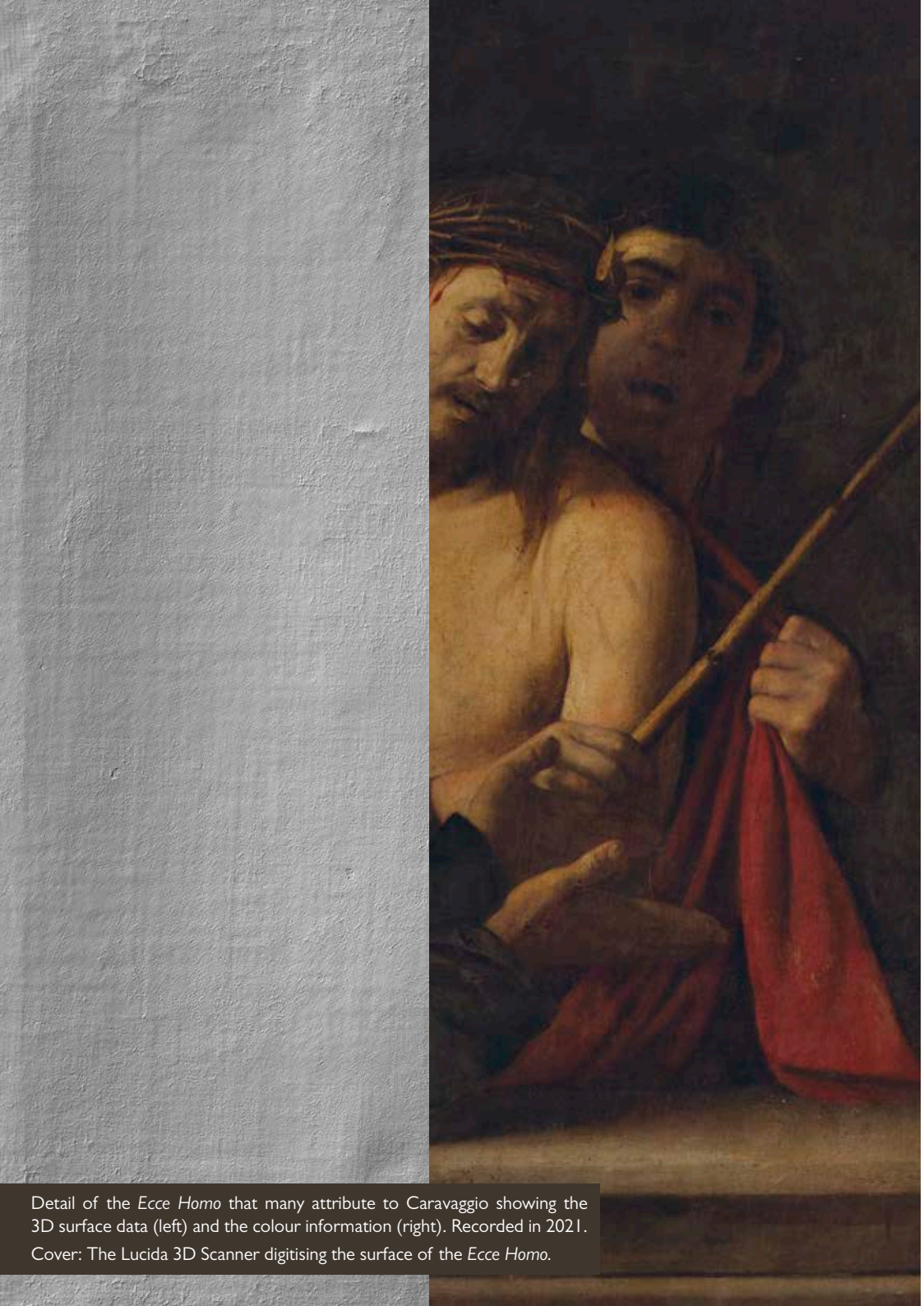
COLNAGHI & FACTVM

COLNAGHI & FACTVM

COLNAGHI & FACTVM

DIGITAL CONNOISSEURSHIP

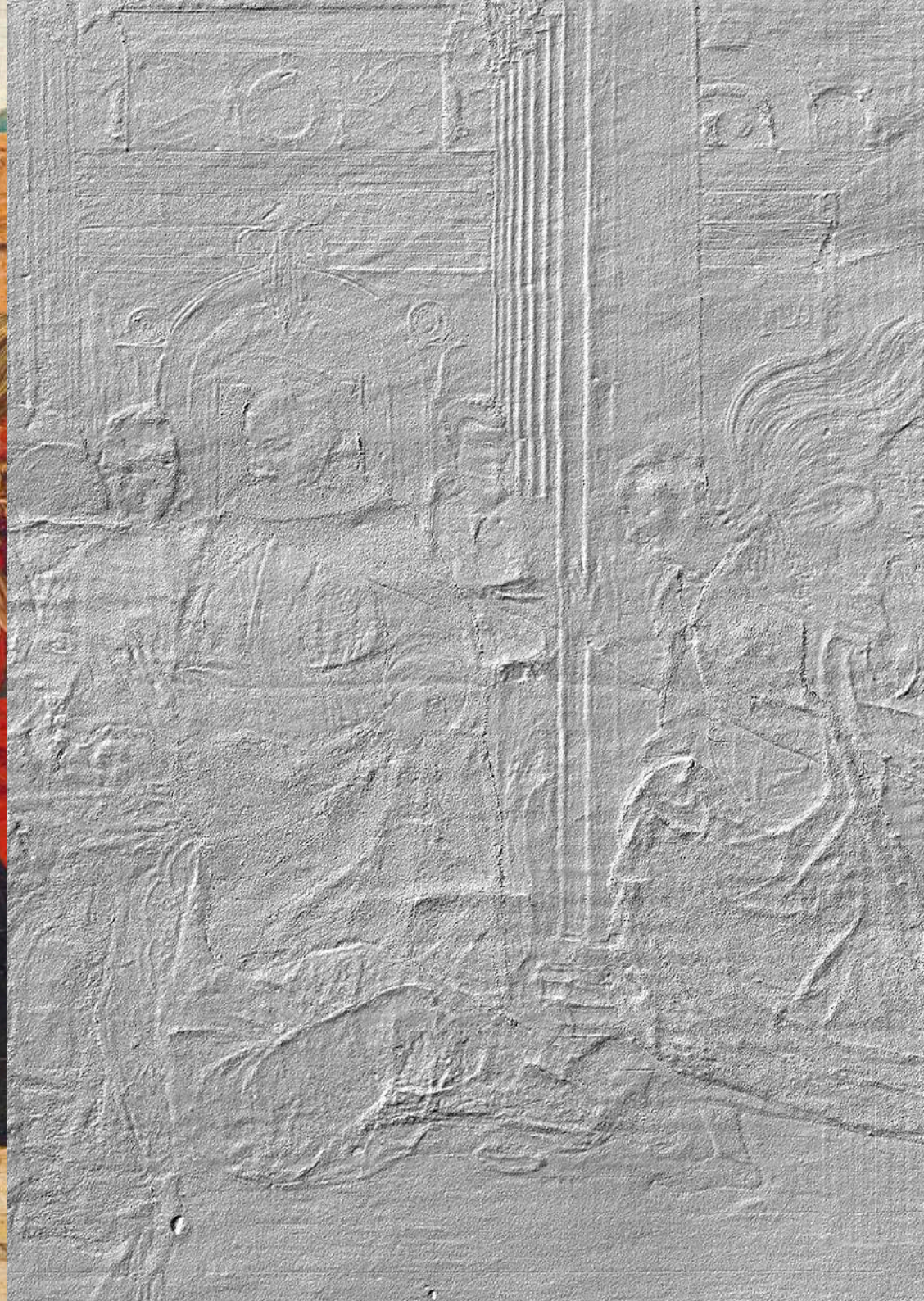


Detail of the *Ecce Homo* that many attribute to Caravaggio showing the 3D surface data (left) and the colour information (right). Recorded in 2021.
Cover: The Lucida 3D Scanner digitising the surface of the *Ecce Homo.*

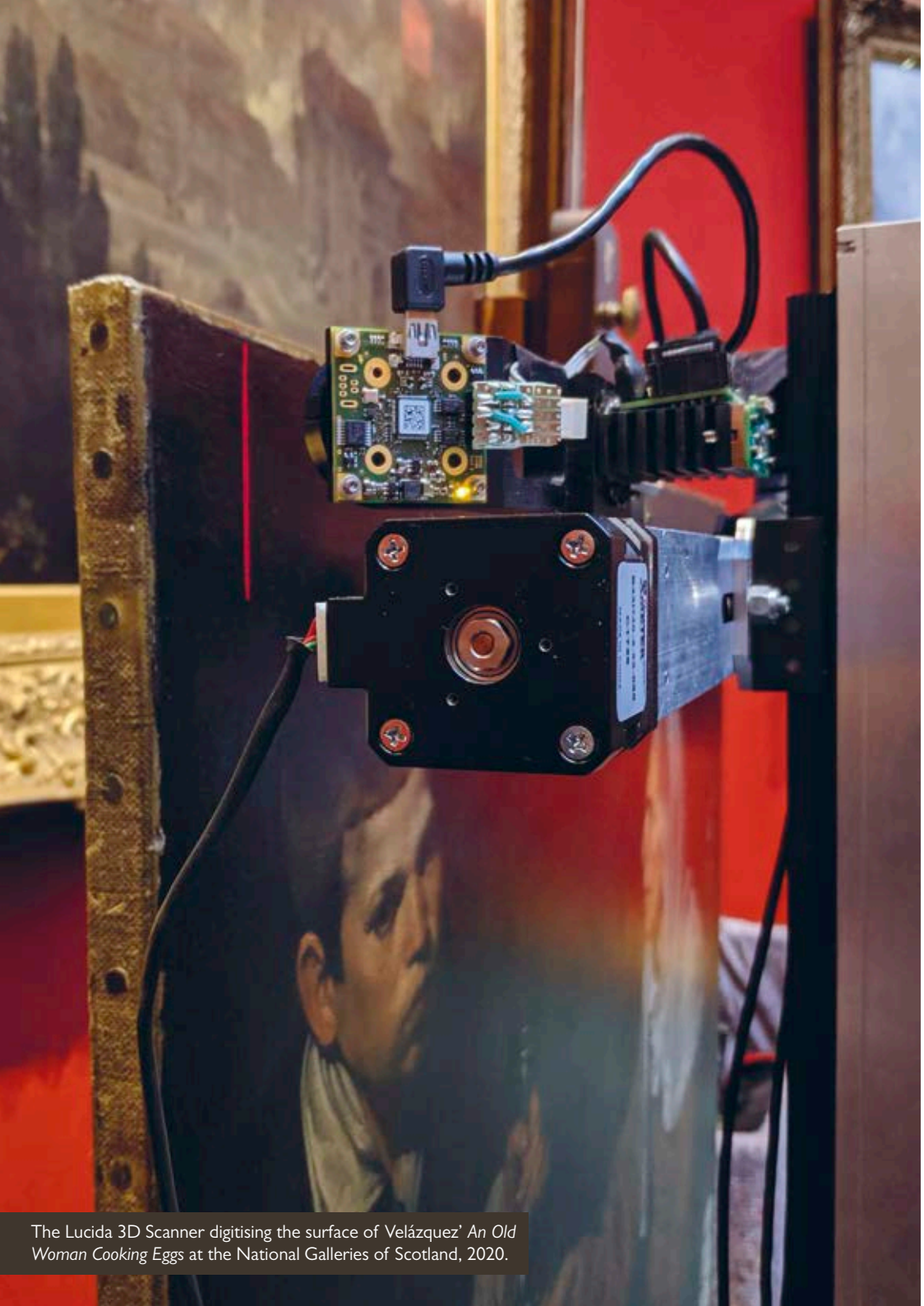
The launch of **COLNAGHI** & FACTVM will make 3D scanning of the surface of paintings easy, accessible and the new norm. The studio in London's St James's will focus on high-resolution surface recording and composite colour photography. This approach has already resulted in a groundswell of interest and a significant change in attitude to both the value and the preservation of works of art.

