

Van Gogh's Sunflowers Illuminated

Art Meets Science

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Edited by Ella Hendriks and Marije Vellekoop

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Foreword

Research forms the basis for all a museum's core tasks, from building, managing and presenting its collection, to conservation and exhibitions. The work of curators, conservators and researchers – at the Van Gogh Museum and at universities, research institutions and museums around the world – continually enriches our understanding of Vincent van Gogh and the art of his time. Research therefore represents a fundamental aspect of the Van Gogh Museum's mission, and the museum maintains an ambitious research and publications programme. This includes the ongoing object-based research for our series of collection catalogues, both on the paintings and drawings by Van Gogh and on the works of his contemporaries; research on the Japanese prints Van Gogh collected (2018); on the founding figures of our museum, Jo van Gogh-Bonger (2019) and Vincent Willem van Gogh; on the canvases used by Van Gogh and on discoloration of late nineteenth-century pigments; as well as research for our exhibitions on topics as varied as Van Gogh's illness (2016), Paul Gauguin's and Charles Laval's stay on Martinique (2018), the influence of Western European artists on the work of Gustav Klimt (2020), Van Gogh's paintings of olive groves (2021) and his works from Auvers-sur-Oise (2023).

The Van Gogh Museum is known for its interdisciplinary approach, in which art-historical and technical research go hand in hand. Thanks to this research tradition, the museum has assumed an international role as a centre of knowledge for Van Gogh and the art of his time (1840–1920). Our most recent research activities can be followed through our scholarly newsletter *Van Gogh Museum Academy*, which is published online three times a year.

The knowledge generated by our research is shared in a wide variety of ways: through collection catalogues, exhibition catalogues, articles in academic journals, online platforms, symposiums and through scholarly books published by the museum in association with specialist publishers. Following on from the *Cahiers* series (1988–2002) and the *Van Gogh Museum Journal* (1995–2003), the Van Gogh Museum began to publish its *Van Gogh Studies* series in 2007. The museum's new, peer-reviewed series, *Van Gogh Museum Studies*, of which this is the first volume, will renew this practice and features academic publications resulting from the museum's research programme. The editorial team is made up of renowned scholars from the Van Gogh Museum and international specialists.

Van Gogh's Sunflowers Illuminated: Art Meets Science is entirely devoted to the research performed over the years into Van Gogh's *Sunflowers*, an icon of Western European art. The artist painted five large versions of the same subject and this book focuses on two of them in which the vase with sunflowers is portrayed against a yellow background: the first study painted from life in August 1888 (in the collection of the National Gallery in London), and the version made in January 1889 (in the Van Gogh Museum in Amsterdam). New information recently came to light when the two paintings were examined in unprecedented depth using a broad array of traditional and state-of-the-art techniques to look closely at and underneath the paint surface. *Van Gogh's Sunflowers Illuminated* presents the outcome of this research undertaken by an international team of more than 30 scientists, conservators and art historians who have contributed as co-authors to this volume.

The publication of a new scholarly book of this kind is an ambitious project that requires not only the help and expertise of many people but also a considerable amount of time, energy and patience. In the first instance I would like to thank the many contributors to this publication. The number of authors for each essay is impressive, as has been their ongoing commitment to coordinate their respective insights and findings. We are very grateful to them for their unflagging efforts and contribution to this publication. Ella Hendriks initiated the research into *Sunflowers* as Senior Paintings Conservator at the Van Gogh Museum. Following her appointment as Professor of Conservation and Restoration of Moveable Cultural Heritage at the University of Amsterdam, she has remained the central figure in both the ongoing study and the production of this book. In addition to her contribution as an author, she has acted as joint editor-in-chief to ensure the substantive quality and coherence of the essays, for which we are extremely grateful. And we owe special thanks to the joint editors Maarten van Bommel, Muriel Geldof and Marika Spring for their precise and helpful comments on the essays.

The Van Gogh Museum has collaborated with the following institutions for the research and development of this book: the National Gallery in London, the University of Amsterdam, the Cultural Heritage Agency of the Netherlands (RCE), the University of Antwerp, Prof. J.J. Boon (Emeritus, AMOLF-FOM Institute for Atomic and Molecular Physics, University of Amsterdam) and Shell Nederland. Access to the MOLAB platform (CNR-ISTM/SMAArt in Perugia, Italy, and Nicolaus Copernicus University in Toruń, Poland) was financially supported by the European research project IPERION CH, funded by the European Commission, H2020-INFRAIA-2014-2015 (Grant 654028). We offer our sincere thanks to all these institutions for their valuable contribution.

