

A comparative study of Vincent van Gogh's *Bedroom* series

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ABSTRACT Recent plans to clean and restore Vincent van Gogh's painting of his *Bedroom in Arles* (Van Gogh Museum, Amsterdam) sparked off a broad collaborative campaign of investigations to compare the materials and techniques used in all three painted versions of this theme, including the *Bedroom* pictures now in the collections of the Art Institute of Chicago and Musée d'Orsay in Paris. The features considered in this paper include picture format and composition, the preliminary sketch, colour scheme and pigments used, paint handling and condition of the works, all related to relevant passages in the artist's letters. Findings help to substantiate chronological sequence, as well as providing insight into the broader question of how Van Gogh's ideas and working methods evolved in the process of making serial repetitions or copies of his own works.

Introduction

Nowadays, Vincent van Gogh's *Bedroom in Arles* is one of his best-known paintings and from the artist's letters we know that it was one he was particularly pleased with (see, for example, letters 715, 741, 765 and 776).¹ He captured the scene in two letter sketches (705 and 706), as well as in three oil paintings now in the collections of the Van Gogh Museum in Amsterdam (F 482, JH 1608), the Art Institute of Chicago (F 484, JH 1793), and Musée d'Orsay in Paris (F 483, JH 1771) (Figs 1–3), subsequently referred to as the Amsterdam, Chicago and Paris pictures.² The importance that Van Gogh attached to the series of paintings after his *Bedroom at Arles* is reflected in the fact that he mentions it in no less than 15 letters and, unusually, expresses his satisfaction with the works several times, expanding upon his ideas and feelings about the theme and outlining the circumstances surrounding the origin of the series, as summarised below.

Van Gogh provides us with detailed descriptions of his first *Bedroom* study, painted in the Yellow House at Arles on 16 and 17 October 1888 (letters 705, 706 and 707). Subsequently, he informs us that during his stay in the Arles Hospital the study had been spoilt by damp, so that he stuck newspapers onto it to secure flaking paint and sent it to his brother, Theo (letter 765), recommending that he have the painting lined (letter 776). Some discussion follows regarding whether this should best be done before or after Theo was to return the painting to Vincent again for the purpose of making a copy (letters 779, 781 and 782). On 5–6 September 1889, writing from the asylum in Saint-Rémy, we learn that Van Gogh has made the copy after the original damaged study, which had yet to be lined

(letter 800). In the same letter, Van Gogh mentions that he will make some copies for his mother and two sisters in Holland, including one of the *Bedroom* (this is the small copy now in the collection of Musée d'Orsay). Around 19 December he announces that he will send 'the *Bedroom*' back to Theo (letter 829), and from Theo's response a few days later on 22 December (letter 830) we know that he received both *Bedroom* paintings; that is the original damaged study and the same-sized copy that was made (the smaller copy, now in Paris, was sent to his sister Wil in Holland).

In the past, the question of which painting came first – the Amsterdam or the Chicago version – has formed a topic of debate.³ Though convincingly resolved in favour of the Amsterdam picture as the first study,⁴ some confusion on this issue has persisted in the art-historical literature up to the present day.⁵ This paper presents new information gained from a broad collaborative campaign of technical examinations aimed at comparing the materials and techniques used in all three *Bedroom* paintings, helping to verify their sequence of execution. More importantly though, the results provide insights into the broader question of how Van Gogh's ideas and working methods evolved in the process of making serial repetitions or copies of his own works.

Picture format and composition (Table 1)

As was his customary practice in France, Van Gogh employed standard commercial size canvases for all three *Bedroom* paintings. Both the Chicago and Amsterdam



Figure 1 Vincent van Gogh, *The Bedroom*, 16–17 October 1888. Oil on canvas, 72.5 × 91.4 cm, Van Gogh Museum (Vincent van Gogh Foundation), Amsterdam.



Figure 2 Vincent van Gogh, *The Bedroom*, September 1889. Oil on canvas, 73.6 × 92.3 cm, the Art Institute of Chicago, Helen Birch Bartlett Memorial Collection, 1926.417.



Figure 3 Vincent van Gogh, *The Bedroom*, September 1889. Oil on canvas, 57.2 × 73.5 cm, Musée d'Orsay, Paris. © C2RMF, E. Lambert.