The services that are offered are aimed at the custodians of paintings (museums, collectors, dealers, owners, and those fortunate enough to look after works of art), who wish to create a digital passport of their artworks.

COLNAGHI & FACTVM



Detail of the *Polittico Griffoni* predella by Ercole de' Roberti showing the colour information (left) and the 3D surface data (right). Recorded at the Pinacoteca Vaticana in 2013.



The Lucida 3D Scanner digitising the surface of Velázquez' *An Old Woman Cooking Eggs* at the National Galleries of Scotland, 2020.

ENLIGHTEN - ENGAGE - ANALYSE - PRESERVE AND SHARE

"... the most radical achievement of Factum [...] is the way its creations can dissolve museum walls and reconnect their treasures not just with new audiences but with the raw, real world they came from."

Jonathan Jones, The Guardian, November 2020

For the last 40 years, as visitor numbers have risen, museums and collections have focused on ticketing and merchandising, as opposed to the potential of an online presence as a communication, research, archival and conservation tool. In the emerging digital domain, new audiences are given more access than ever before to information. Objects are rapidly becoming complex subjects revealing the subtleties and stories not normally visible just through photographic reproductions.

COLNAGHI & FACTVM is a new partnership which celebrates the materiality of works of art, in an increasingly immaterial world. Their first studio in London's St James's will be devoted to the 3D recording of the surface of paintings, offering a new dimension to scholarship and connoisseurship.

Recording the colour of Anton Van Dyck's *Philip Herbert, 4th Earl of Pembroke, with his Family* to produce a photographic record with a resolution of 460 dpi at 1:1 scale to accompany the 3D scan of the surface. Resulting colour file size is 90 Gb.

Detail of *Christ's Charge to Peter* (tapestry cartoon), Raphael, 1515-1516, 344 x 534 cm.
Layers of data (from left to right): colour from Victoria & Albert Museum with punching marks; 3D relief with punching marks; 3D relief; colour from Musee Conde in Chantilly with punching marks.

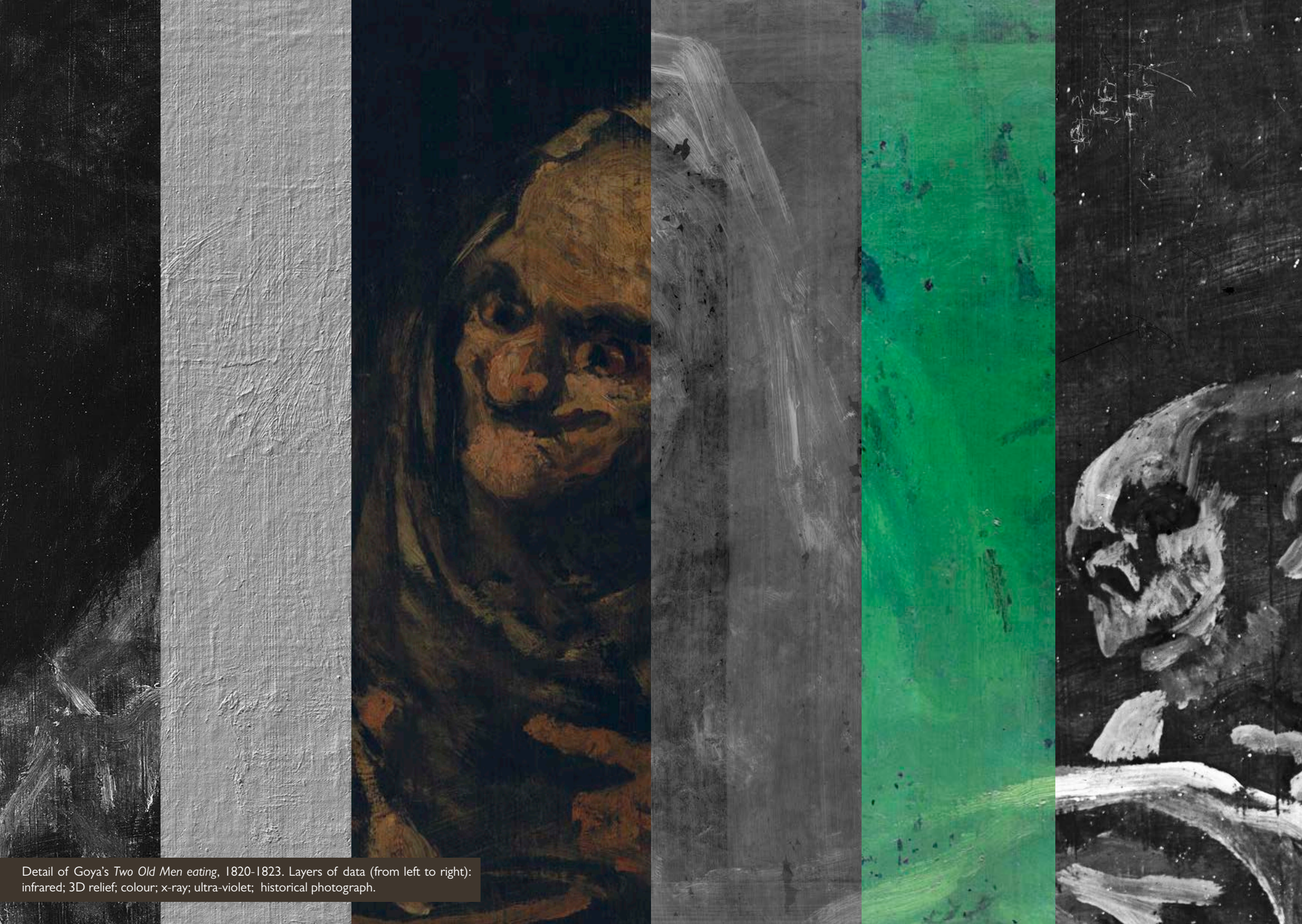
3D SCANNING PAINTINGS AND CREATING MULTI-LAYERED ARCHIVES

As computer screens have become the dominant interface through which culture is accessed, materiality and surface have been overlooked. This is beginning to change. London's National Gallery uses a Factum Lucida 3D Scanner in its conservation department to record the surface changes as pictures are cleaned and restored. The Rijksmuseum has also paid attention to 3D recording in conferences and research.