The production of this book – a complex process due to the many authors and the volume and variety of the visual material – was in the capable hands of Suzanne Bogman, our Head of Publications, and editor Karin Koevoet. Kate Bell provided meticulous and much-valued editorial guidance and Diane Webb and Ted Alkins supplied the expert translations. Essential to such an interdisciplinary publication is a clear and attractive layout, which is precisely what Marjo Starink, the designer, has delivered.

We are fortunate to have Amsterdam University Press as publishing partner for *Van Gogh Museum Studies*. Director Jan-Peter Wissink and his professional team,

and the publisher's comprehensive distribution network have been of immense benefit to the quality and international distribution of the series.

This scientific publication has been made possible thanks to the financial support of the IPERION CH programme, which brings together the expertise and experience of major European institutions specializing in the examination and conservation of cultural heritage.

A special word of thanks to the Vincent van Gogh Foundation, the owner of the major part of the museum's collection, including the *Sunflowers*, for its very supportive collaboration over all these years.

The Van Gogh Museum would also like to focus for a moment on the various supporters of the museum. We are grateful, first of all, to our main partners BankGiro Loterij and Van Lanschot for providing the Van Gogh Museum with the annual funds to mount an appealing programme of exhibitions and publications. And for this project specifically we would like to thank Takii Seed, Shell Nederland and The Sunflower Collective for their warm-hearted support.

In today's world the launch of a new scholarly series is a rare enterprise. We take pride in the fact that the museum is able to fulfil its mission of pursuing and promoting serious scholarship and sharing the results through these publications. We sincerely hope that the series will find a wide readership among specialists and interested general readers around the world, and that it will contribute to the scholarly debate.

Marije Vellekoop
Head of Collections & Research
Editor-in-chief *Van Gogh Museum Studies*



1 Van Gogh's *Sunflowers*: Research in Context

Ella Hendriks and Costanza Miliani

Vincent van Gogh's *Sunflowers* are viewed by many as icons of Western European art. The artist painted five large versions of the motif and this book focuses on two in which the vase with sunflowers is portrayed against a yellow background. The first version, painted from life in August 1888, is now in the collection of the National Gallery in London, and the second, made in January 1889, is in the Van Gogh Museum in Amsterdam. New information recently came to light when the two paintings were examined in unprecedented depth, using a broad array of traditional to state-of-the-art techniques, to look closely at and underneath the paint surface. *Van Gogh's Sunflowers Illuminated* presents the outcomes of this research undertaken by an international team of more than 30 scientists, conservators and art historians who have contributed as co-authors to this publication.

Technical studies of the London and Amsterdam *Sunflowers*

The idea of performing a comparative investigation of the related London and Amsterdam *Sunflower* paintings dates back to 1993, when a longstanding collaborative effort between the National Gallery and the Van Gogh Museum was launched that continues to the present day. Headed by Ashok Roy from the Scientific Department at the National Gallery, the initial study included chemical analysis of micro-samples of paint taken from each picture to facilitate a comparison of the composition and build-up of corresponding areas of colour and their state of preservation. In addition, a first assessment of the structural condition of the Amsterdam painting was made by the conservators Anthony Reeve (National Gallery) and Cornelia Peres (Van Gogh Museum), in view of the idea that the work might travel to London where the two pictures could be shown by side, a plan which did not go ahead at that time. In the years that followed there were few opportunities for short episodes of further examination, as the much-loved *Sunflower* paintings could not be removed from the galleries for long. One such occasion was the joint technical study undertaken by Kristin Hoermann Lister, Inge Fiedler and Cornelia Peres for the 2001–02 exhibition *Van Gogh and Gauguin: The Studio of the South*. All three versions of *Sunflowers* against a yellow background were included in the exhibition. The methodology put forward for sequencing Van Gogh's paint-

ings based on the evidence of their canvas supports (published in the appendix of the exhibition catalogue) deserves special mention, as it has received much follow-up since.¹ It was used in our recent study of the *Sunflower* paintings, now augmented by computer-based techniques for the analysis of canvas weave that were developed in collaboration with the Van Gogh Museum by the Automated Thread Count Project set up in 2007. In 2005, the Van Gogh Museum initiated the Van Gogh's Studio Practice Project in collaboration with the Cultural Heritage Agency of the Netherlands (RCE) and Shell Nederland as main partners. In this project many paintings that Van Gogh made in the south of France were examined and the micro-samples from the *Sunflowers* previously examined by Fiedler were the subject of further investigation. Eight years on, in May 2013, this resulted in the opening of the major exhibition, *Van Gogh at Work*, in which the London and Amsterdam *Sunflowers* were reunited for the first time in Amsterdam. The outcomes of the Studio Practice Project have proved crucial for situating findings relating to the *Sunflower* paintings in a broader context.²