Figure 4 Overlay of the Amsterdam (blue lines) and Chicago (red lines) *Bedroom* paintings, revealing many minor differences in composition.

Table 1 Comparison of picture format.

Painting	Current dimensions (H × W in mm)	Image reduced	Original dimensions (H × W in mm)	Equivalent standard format	Tacking edges removed
Amsterdam F 482	725 × 914	15 mm strip of painting turned over left side of stretcher as tacking margin	725 × 929	Figure 30 (c. 730 × 920)	Left one only
Paris F 483	572 × 735	Possibly few mm cut from bottom edge (now covered by tape)	572 (+ few mm) × 735	Close to vertical landscape 20 (c. 567 × 730)	Yes
Chicago F 484	736 × 923	No	730 × 920	Figure 30 (c. 730 × 920)	Yes

pictures were made on Figure 30 canvases, taking into account that a small portion of the Amsterdam canvas has been folded over the left side of a replacement stretcher at a later date.⁶ Differences in the way the door jamb and chair are depicted at the left side of the Amsterdam painting have been taken as proof to substantiate the view that this (rather than the Chicago picture) is the later copy painted in Saint-Rémy, but the discovered format change disqualifies this argument.⁷ An overlay of the same-sized Amsterdam

and Chicago pictures shows a close, though not exact correspondence in the main outlines, with many differences in the perspective and rendering of individual features (Fig. 4). Clearly the Chicago painting was not a precise copy of the Amsterdam study. For the smaller copy now in Paris, Van Gogh used a canvas very close to vertical landscape 20 format.⁸ The squatter proportions might explain differences such as the absent corner of the ceiling, which would have been hard to cram into the available height.

Ready-primed canvas supports (Table 2)

Comparison of automated thread counts, derived from X-radiographs of the *Bedroom* paintings, reveals a close correspondence in the average and range values obtained along the warp and weft directions.⁹ It seems that all three paintings were made on pieces of the same type of asymmetrically woven artists' canvas, corresponding to the 'ordinary' quality that Van Gogh normally ordered in rolls of 10 or occasionally 5 m from the Paris firm Tasset et L'Hôte, from September 1888 onwards (first mentioned in letters 625, 639 and 680). Examination of Van Gogh's later French canvases has demonstrated the highly standardised quality of the machine-woven canvas supplied by the company over a period of time.¹⁰ Van Gogh would cut out pieces of canvas from the rolls he received and stretch these onto frames to make his own picture supports. Primary cusping present along the bottom edge of the Chicago painting indicates a piece cut close to the warp selvage of a roll, whereas the absence of primary cusp distortions around the edges of the other *Bedroom* canvases suggests that both were cut from the middle part of a roll.

Automated weave maps generated from X-radiographs of the *Bedroom* paintings chart subtle variations in thread count across the canvas supports, providing a specific 'fingerprint' for each of the pieces of linen used (Fig. 5). Using the convention that the warp thread count varies less than the weft, the warp corresponds to the vertical threads in the Paris *Bedroom* and to the horizontal ones in the other two versions. The computer searched for a matching alignment of the three *Bedroom* weave maps along warp or weft, but none was found. It seems that none of the pieces of canvas were cut adjacently from the same bolt of cloth, including those used for the two copies made soon after each other in September 1889 in Saint-Rémy. Comparative examination of samples confirmed that each canvas support was prepared with a different commercial ground and so could not have been cut from the same roll supplied by Tasset et L'Hôte. Up to now, the particular type of two-layered ground with lithopone found in the small *Bedroom* copy has only been found in Van Gogh's paintings from the Saint-Rémy period and

later, which is consistent with the known September 1889 date of this work.¹¹

Both the Amsterdam and Chicago *Bedroom* paintings were lined early on. The Chicago picture retains a somewhat amateurish, apparently French glue-paste lining, applied some time before it entered the collection of the Art Institute of Chicago in 1926.¹² The Amsterdam picture is known to have already been (wax-resin) relined in 1931 by the Dutch restorer J.C. Traas, who records the 'hopelessly bad' nature of the previous lining and that the paint layers had been terribly messed with.¹³ Since no traces of the first lining survive, we can now only speculate as to whether both the Chicago and Amsterdam paint-