For many years, x-ray and infrared recording have revealed what is under the surface. Multi-spectral photography and Raman spectroscopy can reveal information about pigments and composite colour photography can reveal more than the eye can see. The surface recording of paintings, however, has simply been overlooked.

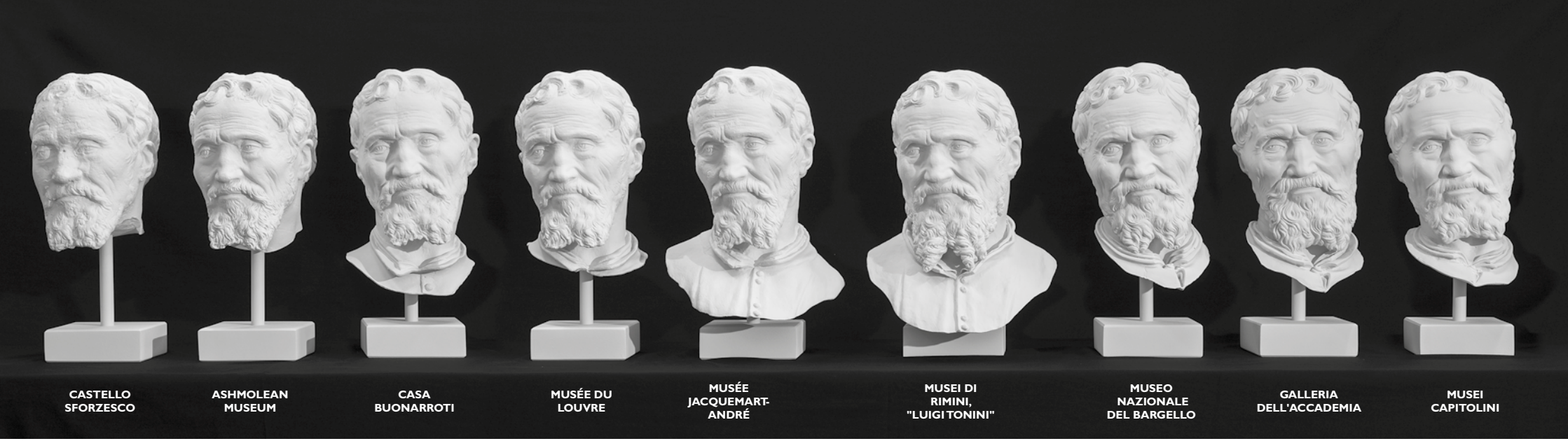
What 3D recording reveals

Brush marks and incisions, pentimenti and fingerprints, retouches, and fills, flaking paint and stretcher bars, canvas weave and relining are all visible in 3D data. Increased computing power and display technologies reveal the flatness of a lithographically printed images. As every collector of taste knows, paintings are both images and material things.

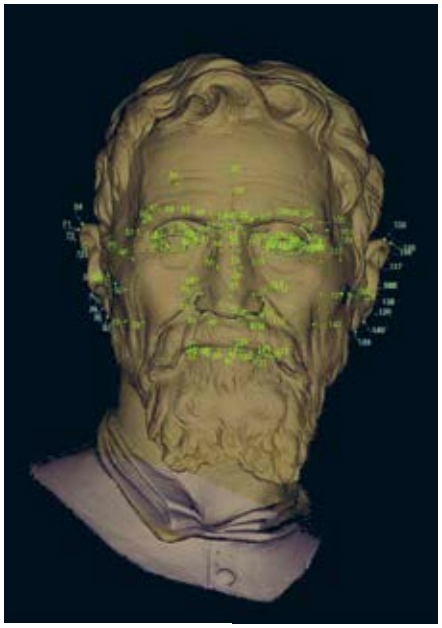


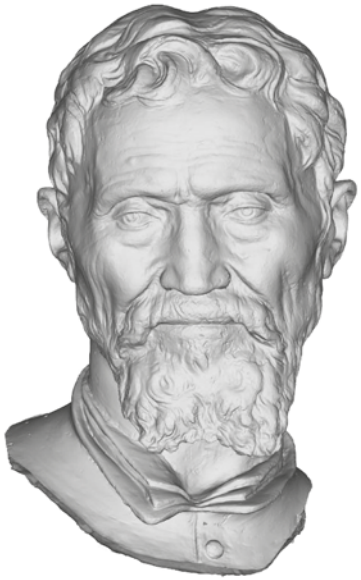
Detail of Goya's *Two Old Men eating*, 1820-1823. Layers of data (from left to right): infrared; 3D relief; colour; x-ray; ultra-violet; historical photograph.

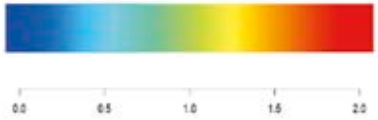
Facsimile of part of the Sarcophagus Room in the Tomb of Seti I. Factum began the high-resolution recording of the largest and most important tomb in the Valley of the Kings in 2001.