In 2012, new impetus was given to the *Sunflowers* study thanks to a CHARISMA ARCHLAB access granting one of the current authors (EH) an opportunity to visit the Scientific Department at the National Gallery in London. The purpose of the trip was to compare relevant archival and technical material on the London picture with the Amsterdam one, in anticipation of a forthcoming MOLAB investigation of the Amsterdam painting at the Van Gogh Museum under the auspices of the same European-funded programme (see under MOLAB below). This visit sparked renewed microscopic examination and additional chemical analysis by the Cultural Heritage Agency of the Netherlands of the paint samples taken in 1993, and ultimately prompted the drawing together of all the existing research material gathered since that date. Under the driving force of Ashok Roy, as the National Gallery's Director of Collections, this culminated in the focused display *The Sunflowers*, held from 25 January to 27 April 2014, in which the idea of exhibiting the two works side by side in London was finally realized.³ Two years later, a fuller account of the research presented in the show was published by Roy and Hendriks in the *National Gallery Technical Bulletin*.⁴ The current book, *Van Gogh's Sunflowers Illuminated*, contributes new research that builds on these earlier studies conducted over a period of about a quarter of a century. Therefore more than a case study comparison of two paintings, it allows us to contemplate developments in methods and approaches towards conservation research that have taken place since the *Sunflowers* project began.

New developments: a combined non-invasive and invasive approach

The past decade in particular has witnessed significant changes in scientific analysis performed for conservation research. Increasingly, paint sampling has made way for non-invasive, diagnostic techniques using mobile instruments that can be brought to the paintings for in-situ analysis (rather than the paintings having to be moved to the laboratory).⁵ Samples cannot be dispensed with entirely, for they yield certain types of information that as yet cannot be gained in any other way, but the

advent of these new methods greatly reduces the number of samples required and aids their selection. The in-situ non-invasive approach has undergone a significant development to ensure it meets specific needs in the field of heritage science. Many efforts have been oriented towards the design and setting up of innovative mobile instruments with a sensitivity and specificity comparable to their bench-top counterparts, achieving the best compromise between efficiency and portability.⁶

We have been fortunate to exploit these possibilities for our research on the Amsterdam *Sunflowers*, leading to a new wave of non-invasive campaigns of examination conducted in the period 2012–17. In 2013 and 2014, scanning MA-XRF (macro X-ray fluorescence) and MA-XRPD (macro X-ray diffraction) were performed by Geert Van der Snickt and Frederik Vanmeert from Koen Janssens's research group at the Department of Chemistry, University of Antwerp.⁷ Early in 2017, the National Gallery acquired its own scanning MA-XRF apparatus and used it to examine the London *Sunflowers*, providing data to compare with the Amsterdam picture. A key contribution was provided by the European mobile laboratory MOLAB which visited the Van Gogh Museum twice, first from 18 to 20 April in 2012, and again from 7 to 13 March in 2016 (figs. 1.1, 1.2). These campaigns were complemented by additional chemical analysis of samples by the Cultural Heritage Agency of the Netherlands using several techniques. The spatial information available from non-invasive scanning techniques combined with the highly specific information obtained from sample analysis proved to be a powerful approach.

MOLAB

MOLAB (Mobile Laboratory) is a distributed infrastructure of facilities providing coherent access, under a unified management structure, to a set of portable equipment and related expertise, for in-situ non-invasive measurements on artworks, monuments and sites. The specific motivation for a mobile laboratory arises from the fact that a large part of historical European patrimony consists of monuments, sculptures and buildings that cannot be moved from their location. This implies that non-invasive studies of materials on these objects must necessarily be carried out in situ using portable instruments. In addition, even in the case of moveable patrimony (such as paintings, ceramics, gems, manuscripts, etc.), it can often be quite difficult, if not impossible, to move such works to a laboratory, due to the high risks and costs connected with their transportation and often fragile state.