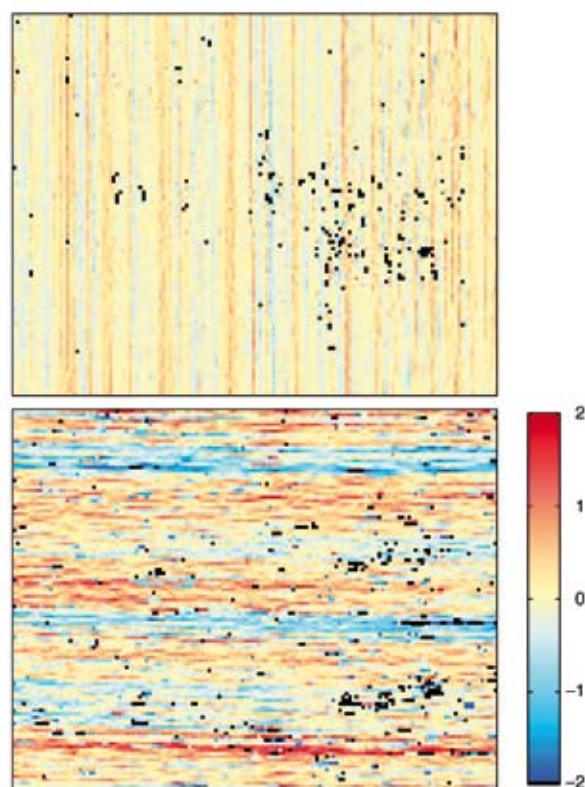


Figure 5 Automated vertical and horizontal weave maps produced from an X-radiograph of *The Bedroom*, Musée d'Orsay, Paris. The deviation from average thread count values is given by the colour legend. The vertical thread count is more consistent and shows less colour variation, corresponding to the warp direction.

Table 2 Comparison of the ready-primed canvas supports.

Painting	Range vertical threads/cm	Average vertical threads/cm	Range horizontal threads/cm	Average horizontal threads/cm	Warp	Primary cusping	Ground layer(s)
Amsterdam F 482	12.6–19.8	16.3	9.9–13.5	11.7	horizontal	none	One layer: lead white, calcium carbonate, a little mineral barium sulphate, probably a little zinc white and very few orange ochre and blue particles.
Paris F 483	10.4–12.5	11.4	14.5–19.3	17.0	vertical	none	Layer 1: lead white, a little calcium carbonate, lithopone and very little silicon dioxide. Layer 2: same as 1 but with a little more lead white. Very few yellow and blue particles.
Chicago F 484	12.7–22.4	17.7	10.3–12.6	11.4	horizontal	bottom edge	One layer: lead white, calcium carbonate, probably a little zinc white and a few iron oxide yellow and carbon black particles.

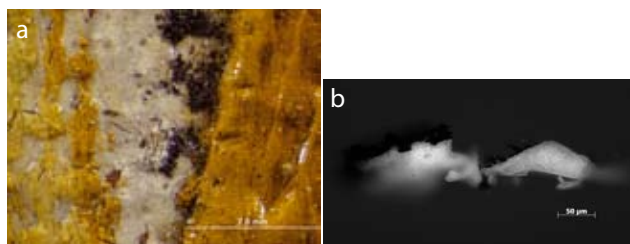


Figure 6 (a) Photomicrograph of underdrawing visible in *The Bedroom*, the Art Institute of Chicago; (b) paint cross-section showing the angular, dark particles of underdrawing material on the ground. Photographed in oil immersion conditions, darkfield illumination at 200× magnification.

ings were treated by the same French liner after they were sent to Theo in December 1889, following up on Vincent's recommendations in the letters (see especially letters 776 and 800). The Paris *Bedroom* picture was lined for the first time, with glue-paste, in 1958.¹⁴