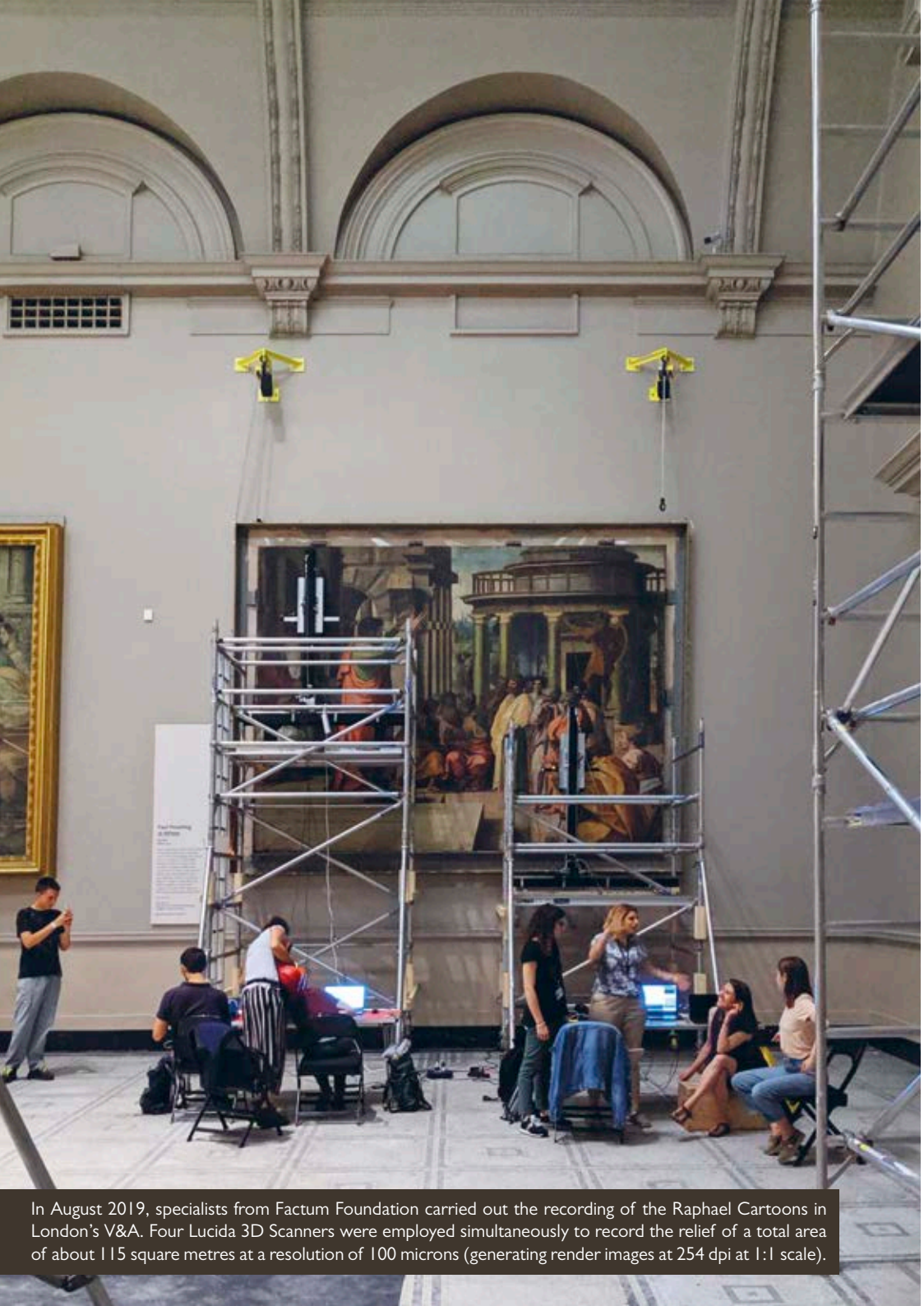
3D prints of different versions of the bust of Michelangelo by Daniele da Volterra. From left to right: Castello Sforzesco-Civiche, Milan; Ashmolean Museum, Oxford; Casa Buonarroti, Florence; Musée du Louvre, Paris; Musée Jacquemart-André, Paris; Museo della città "Luigi Tonini", Rimini; Museo Nazionale del Bargello, Florence; Galleria dell'Accademia, Florence; Musei Capitolini, Rome.







Data analysis of the bronze cast in Casa Buonarroti. Colour mask comparing Buonarroti's cast against Castello Sforzesco's bust.



In August 2019, specialists from Factum Foundation carried out the recording of the Raphael Cartoons in London's V&A. Four Lucida 3D Scanners were employed simultaneously to record the relief of a total area of about 115 square metres at a resolution of 100 microns (generating render images at 254 dpi at 1:1 scale).

3D SCANNING PAINTINGS FOR PUBLIC AND PRIVATE COLLECTIONS

A new approach to owning and sharing

The digitisation works of art can now be carried out in more automated ways. It will be the key to the new era of digital connoisseurship, where access to information about the materiality of objects is becoming the new norm. We are no longer dependent on small-scale reproductions in books to understand the real character and impact of a painting and the way it was made.

One question we are often asked is: *"If some major public collections have started to grasp the digitisation of artworks in their collection, is it possible for private collectors to follow their lead? "* The answer is: *"Yes"*.

Factum Foundation has been recording paintings in world-class museums and cultural institutions; **COLNAGHI** & FACTVM brings this service to the heart of London, making it easy for collectors to add another layer of understanding to their works of art.

The three-dimensional qualities of the surface of paintings have been neglected for too long; artists, curators, art historians, and collectors alike agree on the importance of texture to determine the unique character of a painting. The techniques the Old Masters used can be explained through surface texture, and the condition of an artwork is visible in its superficial qualities; its skin. This is the first time that the high-resolution recording of paintings, using 100% non-contact methods, is offered in London. Surface data is the next frontier in our knowledge about works of art.

The Lucida 3D Scanner digitising the surface of Velázquez' *An Old Woman Cooking Eggs* at the National Galleries of Scotland, 2020.

What changes will technology bring

Originality is a dynamic process as all things change with time. Through 3D recording of the surface, attention is focused both on original intention and the way the work of art has evolved.