Founded in 2001 in Italy and open for transnational access within the European projects Eu-ARTECH (FP6),⁸ CHARISMA (FP7)⁹ and IPERION CH (H2020),¹⁰ MOLAB offers a unique collection of high-performance and well-integrated portable experimental techniques (ranging from point analysis to 2D/3D imaging and multispectral/hyperspectral imaging) operated by five European facilities. The exploitation of the MOLAB instrumentation available through competitive calls, permits scientists, conservators, art historians and archaeologists to carry out studies that would not otherwise be viable, for example, when sampling is prohibited, or the poor state of conservation and the dimensions of the object to be examined render transportation impossible. In the last decade, the MOLAB access programme demonstrated that useful analytical results can be obtained through

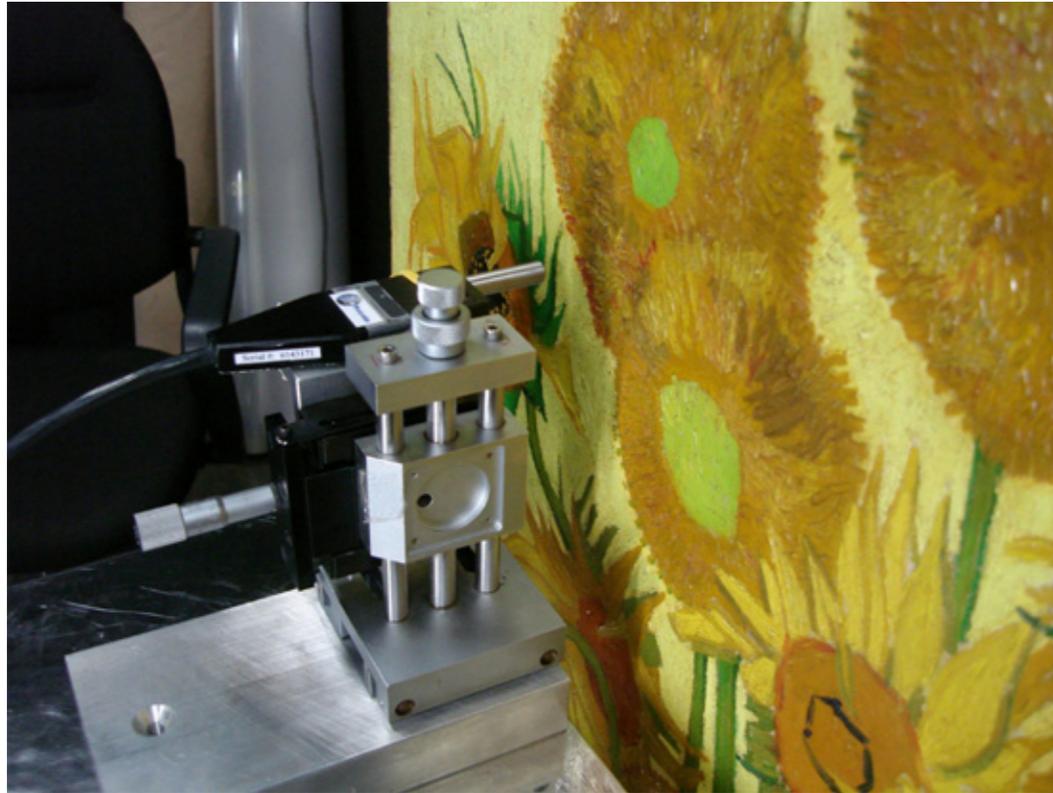


Fig. 1.1 Contactless measurements being made of the Amsterdam *Sunflowers* using a mobile analytical instrument.



Fig. 1.2 Paintings conservator discussing the Amsterdam *Sunflowers* with conservation scientists during the 2012 MOLAB visit to the Van Gogh Museum.

in-situ studies of a variety of heritage objects, without sampling or moving them to a laboratory, achieving significant overviews on the chemistry and structure of their materials.¹¹ In fact, observations derived from multiple analytical techniques, each overcoming intrinsic limitations of the others, can provide extensive and complementary information. In addition, since non-invasive measurements do not require any contact with the examined object, they can be carried out all over the surface at a virtually infinite number of points, obtaining numerous integrative and representative data.