Preliminary sketch

Comparative examination reveals that each of the *Bedroom* scenes was sketched onto the surface of the primed canvas using different materials. Dark particles are evident in the Chicago painting, resembling a dry and easily dispersed medium, such as charcoal, that has been readily picked up by brushstrokes applied on top (Figs 6a and b).¹⁵ For the other two *Bedroom* paintings, Van Gogh seems to have sketched in the compositions directly with painted lines. Light orange to orange-brown lines that appear rich in medium outline the main shapes of the bed, table and chairs in the small Paris copy. X-ray fluorescence (XRF) analysis identified iron as the main element present in the brownish paint, indicating an earth pigment. More varied colours were used for the painted sketch in the Amsterdam version. Sample analysis showed that the striking vivid red outlines of the table and left chair consist of the relatively stable variety of cochineal lake on an aluminium- and calcium-containing substrate.¹⁶ Though these lines have preserved their colour well, they have been prone to fine flaking losses and, hence, have been extensively retouched.

In all three versions, the initial sketch provided a rather precise guide for filling in subsequent areas of colour. The composition of the Amsterdam *Bedroom* seems somewhat less carefully planned though, providing the only observed example of a *pentimento* where the front legs of the bed were shortened with respect to the initial outline sketch on the ground. Another difference occurs in the planning of features depicted in front of the wall: the paintings, prints, mirror, coats and still life on the dressing table. In the Amsterdam painting, all these elements were simply added on top of the finished wall, whereas in the two copies the equivalent shapes were held in reserve; either in the first or in the second paint layer of the wall. Again, the more improvised, additive approach of the Amsterdam *Bedroom* seems to fit with its identity as the first study.

Colour schemes

To gain an idea of the range of pigments used, each of the *Bedroom* paintings was examined *in situ* using portable XRF, supplemented by X-ray diffraction (XRD) for the Paris and Amsterdam pictures, and micro-Raman spectroscopy (MRS) for the Paris version alone.¹⁷ These results were combined with those obtained by the investigation of paint samples using optical microscopy (OM), scanning electron microscopy–energy dispersive X-ray spectroscopy (SEM–EDX) and high performance liquid chromatography (HPLC).¹⁸ Here, limiting our comparison to the main features described by Van Gogh in his first *Bedroom* study (letters 705 and 706), it emerged that Van Gogh used a similar palette to depict corresponding elements across the series. For example, bright emerald green was used to render the 'green' windows in all three paintings. This was alternated with the use of chromium oxide green found in the windows of the Paris and Chicago *Bedroom* studies, confirmed to be viridian (rather than the anhydrous and opaque variety of chromium oxide green) by OM examination of a sample from the latter painting. Standing in vivid complementary contrast to the green windows are the 'orange' dressing tables painted with red lead as the main pigment, and the 'blood red' or 'scarlet red' bedspreads containing vermilion. Chrome yellow was indeed used for the 'chrome yellow' or 'fresh butter yellow' bed and chairs, and OM of samples from the Chicago painting revealed that two different shades of the pigment had been employed, including a lemon-yellow variety. For the 'very pale lemon green' or 'very bright lemon green' pillows and sheet, Van Gogh added zinc white to lighten the chrome yellow, and a little emerald green or cobalt blue to provide a greenish tint. It seems that dark Prussian blue was used in the 'black' mirror frame, analysed by XRF in the Paris and Chicago paintings. All of the above-mentioned pigments, as well as French ultramarine, were identified in other spots on the paintings too.

Though Van Gogh described the colours of the walls and doors in his first study as 'violet' or 'lilac', it is striking that these are now light blue in all three *Bedroom* paintings, leading us to suspect that colour change has occurred. X-ray fluorescence analysis identified a mixture of cobalt blue and zinc white in these areas, which have been prone to cracking and paint loss, especially in the Chicago painting where this damage was already recorded when it entered the Art Institute collection in 1926.¹⁹ A paint cross-section from the right door of the Chicago *Bedroom* shows the presence of dark red lake particles on an aluminium-containing substrate, presumably the more stable type of cochineal lake that was also identified in the preliminary sketch of the Amsterdam *Bedroom* painting, as mentioned above (Figs 7a and b). No HPLC analysis has been performed, so we cannot rule out the use of another less stable red lake pigment that has vanished from the paint mixture, causing the suspected shift from violet to blue. There is physical evidence for such colour change at one spot on the Amsterdam *Bedroom*, since a light blue brushstroke delineating the underside of the door preserves a bright lilac colour where it ends at the right edge of the picture, covered by the frame.