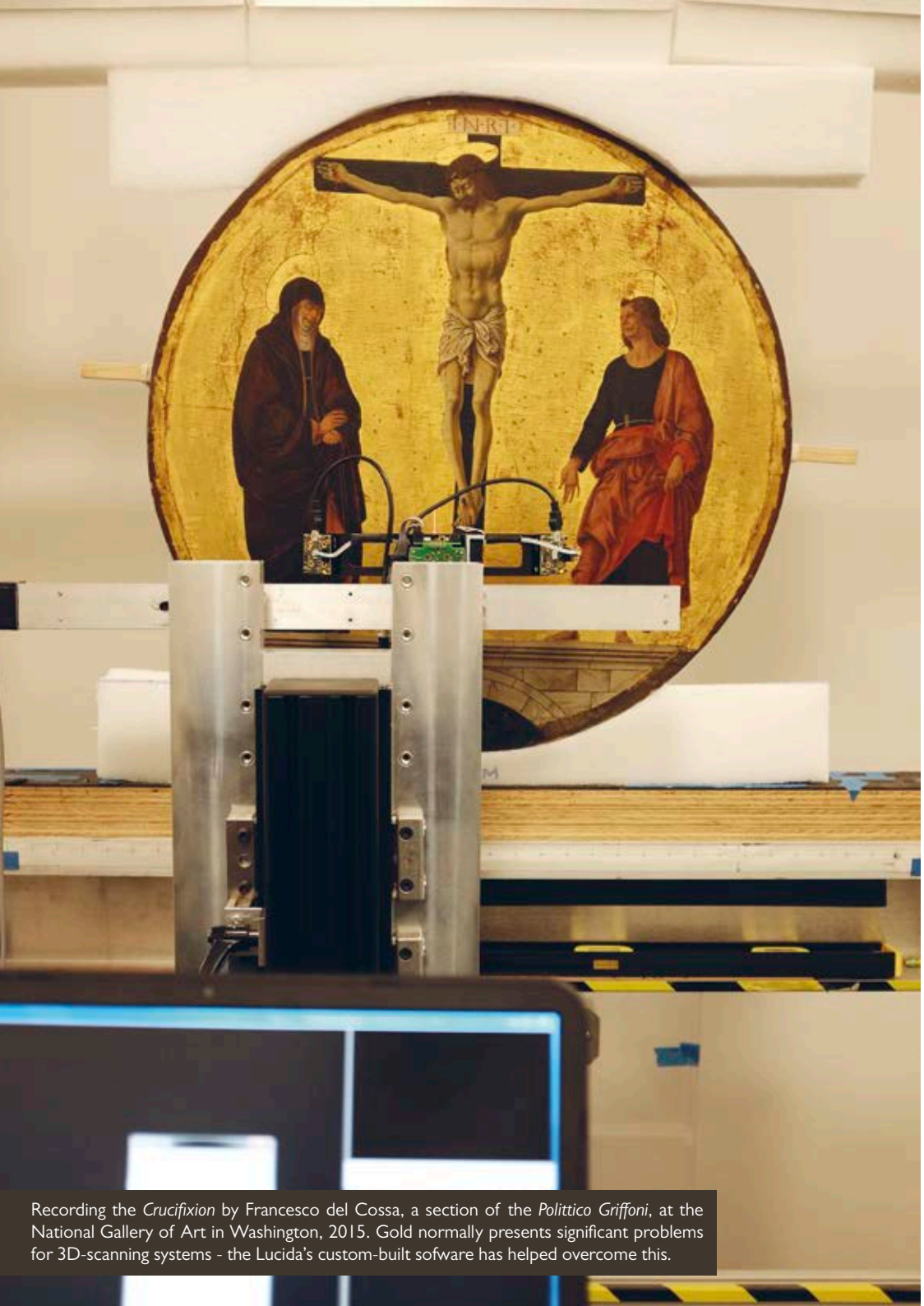
Machine Learning (ML) and Artificial Intelligence (AI) are revealing new ways of seeing and applying new metrics. This will encourage a rethinking of the relationship between owning and sharing, while also helping with our understanding of the preservation of paintings.

What would happen if Machine Learning algorithms could use 3D surface information to identify the hand of a specific artist? Would it be possible, on a painting by El Greco for example, to identify and attribute identities to the many hands at work on the same painting? Doménikos Theotokópoulos (El Greco), his son Jorge Manuel, the various studio assistants, the restorers… If they could be identified by the unique traces in the high-frequency data and revealed through machine learning would this change authentication, pinpoint errors in attribution and help clarify the original intention of the artist. Will this reveal things about the painting's production and its biography. It will realign financial value; sometimes adding value and sometimes revealing errors of understanding.

What can be done and what opportunities await?

High-resolution recording of the surface and colour is now available through the COLNAGHI & FACTVM studio in London.

This process will enable clients to safeguard their collections, create coherent digital and physical archives, share works of art, rethink loans and the movement of fragile works of art, and further knowledge about collections.



Recording the *Crucifixion* by Francesco del Cossa, a section of the *Polittico Griffoni*, at the National Gallery of Art in Washington, 2015. Gold normally presents significant problems for 3D-scanning systems - the Lucida's custom-built sofware has helped overcome this.

Since its formation in 1760, Colnaghi has been devoted to helping collectors acquire, appreciate and preserve their collections. Introducing Old Masters to new audiences and encouraging connoisseurship are of growing importance to the gallery.

Since its launch in 2009, Factum Foundation has worked with a wide range of museums worldwide to demonstrate the potential of surface scanning and perfecting the process. The Foundation has scanned major paintings by Fra Angelico, Goya, Michelangelo, Monet, Raphael, Leonardo, Titian, Rembrandt, Velázquez and many more. Factum has recorded facades, frescoes, maps, caves, sculptures and tombs. It has even recorded the whole the island of San Giorgio in Venice and the Nabataean tombs and rock-cut inscriptions at Hegra in Saudi Arabia.

