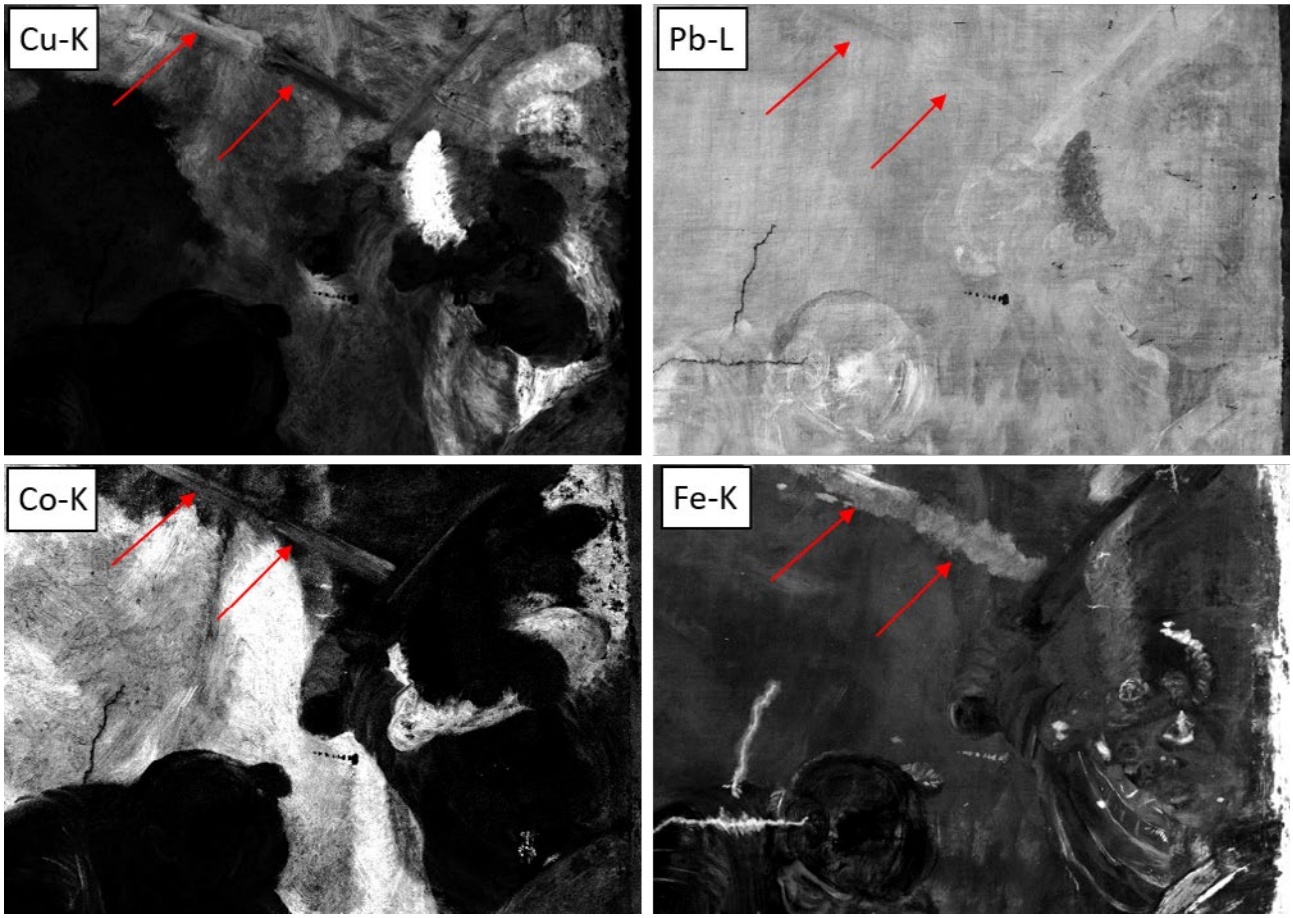

Figure 5 A pentimento in the upper right corner can be identified as a raised spear. It becomes particularly apparent when different micro-XRF elemental distribution images are compared. © Städel Museum, Frankfurt am Main (images: Mareike Gerken).