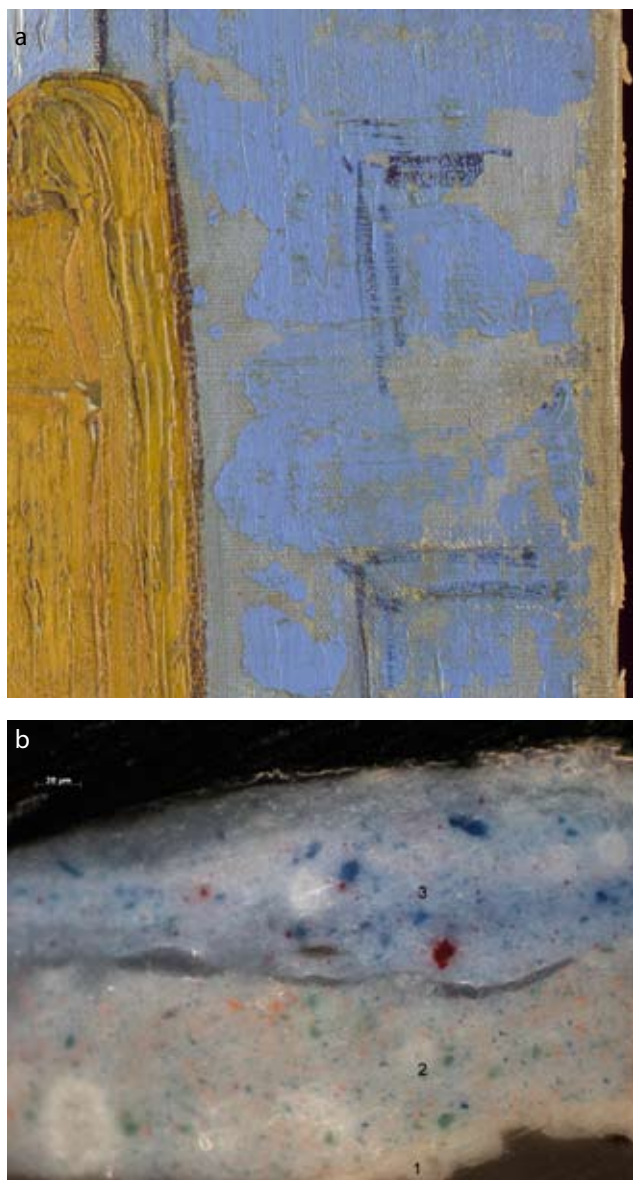


Figure 7 (a) Detail showing an area where a light blue layer has flaked off a pinkish-grey underlayer in the right door of *The Bedroom*, the Art Institute of Chicago; (b) paint cross-section from the same area showing the interlayer cleavage, photographed at 500× magnification. Layer 1: ground; Layer 2: pinkish-grey paint containing zinc white, ultramarine blue, vermilion, emerald green and iron oxide; Layer 3: light blue paint containing cobalt blue, zinc white, some lead white and a red pigment, probably cochineal lake on an aluminium- and calcium-containing substrate.

Examination of the Amsterdam *Bedroom* also provides visual evidence for colour change in the ‘red’ tiled or ‘broken and faded red’ floor, due to faded red lake. A strip along the bottom edge of the floor, which has been covered by tape since the painting was lined in 1931, preserves a peachier colour compared to the purplish tone of adjacent paint that has been exposed to light. The preserved strip of colour is still quite close to that of retouches in the floor dating from the 1931 treatment. The paint layer of the floor has a general pink tinge when viewed in sample cross-sections, though no red lake pigment is visible. However, HPLC analysis of a sample revealed the presence of geranium (eosine) lake in the paint mixture, together with cochineal lake (*Dactylopius coccus* Costa) and a trace

of indigo (*Indigofera tinctoria* L.). The observed colour change is attributed to fading of the highly fugitive geranium lake in particular. Some record of the former, brighter pink colour of the floor is given by Isaac Israël’s painting of *Two Women in the Studio*, dated to around 1920, in which the artist portrayed the *Bedroom* study hanging on the rear wall of his studio.²⁰