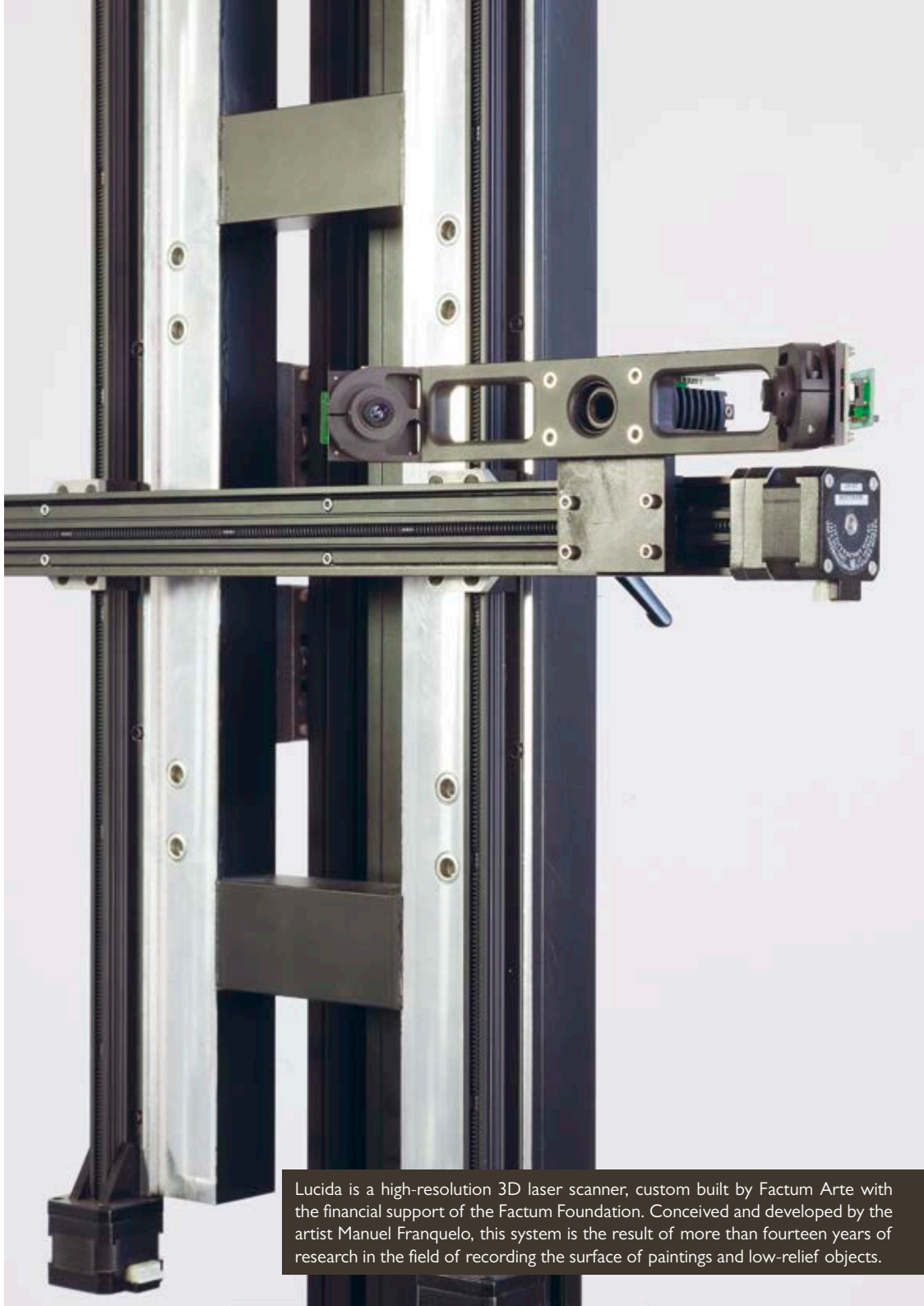
The launch of **COLNAGHI** & FACTVM makes the 3D scanning of a painting's surface more accessible. We hope this will result in a change in attitude to both the value and preservation of works of art.

Technology, provided again by Factum Arte, enables the juxtaposition of a facsimile of Raphael's cartoon of the Sacrifice at Lystra (around 1515-16) with the respective Vatican tapestry. The educational impact for the general public is indisputable; now scholars have to face the challenge of inserting these new tools into their research and exploiting their potential, before they are once more outwitted by commercial applications. The exhibition implicitly urges collaborations beyond the borders of museums and disciplines.