One clear advantage of MOLAB is the fact that measurements, being carried out in situ and directly on the artwork, lead to (close to) real-time results, permitting an immediate group discussion of the recorded data. For the users, be they scientists, conservators or scholars, this exchange can drive the acquisition of further measurements, or lead to changes in the strategy of investigation in order to resolve the specific case being studied. This possibility not only improves the quality of the examination, but also strongly contributes to the creation of a ‘common language’ between scientists and the other professional figures in conservation, overcoming any barriers that might be imposed by their different disciplinary backgrounds.¹²

In the first MOLAB campaign, granted to the Van Gogh Museum through the CHARISMA project,¹³ a combination of spectroscopic point analysis measurements were exploited to complement the MA-XRF elemental mapping and paint-sample analysis, providing a better understanding of the palette used. Most notably, portable reflection FTIR and Raman spectroscopies were used to characterize the molecular composition and structure of the different chrome yellow types and their association with other pigments throughout the *Sunflowers*.¹⁴ During the second MOLAB campaign, granted to the Van Gogh Museum through the IPERION CH project,¹⁵ the study was integrated with new methodologies that had meanwhile been added to the MOLAB portfolio. These included Visible hyper-spectral imaging that permitted an understanding of the chemical composition of the green, blue and ochre-orange hues of the painting, and a combination of optical coherence tomography (OCT) and reflection FTIR spectroscopy to obtain insight into the 3D structure and chemical composition of multiple layers of non-original varnish. This second MOLAB session formed one aspect of the full investigation of the painting that took place from 18 January to 14 March 2016, with a main goal of improving understanding of the painting’s condition some 130 years after it was made, as a basis for recommending possible conservation and restoration treatment. While the non-invasive techniques offered by MOLAB proved extremely insightful, to fully answer questions relating to the condition of the painting, additional types of analysis were required. This involved the examination of paint cross-sections in combination with ATR-FTIR spectroscopy, as well as the analysis of varnish samples using several mass spectrometric techniques, performed at the Cultural Heritage Agency of the Netherlands and Shell laboratories. It is the combined results of these non-invasive and invasive investigations that have led to our current comprehension of the condition of the painting in relation to the past treatments it has undergone.

Drawing up the balance: current knowledge of the *Sunflower* paintings

Van Gogh's Sunflowers Illuminated synthesizes the results of these campaigns of technical examination and discusses the outcomes from multiple angles that bring us closer to understanding Van Gogh the painter and his *Sunflowers*. It opens with an art-historical chapter by Nienke Bakker and Christopher Riopelle, explaining the context in which the *Sunflower* paintings were made and the special place that these works occupy in Van Gogh's oeuvre, framing the more technical essays that follow. In the next chapter, Catherine Higgitt, Gabriella Macaro and Marika Spring describe the results of detailed technical examination and analysis of the first version of *Sunflowers* in the National Gallery. They incorporate the recent insights given by scanning MA-XRF discussed in relation to Van Gogh's choice of painting materials and his working process. The following chapter by Ella Hendriks *et al.* examines the materials and methods used to create the Amsterdam picture in an equivalent manner. New information allows a fuller comparison to be made of the similarities and differences between the two versions (the original and the repetition) than was possible before. Changes in the appearance of both works due to both natural ageing of the materials used and past restorations are also taken into account, bringing us closer to appreciating how the paintings may originally have looked. The topic of colour change caused by chemical deterioration of light-sensitive pigments used by Van Gogh, notably chrome yellows and geranium lakes, is explored in greater depth in the next chapter by Letizia Monico and her co-authors. It explains broader studies set up to gain understanding of the causes and pathways of chemical degradation, which in turn has contributed to the definition of safer lighting guidelines for the display of Van Gogh's *Sunflowers* and other works painted with similarly fugitive materials. The work relies on the exploitation of the most advanced techniques of chemistry and materials sciences (synchrotron microbeam-based multimodal combinations, namely, micro-XRF in combination with micro-XANES, micro-XRD and micro-FTIR spectroscopy),¹⁶ allowing for additional investigations of a selection of paint samples taken in the 1990s previously analysed in the RCE laboratory (with optical microscopy, SEM-EDX, Raman, HPLC and XRD), combined with the study of artificially aged mock-ups. The next chapter by Klaas Jan van den Berg *et al.* moves on to discuss the challenging process of identifying the multiple layers of non-original varnish and other surface coatings now present on the Amsterdam painting. Examining the stratigraphy of these layers has established a sequence for when they were added in relation to the timeline for the restoration history of the painting set out in the last chapter by Ella Hendriks *et al.* While few records have been kept of what was done to the painting in the past, broader archival research combined with technical examination and chemical analysis of *Sunflowers* has greatly improved our knowledge of its treatment history, and in turn helped us to understand the impact of subsequent restoration campaigns on the way the painting looks today. The question that remained was, which of the changes that have taken place do we now accept as belonging to the history of the painting and which should, or could, be safely undone or 'improved'?