Colour change was also suspected to have taken place in the floor of the Chicago painting, due to the present, strangely disjunctive colour relationship between the pink layer of the floor and the emerald green shading added later on top. Again, HPLC of a sample confirmed geranium lake to be present in the paint mixture, which is likely to have faded. Possibly the colours of the floor in the Paris *Bedroom* have also changed, but examination of the picture surface did not provide any definite proof for this and no samples have been taken for analysis. However, XRF detected small amounts of bromine, indicative of geranium lake, in other spots on the painting, such as the outlines of the bed. The geranium lake was found alone or mixed with a red lake on a tin-containing substrate that visually resembles degraded cochineal. In both the Paris and Chicago versions of the *Bedroom*, hatched shading was added as a last touch to the floor (green in the Chicago painting and dark pink in the Paris one). Even taking into account that faded red lake has probably exaggerated the contrast of colour areas, this must always have provided a bold accent. The more unified handling of the floor in the Amsterdam picture fits better with Van Gogh’s description of the first study in which ‘The shadows and cast shadows are removed; it’s coloured in flat, plain tints like Japanese prints’ (letter 705).²¹

Paint handling

Other features of paint handling in the different *Bedroom* versions also seem to corroborate the Amsterdam picture as being the first study. The looser and more varied brushwork, coarsely textured in places (as in the lit side of the bed frame, in the blanket, and where thick underlying strokes of zinc white were applied in the left coat and in the floor), seems to fit better with the ‘simpler and more virile’ execution of the first study (letter 707), which Van Gogh further described as being done in ‘flat tints, but coarsely brushed in full impasto’ (letter 706), with ‘no stippling, no hatching, nothing; the tints flat, but in harmony’ (letter 707). The Chicago and Paris paintings on the other hand, are similar in their more structured, hatched application of narrower brushstrokes, vividly illustrated by a raking light photograph of the smaller copy (Fig. 8). The more deliberate patterning of marks in the Chicago and Paris versions, as opposed to the improvised character of a live study, is a stylistic feature seen more often in copies or repetitions by the artist. At the same time, it reflects the stylistic development that had taken place in Van Gogh’s works in the interim period, away from the broader application of colour areas influenced by the ideas of Paul Gauguin and Emile Bernard, towards the more graphic touch that returns in his Saint-Rémy paintings.



Figure 8 *The Bedroom*, Musée d'Orsay, Paris. Raking light photograph revealing the ordered patterning of narrow brush marks. © C2RMF, E. Lambert.

Conclusions

Comparative technical examination of the three *Bedroom* paintings has shown that a similar palette was used across the series and revealed colour changes that undermine Van Gogh's balanced complementary colour scheme, which, he explained, was intended to convey a feeling of 'utter repose' (letter 706). Differences in paint handling and the style of brushwork support the notion that the Amsterdam picture is the first study made in Arles, and the Chicago version the later copy. Furthermore, aspects of the condition of the Amsterdam picture can perhaps be related to the episode of water damage that took place in Vincent's Arles studio including flaking losses of paint and ground down to the level of the canvas, and transferred newsprint (absent in the Chicago picture), possibly from the 'newspapers' that Van Gogh recorded as having been stuck onto the flaking surface of his *Bedroom* study (letter 765). Finally, it is noted that the Chicago and Paris pictures bear a stronger resemblance to each other than to the Amsterdam study, which one might expect for two paintings made as copies soon after each other.

Acknowledgements

We are grateful to the curators, Laurence Madeline and Anne Roquebert at Musée d'Orsay and Douglas Druick and Gloria Groom at the Art Institute of Chicago, for allowing us to examine the *Bedroom* paintings, and to Frank Zuccari, Grainger Executive Director of Conservation, who kindly facilitated examination of the Chicago picture. The Van Gogh Museum acknowledges the support of Shell Global Solutions, Partner in Science. High resolution multispectral images of the Amsterdam and Chicago *Bedroom* pictures were generously provided by Lumiere Technology. Infrared multispectral analysis of the Paris *Bedroom* was kindly performed by Claudia Daffara from the Art Diagnostic Group, Florence, and a 3D scan of the painting image was created by the Breuckmann Group. In addition, we thank the following colleagues for their contributions to this research: Roy Berns, Francesca Casadio, Jacques Castaing,

Jean-Jacques Ezrati, Gwénaëlle Gautier, Morwena Joly, Elsa Lambert, Eric Laval, Kees Mensch, Kim Muir, Han Neevel, Travers Newton, Sandrine Pagès-Camagna, Ruven Pillay, Marcia Steele and Frans Stive.