Figure 6 The low-energy Pb-M signals, which originate from surface paint layers inter alia map the use of lead-tin yellow. The pigment was used for both highlights as in Delilah's garment (above) and blended into broader applications of paint as in Samson's gown (below). © Städel Museum, Frankfurt am Main (image: Mareike Gerken).

hair of both Delilah and Samson, were also articulated by scratching through the overlying dark layer of paint to reveal the light paint beneath. The varied use of scratch marks was a characteristic technique of Rembrandt's, and it is encountered in many works.[23]

This painting's palette, as deduced from SEM-EDX analysis carried out on microsamples in 1980[24] and from the recent micro-XRF analysis, includes various earth pigments in red, yellow and brown (Fe-K, Mn-K). These are found mainly in the dark background, in earth tones, in flesh areas and in the garments. The copper blue that is detectable with XRF was at least partially identifiable as azurite in the SEM-EDX analysis of 1980. It was used in the dark curtains in the background, in Delilah's dress and in the feathered headgear of both Delilah and the soldier at the far right (Cu-K).[25] Whereas the skirt of Delilah's dress to the left of Samson's upraised leg was painted in copper blue, the area of the skirt to the right of his leg contains smalt (Co-K, K-K, Ni-K). Smalt was generally used for painting various garment details, for example, in Delilah's clothing. Moreover, Rembrandt presumably added smalt to other pigments as a drying agent and to modify paint textures, as has been suggested for other works.[26] Smalt thus also appears in dark areas of the background, where its chemical degradation has caused a significant change in colour. This manifests as a greenish-brown hue with a loss of tonal nuance, as has been observed in other paintings by Rembrandt.[27] With a few exceptions, such as Delilah's skirt, azurite is the primary blue pigment used for the indication of colour. According to Roy and Kirby in 2006, azurite is often encountered in Rembrandt's early works as an addition to brown paint and as a drying agent.[28] This hypothesis was taken up by Trentelman et al. in 2015[29] and by Noble et al. in 2023.[30] However, the copper distribution in *The Blinding of Samson* shows that here, azurite was put to broader use than merely as a cool-toned additive; in the Städel Museum's painting, it served as a main determinant of colour, as is particularly apparent in the two contrasting shades of blue in Delilah's dress.

Vermilion, a pigment of high tinting strength, was used in the flesh tones and garments, often admixed to further pigments. It is found, for example, in the clothing of the halberdier, but it also shows up in the signature and in fine details executed towards the end of the working process, such as the blood spurting from Samson's eye socket (Hg-L). Broad calcium signals, the source of which is not always clear, could be indicative of filling materials, colour modifiers or substrates of lake pigments (Ca-K). In some areas, including the figure of the halberdier and details of the armour on the other soldiers, the presence of bone black can be deduced based on the co-occurrence of black paint layers and signals of calcium and phosphorus. The extensive Pb-M signals detected in layers near the surface come primarily from lead white. Admixture of lead white

to the uppermost layers of paint is almost entirely limited to light-toned areas. Some details give off signals of tin (Sn-L), which suggests the use of lead-tin yellow (Figure 6). The tin signals are detectable both in broad applications, as in Samson's light yellow garments, and in fine details, such as light reflections. In those locations, as in Delilah's clothing, they appear in pure form, yet in other places they are mixed with vermilion, as in the red, silk-like garment of the halberdier.

The new findings in art-historical context

The micro-XRF results of *The Blinding of Samson* broaden our understanding of the work's genesis in surprising ways. Although the compositional core around Samson, Delilah, the halberdier and the attacking soldiers appears to have been largely worked out before any painting began,[31] the group of soldiers ultimately underwent extensive changes. By strengthening the compositional diagonal aimed at Samson's head, those changes in form brought about a dramatic intensification in content, amplifying the work's stunning theatrical impact. Moreover, when compared with that same-size workshop version of the composition that was formerly in Kassel (destroyed during the Second World War, Figure 7), the micro-XRF findings offer additional concrete insight into the pedagogical workings of the Rembrandt studio. Furthermore, this latest investigation provides new evidence as to why Rembrandt used his own facial features for the sabre-wielding soldier.