The final chapter weighs up and discusses these issues and draws up a balance, concluding with recommendations for safe methods of conservation and restoration treatment.

The 2019 conservation treatment of the Amsterdam *Sunflowers*

The latest investigations of the Amsterdam *Sunflowers* have made very clear the extent to which its present condition is profoundly affected by the restorations it has undergone in the past. As the former interventions (including wax-resin lining, reinforcement of the attached wooden strip, campaigns of cleaning, varnishing and retouching and local surface consolidation with wax) can no longer be safely undone or their consequences reversed, they must now be accepted as forming part of the history of the painting, significantly reducing options for re-treatment. Only a limited measure was proposed to improve the appearance of the painting, which was approved after discussion by an expert advisory committee. This entailed the removal of unsightly patches of beeswax on the picture surface and adjusting old mismatched retouchings with new ones applied on top of the existing varnish layer. On 24 January 2019, a press conference was held in the conservation studio of the Van Gogh Museum with the *Sunflowers* at hand, explaining the treatment that was about to commence and the reasoning behind it. The announcement by the museum's Director, Axel Rüger, that in view of the fragile if stable condition of the painting it would no longer be allowed to travel, received international press coverage and was met with broad interest and understanding. Within six weeks the restoration treatment performed by Senior Conservator, René Boitelle, drew to a close and on 22 February the painting was returned to the gallery. While limited in scope, this intervention has significantly improved the overall appearance of the painting and it is hoped will enhance its enjoyment by future audiences for generations to come. The painting will take centre stage in the exhibition *Van Gogh and the Sunflowers* (on display from 21 June to 1 September 2019) introducing the recent research and conservation treatment, which will also form the theme of a symposium, open to scholars and the general public alike.

Epilogue

In February 2019, the opportunity arose to make an infrared reflectogram of the reverse of the Amsterdam *Sunflowers* while the painting was off the wall for conservation treatment. This revealed a number – apparently 195 – written on the back of the original canvas, now covered by the lining (fig. 1.3).¹⁷ It refers to the catalogue inventory list of the artist's estate compiled by Jo van Gogh-Bonger, who up until 1905 used these numbers to identify pictures when lending them to exhibitions.¹⁸ Soon afterwards, in March 2019, it proved possible to record an equivalent infrared reflectogram of the reverse of the London *Sunflowers* for comparison (fig. 1.4).¹⁹ This revealed the number 4 written upside-down in the top left quadrant of the canvas, which, as in the Amsterdam painting, is now covered by a lining. The current stretcher is reinforced with a cross and unfortunately the upper vertical strut