Notes and references

1. The numbers of the letters given in this article correspond to those of the newly published website edition of *Vincent van Gogh, The letters*; see Jansen, L., Luijten, H., and Bakker, N. (eds), *Vincent van Gogh, The letters*, www.vangoghletters.org (accessed June 2010).
2. The F numbers refer to the catalogue numbers in De la Faille, J.-B., *The Works of Vincent van Gogh: His Paintings and Drawings*, 2nd edn, Meulenhoff International, Amsterdam (1970). The JH numbers refer to Hulsker, J., *The Complete van Gogh: Paintings, Drawings, Sketches*, J.M. Meulenhoff and John Benjamins, Amsterdam and New York (1980).
3. Brettell, R.R., 'Van Gogh's *Bedrooms* at Arles: the problem of priority', *Museum Studies* **12**(2) (1986) 137–151.
4. Hulsker, J., 'Bedroom problems', *Simolius: Netherlands Quarterly for the History of Art* **18**(4) (1988) 257–261. Hulsker points out that the identity of the different portraits painted on the walls in successive versions of the *Bedroom* painting provides evidence for dating.
5. See for example; Zimmer, N., 'Saint-Rémy: from triptych to polyptych', in *Vincent van Gogh – Between Earth and Heaven: The Landscapes*, Kunstmuseum Basel (2009) 110. Here it is suggested that the Chicago painting should be dated to September 1889, yet this contradicts the claim that the same painting is identified as the first version that was water-damaged in his Arles studio.
6. Like other painters of his day, Van Gogh was able to buy ready-made artist canvases stretched on frames in a fixed range of standard formats. See on this topic; Bomford, D., Kirby, J., Leighton, J. and Roy, A., *Art in the Making: Impressionism*, National Gallery, London (1990) 44–50. A standard Figure 30 size corresponded to 92.0 × 73.0 cm.
7. Brettell 1986 (cited in note 3) 147, argues that Van Gogh expressly omitted the outer portion of the left door jamb and shifted the position of the chair to close off the doorway leading to the guest room where Gauguin had stayed, heightening the psychological emptiness of the *Bedroom* experienced by Vincent after Gauguin's departure.
8. A slightly extended range of standard formats was advertised by companies such as Lefranc and Cie, which included both vertical (*haute*) and horizontal (*basse*) landscape and marine canvases for size numbers 5–30. See Callen, A., *The Art of Impressionism: Painting Technique and the Making of Modernity*, Yale University Press, New Haven and London (2000) 15. The dimensions of the Paris *Bedroom* copy closely correspond to the vertical landscape 20 format (56.7 × 73.0 cm) included within this range.
9. For publications on the new automated tools developed for thread counting, see: Johnson, C.R. Jr, Hendriks, E., Noble, P. and Franken, M., 'Advances in computer-assisted canvas examination: thread counting algorithms', in *37th Annual Meeting of the American Institute for Conservation of Historic and Artistic Works, Paintings Specialty Group*, Los Angeles, CA (May 2009) forthcoming. Also, Johnson, D.H., Johnson, C.R. Jr, Klein, A.G., Sethares, W.A., Lee, H. and Hendriks, E., 'A thread counting algorithm for art forensics', in *Proceedings of the 13th IEEE DSP Workshop*, Marco Island, FL (January 2009) 679–684.
10. Ravaut, É., 'The use of X-radiography to study paintings by Cézanne and Van Gogh in the Gachet Collection', in *Cézanne to Van Gogh: The Collection of Doctor Gachet*, The Metropolitan Museum of Art, New York (1999) 68–69. Hendriks, E. and Van Tilborgh, L., 'Van Gogh's *Garden of the Asylum*: genuine or fake?', *Burlington Magazine* **CXLIII**(1176) (March 2001) 151.
11. Ongoing investigation of ground samples from Van Gogh's paintings in the collection of the Van Gogh Museum undertaken