A striking aspect of this painting's genesis is the simultaneous presence of fully clarified parts of the composition alongside parts that underwent considerable changes. Whereas the figures of Samson, Delilah and the halberdier, and even the Indonesian kris shape of the dagger,[32] had obviously been worked out in detail before the execution in paint began, the soldier group at the right arrived at its final form only in the course of the painting process. Although Rembrandt had initially included raised spears at the upper right to suggest a vast surge of Philistines, in the course of the painting's execution he reduced the number of attackers to those whose forms are actually visible in the foreground. In doing so, he focused the composition on the violent overthrow of the hero stripped of his superhuman strength. In the earlier formulation, even though the raised spears indicated the presence of more soldiers beyond the right boundary of the picture, the sense of immediate menace was deflated by the spears' upward orientation. Apparently in the midst of the painting process, Rembrandt decided to transform the soldier at the right edge from a mere observer to a deadly adversary by showing him swinging a sabre over his head. This change closed the previously open right edge of the composition and at the same time created a proper counterbalance to the halberdier at the left. In the same process of clarifying the composition, the underdrawn figure of a soldier to the right of Delilah was eliminated,[33] thus consolidating the dramatic diagonal that runs through the three attackers and terminates in the dagger being stabbed into Samson's eye. These adjustments to the initially disorderly conglomeration of soldiers served to emphasise the decisive moment of the blinding, concentrating the action to such a degree that it looks as if captured in freeze-frame.

Figure 7 Rembrandt Workshop, *The Blinding of Samson*, *c.*1636, oil on canvas, 195 × 261 cm, formerly Kassel, Gemäldegalerie (war loss 1945).

Thanks to the X-radiographs produced for the RRP's examination of the painting, it has been known for some time that Rembrandt made a sizeable, compositionally significant correction to the proper right of arm of the soldier who is blinding Samson.[34] The Kassel version of the composition destroyed in 1945 (Figure 7) does not show that correction. Therefore, the authors of the *Corpus* elevated it from a weak copy to a workshop variant, carried out by an assistant who must have been in the studio during the creation of the original. That assumption is now confirmed by the evidence of the spears that Rembrandt had initially planned in the upper right: the painter of the Kassel version must have based his composition on the state of Rembrandt's original before the spears were painted over. Yet the Kassel version still reflects the original in a relatively advanced state of execution, since it also

Figure 8 Rembrandt Workshop, *The Blinding of Samson*, brush on paper, 322 × 399 mm, whereabouts unknown (image from Neumeister 2005: 412, fig. 378).

lacks the one soldier whose head was initially sketched-in with vermilion in the original, to the right of Delilah. The same applies to a drawing first published by Eich, which cannot be studied in greater detail because its current whereabouts are unknown (Figure 8).[35] Thus, the painting formerly in Kassel appears to have been another example of Rembrandt's practice of engaging in creative competition with workshop members while executing paintings of the same subject.

The face of the triumphant Delilah has repeatedly been seen as a likeness of Rembrandt's wife, Saskia von Uylenburch.[36] In addition, the physiognomy of the sabre-wielding soldier at the far right is reminiscent of self-portraits by Rembrandt, as Stephanie Dickey has recently made clear in reference to the portrait at Buckland Abbey (Devon, UK), a work whose attribution, however, is disputed (Figure 9).[37] A resemblance to Rembrandt is also apparent in *The Standard Bearer*,[38] recently acquired by the Rijksmuseum, which Rembrandt painted in the same year as *The Blinding of Samson*. The sabre-wielding soldier in *The Blinding of Samson* and these two other figures are connected not merely by their physiognomic similarity – all three have in common a prominently feathered hat. The findings of the micro-XRF analysis of the sabre-wielding soldier are particularly interesting in this regard: not only do they reveal that the soldier's feathered beret was initially broader and thus more like the hat in *The Standard Bearer*, they also document Rembrandt's search for the final form of the attached feather. It was only on Rembrandt's third attempt that the feather found its current position in the Frankfurt painting, similar in angle to the main feather in the self-portrait at Buckland Abbey.