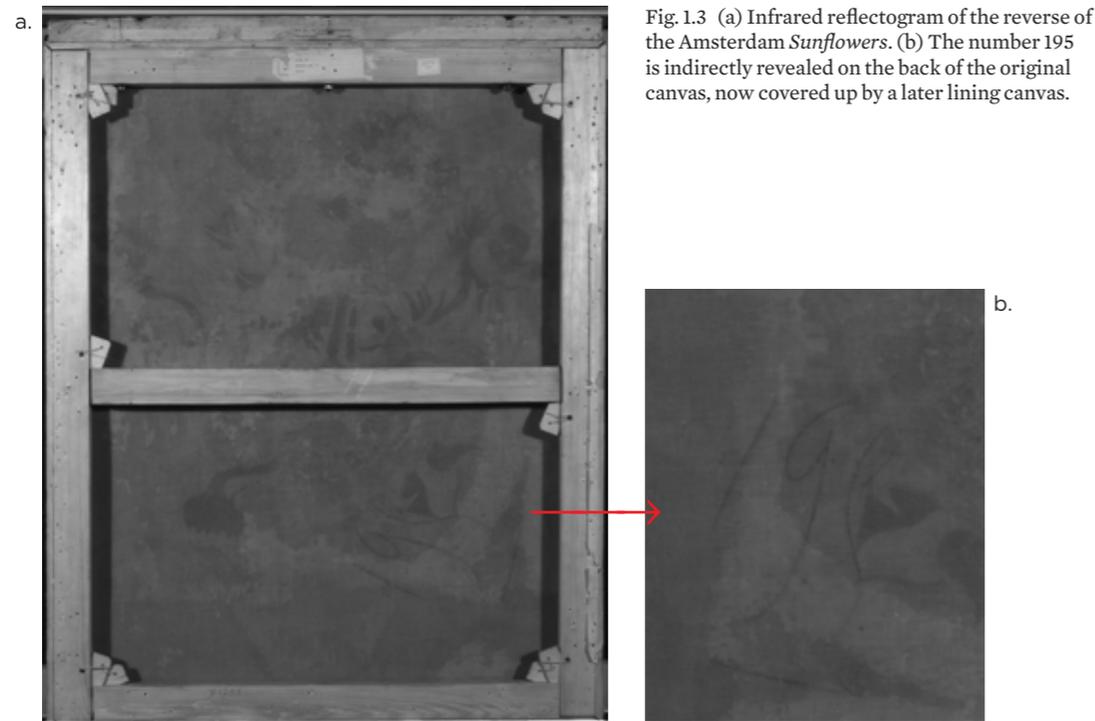


Fig. 1.3 (a) Infrared reflectogram of the reverse of the Amsterdam *Sunflowers*. (b) The number 195 is indirectly revealed on the back of the original canvas, now covered up by a later lining canvas.

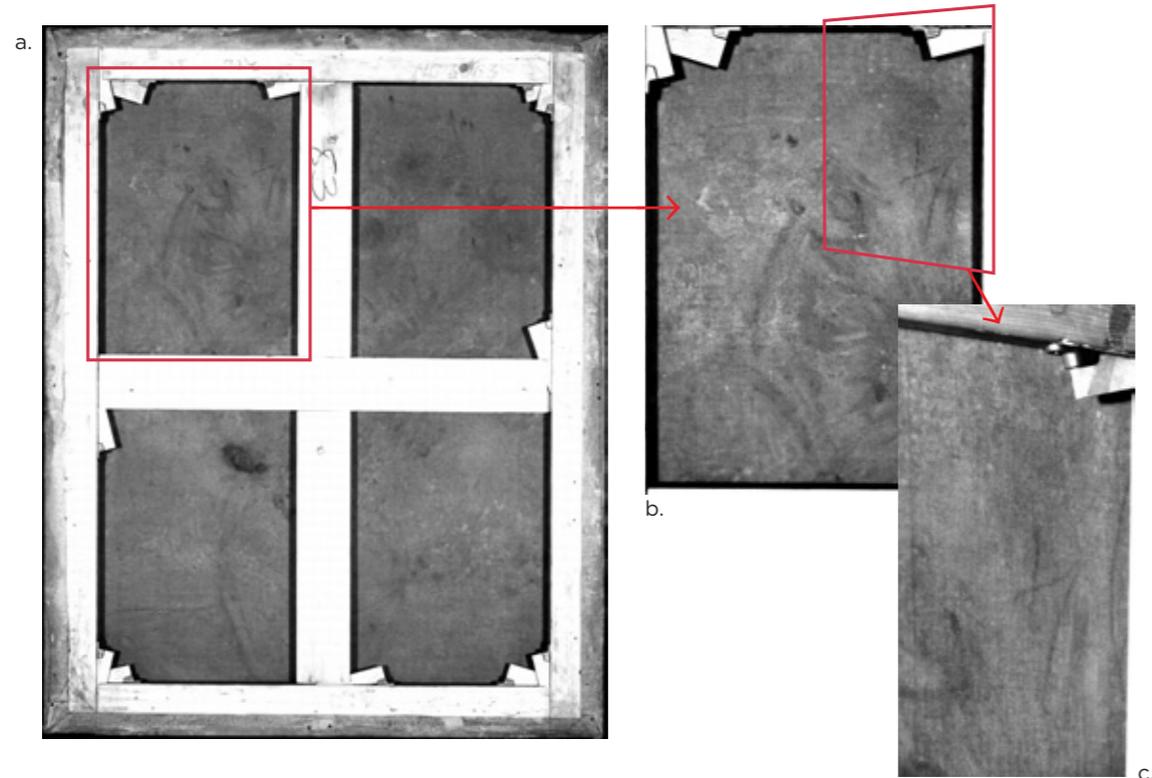


Fig. 1.4 (a) Infrared reflectogram of the reverse of the London *Sunflowers*. (b) Infrared reflectogram detail of the upper left quadrant showing a number 4 on the back of the original canvas, now hidden by the lining. It is thought that the rest of the number 194 is hidden by the (non-original) stretcher bar. (c) Detail of infrared reflectogram taken at an oblique angle to look behind the stretcher bar, showing a curved line that is probably part of the 9.