- at the Netherlands Institute for Cultural Heritage (ICN), has so far revealed the same type of ground present in the following Saint-Rémy and Auvers period works: F 607, F 651, F 659, F 779 and F 816.
12. Conservation and curatorial files, accession no. 1926.417, the Art Institute of Chicago. The French origin of the lining is suggested by the marks of a *pince dentelée* used to stretch the lined canvas onto its early commercial stretcher, which is stamped size 30 and bears the brand mark of the company Bourgeois Aîné.
 13. Invoice from J.C. Traas, December 1931–January 1932, Number 1, The Bedroom. Document b 4200, Vincent van Gogh Foundation archives.
 14. Centre de recherche et de restauration des musées de France (C2RMF), Versailles archives, file F5702, includes a photographic and written account of the lining and restoration performed from 21 April to 28 May 1958.
 15. Light microscopy showed that the particles of underdrawing material are semi-opaque to opaque, brown to dark brown in colour and very angular, which is consistent with reference samples of charcoal black examined for comparison. However, Fourier transform infrared spectroscopy could not unambiguously determine whether the material is charcoal black or Vandyke brown due to the similar spectral signature that these provide. This may be explained by the presence of lignite or incompletely burned wood components in the charcoal sticks. For a comparison of spectra see: Feller, R.L. and Johnson-Feller, R.M., 'Vandyke brown, Cassel earth, Cologne earth', in *Artists' Pigments: A Handbook of Their History and Characteristics*, Vol. 3, ed. E.W. FitzHugh, National Gallery of Art, Washington, DC (1997) 80.
 16. The red lake was identified using OM, SEM–EDX and HPLC. For a description of these techniques, see the appendix in: van Bommel, M., Geldof, M. and Hendriks, E., 'An investigation of organic red pigments used in paintings by Vincent van Gogh (November 1885 to February 1888)', in *Art Matters: Netherlands Technical Studies in Art* 3 (2005) 135.
 17. Results of all the analyses performed on the Musée d'Orsay *Bedroom* are held in the C2RMF Carrousel archives, file F5702. For the XRF analysis an X-ray tube with a molybdenum anode was employed. For a description of the portable XRF–XRD apparatus used to examine the Amsterdam and Paris pictures, see: Gianoncelli, A., Castaing, J., Ortega, L., Doorhyée, E., Salomon, J., Walter, P. and Hodeau, J.-L., 'A portable instrument for *in situ* determination of the chemical and phase composition of cultural heritage objects', *X-Ray Spectrometry* 37 (2008) 418–423. XRF analysis of the Amsterdam *Bedroom* was performed with a Bruker Tracer III–V apparatus with a spot size of 5 mm, under vacuum with a tube voltage of 40 kV and current of 2.2 μ A. At the Art Institute of Chicago, XRF was performed using a Röntec ArtTAX system equipped with a molybdenum target X-ray tube.
 18. In total, 31 samples are available from the Chicago *Bedroom* painting, collected in the period 1974 to 2009. This includes 25 prepared as microscopic slides for polarised light microscopy (PLM), two samples used for HPLC to identify the discoloured red lake pigment used in the floor, a sample of underdrawing material analysed with FTIR, and the remainder prepared as paint cross-sections and investigated with OM and SEM–EDX. Nine paint samples are available from the Amsterdam *Bedroom* painting, including three used for HPLC to determine the red lake pigments used, and six prepared as paint cross-sections and examined with OM and SEM–EDX. One sample of ground was examined from the Musée d'Orsay *Bedroom* using OM, SEM–EDX and micro-XRD.
 19. See the report referred to in note 10.
 20. The painting, in the collection of the Gemeentemuseum in The Hague, is reproduced in the exhibition catalogue: Sillevius, J., Dekkers D. and Vlieger-Moll, W. de, *Jozefen Isaac Israëls; vader en zoon*, Waanders/Gemeentemuseum (2008) 37.
 21. At an earlier stage of execution, Van Gogh laid in areas of light green shadow and zinc white highlights, but these were largely covered up by the pink layer added on top, evening out the colour scheme of the floor.

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