Figure 9 Rembrandt, *Self-Portrait Wearing a White Feathered Bonnet*, 1635, oil on poplar panel, 91.2 × 71.9 cm, Buckland Monachorum, Buckland Abbey, Devon, UK, inv. no. NT 810136.

Originally, just as the sabre-wielding soldier and Delilah were connected through their portrait-like characterisations, they also had in common the feathered decoration of their respective headgear. As the copper distribution of the micro-XRF analysis makes unambiguously clear, Delilah's head was initially adorned with a large feather, as is visible in the destroyed Kassel version of the painting and the lost drawing. In the finished state of the Frankfurt painting, only the base of the feather is discernible when viewed up close, and it merges visually with the cloth that covers part of Delilah's hair. While Samson's immediate attackers seem to go about their brutal business in cold-blooded fashion, Delilah and the sabre-wielding soldier respond emotionally to what is happening. In doing so, they direct the beholder's attention to the agony of Samson in the episode's gruesome climax. Owing to Rembrandt's strong foreshortening of the main attackers' heads, we are denied a direct view of their faces. Delilah's expression simultaneously evokes triumph, amazement and budding horror but the soldier's face is marked by incredulous astonishment – precisely the emotional state in which Rembrandt repeatedly portrayed himself in paintings and prints. His characteristic astonished expression was therefore probably recognisable to contemporary viewers of *The Blinding of Samson*. As proposed by Dickey, we can see in the soldier's countenance a kind of inbuilt guide for viewers on how to respond, along with the master himself, to the unprecedented achievement embodied by this shockingly realistic depiction of Samson's blinding.[39] The feather in the soldier's cap could therefore also be a playful iconographic reference to the painter's artistic *ingenium*.[40] In that case, the decision to mostly eliminate Delilah's feather would have been a logical consequence, since it represented merely an extravagant accessory to the outfit of a beautiful woman. And, indeed, it was the enticement of Delilah's beauty to which Samson had succumbed, paying a steep price for his subservience to 'the lust of the eyes'.

Conclusion

The investigations show that even in the earliest detectable applications of paint in *The Blinding of Samson*, Rembrandt had a clear idea of how to depict the scene's main protagonists – Samson, Delilah and the halberdier. Numerous small pentimenti are associated with those figures, but no changes that fundamentally modified the composition. However, the situation differs with the background and the group of attacking soldiers. While the changes to certain parts of the physical setting remain difficult to interpret, the modifications made to the attackers show that Rembrandt endeavoured to intensify the pictorial

statement throughout the working process, from the underdrawing and underpainting all the way up to the final layers of paint. By reducing the number of figures and continually adjusting the scene, Rembrandt achieved an incomparable distillation of the biblical story at its climax.

The new findings also confirm our knowledge of Rembrandt's colour palette, as worked out in past scholarship on the basis of other paintings.[41] The detection of this painting's unusual vermilion-based underdrawing expands the known repertoire of underdrawing techniques employed by Rembrandt. Comparison with the destroyed Kassel version of the painting offers insights into the simultaneous production of copies in the Rembrandt workshop. In addition, the new findings reveal previously unknown aspects of Rembrandt's use of his own likeness for the sabre-wielding soldier.