covers what is thought to be the rest of the number 194: a detail infrared reflectogram looking from the side behind the stretcher shows a long curved line that could be the edge of the 9. Surviving correspondence records that in June 1900, Jo lent *Sunflowers* Bonger catalogue no. 194 along with seven other Van Gogh paintings to the Paris art dealer Julien Leclercq, who hoped to find buyers among visitors to the World's Exhibition. After the exhibition closed on 12 November, Leclercq returned the unsold works to Jo, but kept the *Sunflowers* as it required treatment for flaking paint. The initial intention had been to line the painting, but instead the loose paint was consolidated by injecting it with glue in what was described as a long and painstaking procedure that was completed at the end of March 1901. The discovery of the Bonger numbers written on the reverse of the two *Sunflowers* provides new, undisputed evidence for the fact that this episode does not refer to the Amsterdam picture as was previously supposed, but probably refers to the London painting, which appears to be the painting referred to as catalogue 194.²⁰ It therefore contributes towards reconstructing an important part of the early restoration histories of the *Sunflowers*.

Notes

- 1 Hoermann Lister *et al.* 2001, appendix pp. 354–69.
- 2 Vellekoop *et al.* 2013; Vellekoop (ed.) 2013.
- 3 <https://www.nationalgallery.org.uk/the-sunflowers-feature>.
- 4 Roy and Hendriks 2016.
- 5 Miliani *et al.* 2010.
- 6 Brunetti *et al.* 2016.
- 7 Vanmeert *et al.* 2018.
- 8 Eu-ARTECH, Access, Research and Technology for the Conservation of the European Cultural Heritage, 6th FP RII3-CT-2004-506171.
- 9 CHARISMA, Cultural Heritage Advanced Research Infrastructures: Synergy for a Multidisciplinary Approach to Conservation, 7th FP GA n.228330.
- 10 IPERION CH, Integrated Platform for the European Research Infrastructure on Cultural Heritage, H2020-INFRAIA-2014-2015 (Grant 654028), www.iperionch.eu.
- 11 Brunetti *et al.* 2016.
- 12 Ibid.
- 13 See note 9.
- 14 Monico *et al.* 2015a.
- 15 See note 10.
- 16 Janssens *et al.* 2008.
- 17 Two infrared reflectograms of the reverse of the painting were made in the photography studio of the Van Gogh Museum by Heleen van Driel. The painting was illuminated with two Elinchrom halogen spots and the reflectogram made using an

Osiris camera (Opus Instruments), both with a filter in the bandwidth region 1250–1510 nm and without a filter in the bandwidth region of 1100–c. 1700 nm. The revealed number recalls other known examples of Bonger numbers written in black chalk on the reverse of Van Gogh's paintings. Also striking in the infrared reflectogram are areas of emerald green paint that appear to have migrated through to the reverse of the canvas. The short wavy line that runs out from the last digit 5 is an example. It corresponds to the green contour of a painted stem visible on the front and should not be read as part of the inscription.

- 18 For a full account of the documented early provenance of the *Sunflowers*, including evidence from the Bonger catalogue inventory, see Dorn 1999.
- 19 The infrared reflectograms were made by Rachel Billinge on 19 March using an Apollo camera (Opus Instruments) which contains an InGaAs array sensor sensitive 900–1700 nm and returns 16-bit images. The stretcher (which is not original and so information on it, such as the number 83, is not relevant to the research) looks white in the infrared image because it was intentionally overlit, allowing more radiation to reach the canvas. In addition to the image of the whole reverse four details were recorded at higher resolution, one of each of the four quadrants of exposed canvas. A fifth detail was also recorded, with the camera and lights at an oblique angle to try to see behind the stretcher bar near where the number 4 was found.
- 20 Dorn 1999, pp. 54–55; Van Tilborgh and Hendriks 2001, p. 27.