Acknowledgements

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Notes

1. *Corpus* III [1989]: 190, no. A116; Manuth et al. 2019: 96–9, no. 15.
2. *Corpus* III [1989]: 183–8; Neumeister 2005: 408–13.
3. Machmer 1980; *Corpus* III [1989]: 183–8; Neumeister 2005: 395–422.
4. Bruker M6 JETSTREAM (Alfeld et al. 2013) with a rhodium-target X-ray tube at 50 kV and 600 µA. The primary energy was focused, without filtering, on a spot size of 100 µm. Detection was carried out using a 30 mm² SDD detector at a maximum throughput of 275 kcps. For the 16 overview scans, a 500 µm pixel size and 35 ms/px dwell time per pixel were used. The detail scan was made with a pixel size of 500 µm and a dwell time per pixel of 100 ms/px. The data were evaluated with the Bruker M6 software, PyMca (Cotte et al. 2016; Solé et al. 2007) and datamuncher (Alfeld and Janssens 2015).
5. *Corpus* III [1989]: 183–8; Machmer 1980; Neumeister 2005: 395–422.
6. Koller 1988: 352; Noble et al. 2023: 173; Stols-Witlox 2012: 174.
7. Neumeister 2005: 395. Also, from 1640 to 1669, the grounds used in Rembrandt's workshop included an unusual composition containing clay with large admixtures of sand and small amounts of brown ochre and lead white (Stols-Witlox 2012: 174).
8. Machmer 1980.
9. The admixture of a black pigment was detected in one of the samples taken in 1980 (Machmer 1980).
10. Because of their higher energy, the lead-L signals mostly come from deep layers. In contrast, the low energy of the Pb-M lines allows them to be assigned to layers near the surface.
11. The present authors are unaware of other cases in which comparable application traces have been observed. It cannot be determined whether the canvas was grounded within the Rembrandt workshop or prior to its acquisition by the workshop.
12. See fol. 5r in the De Mayerne Manuscript: Theodore Turquet de Mayerne (1620–1646), '"De Mayerne Manuscript": Pictoria, sculptoria et quae subalternarum atrium', Sloane MS 2052, British Library.
13. See note 5 above.
14. Neumeister 2005: 395.
15. *Corpus* III [1989].
16. Machmer 1980; Neumeister 2005: 395. These samples were taken exclusively from dark areas of the painting (Machmer 1980).
17. Neumeister 2005: 395.
18. The change in arm position of the soldier with the dagger, which overlaps the dark underlayer of the background, has already been discussed at length in *Corpus* III [1989]: 188.
19. *Corpus* III [1989]: 188, 191.
20. Ibid., 186; Neumeister 2005: 408.
21. *Corpus* III [1989]: 188, 191; Neumeister 2005: 408.
22. Neumeister 2005: 395.
23. For an extensive discussion of this technical feature, see Kleinert and Laurenze-Landsberg in the present publication. A similar scratching technique was used to describe Delilah's curls in the *Samson and Delilah* of 1628 at the Gemäldegalerie in Berlin.
24. Machmer 1980.
25. The last of those details is consistent with the findings of XRF analysis of *The Standard Bearer* (Amsterdam, Rijksmuseum), in which the feathered hat decoration also contains azurite (Noble et al. 2023: 175).
26. Noble et al. 2023: 174; Van Loon et al. 2020: 16.
27. Van Loon et al. 2017: 4; Van Loon et al. 2020: 17.
28. Roy and Kirby 2006: 45.
29. Trentelman et al. 2015: 807.
30. Noble et al. 2023: 175.
31. It seems rather unlikely that this was first designed in a now-lost preparatory drawing. Rembrandt's sketch for *The Anatomy Lesson of Dr Jan Deijman* of 1656 (painting and sketch both in the Amsterdam Museum, inv. nos. SA 7394 and TA 7395; see *Corpus* VI [2015]: 634, no. 246; Schatborn and Hinterding 2019: 424, no. Z646) is the only known preparatory drawing that Rembrandt made for a large-format painting.
32. See Göttler 2018: 55–71.
33. Based on the X-radiographs available to them at the time, the authors of *Corpus* III [1989]: 191 suspected that Rembrandt might have painted over the head of a soldier 'just left of the masonry arch, level with Delilah's head'. However, the overpainted head that has now been identified unambiguously with micro-XRF analysis is compatible neither with the unclear information in the X-radiographs nor with the conclusions previously drawn from it. The head identified by XRF analysis is at a different location than the one that the *Corpus* authors are thought to have discerned.
34. *Corpus* III [1989]: 188–90, fig. 2.
35. Eich 1981: 288–300.
36. Neumeister 2005: 402 n. 66
37. *Corpus* VI [2015]: 545–6, no. 134; Dickey 2021: 236–7.
38. Manuth et al. 2019: 689–90, no. 289.
39. Dickey 2021: 236–7.
40. Raupp 1984: 176–8.
41. Roy and Kirby 2006; Noble et al. 2023: 173.

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