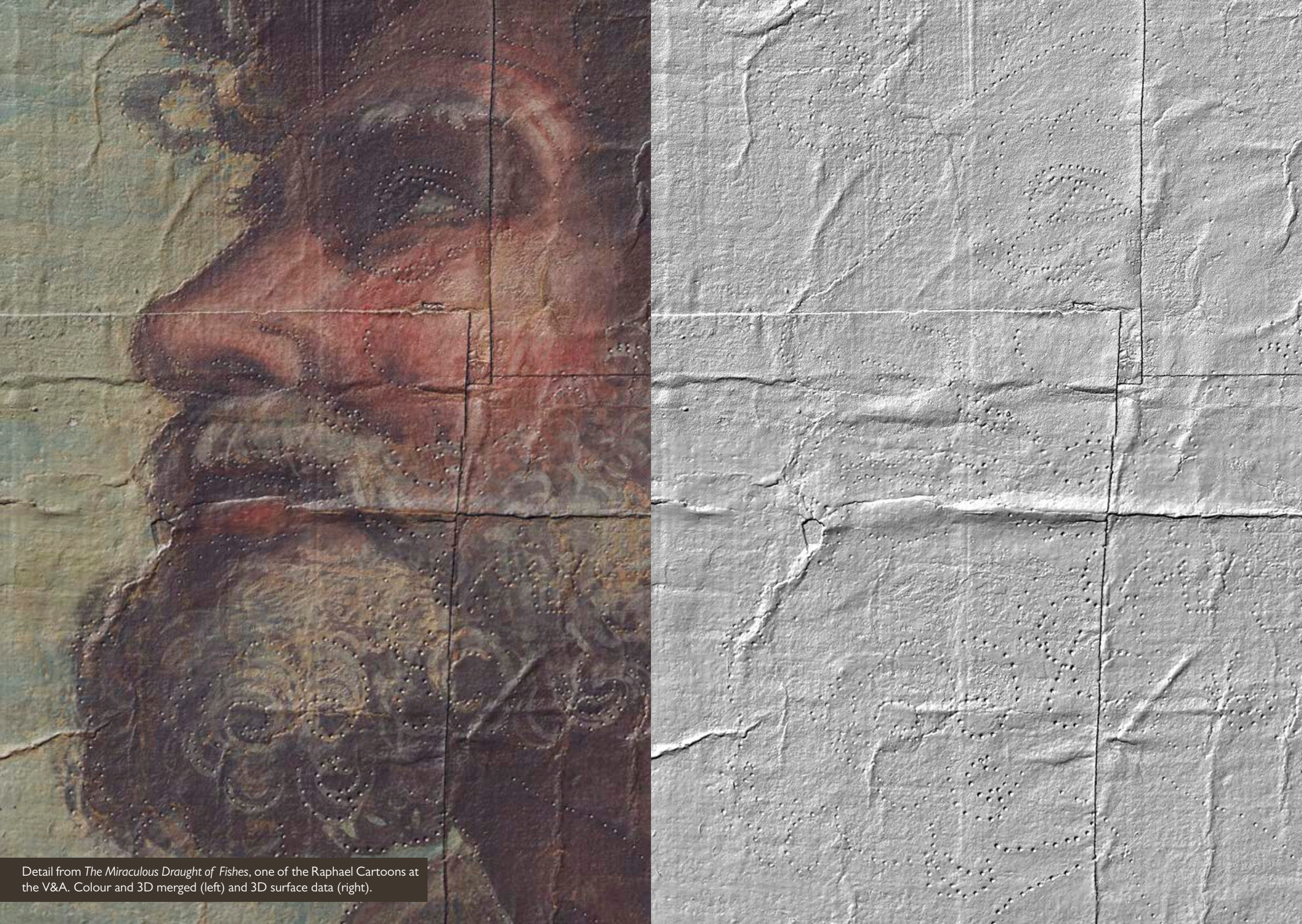
Arnold Nesselrath, *The Big Review*, The Art Newspaper, August 2020

WHY RECORD THE SURFACE OF PAINTINGS AND SCULPTURES?

- 3D scanning with the Lucida is dimensionally accurate establishing a true size onto which other layers of information can be mapped. The ability to change scale and exaggerate the surface texture is important for study and forensic analysis.
- It can provide a physical sense of the artwork for experts to study and the wider public to enjoy.
- There is a thin line between restoration and alteration. 3D scanning and high-resolution composite photography have opened the doors for digital restoration – trying things out in a virtual space before touching the original.
- It can help recontextualise and exhibit works of art. The exhibition 'Raffaello (1520-1483)' at the Scuderie del Quirinale in Rome in 2020 contained a recreation of Raphael's tomb (the recreation is now on permanent display in Urbino) and an exact facsimile of the cartoon of the *Sacrifice at Lystra* hanging next to the tapestry made from it.
- The ability to have both an online (digital) and an offline physical presence (an exact facsimile) is having an impact on exhibitions and loans. It is helping to understand altarpieces that have been broken up, paintings that have been cut into sections, frescoes and low relief carvings that have been removed from their context and collections that have been dispersed.
- High-frequency data (the small details rather than the undulations of the canvas) reveals the hand of specific artists. Initial tests are ongoing with Case Western Reserve University in Cleveland using various types of 3D data. The first results have been published in peer-reviewed journals and Nature. The potential is clear and the results of machine learning are encouraging.



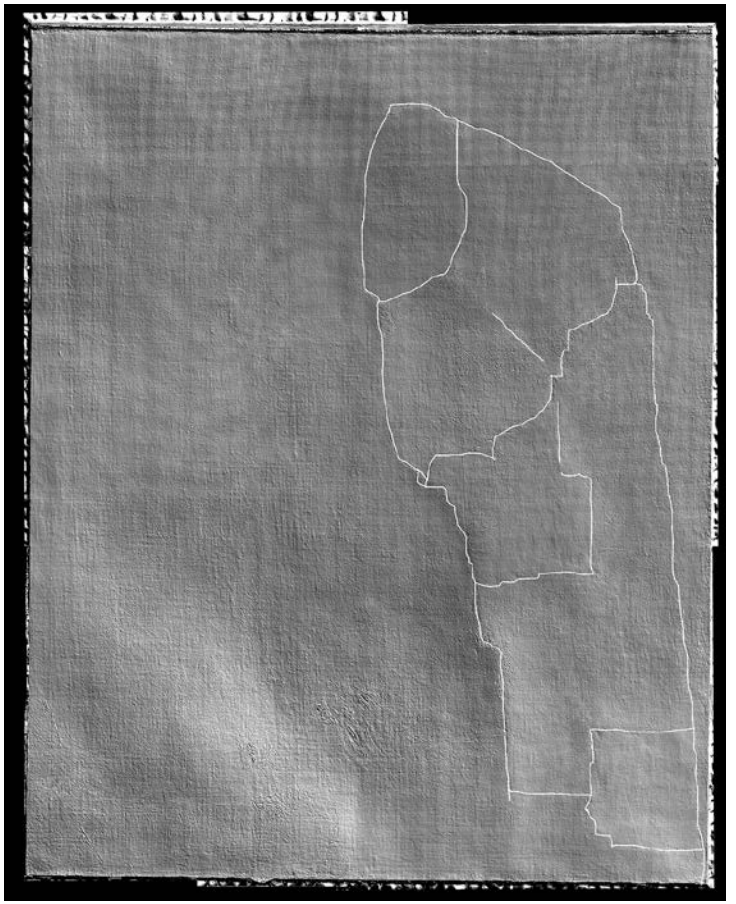
Lucida is a high-resolution 3D laser scanner, custom built by Factum Arte with the financial support of the Factum Foundation. Conceived and developed by the artist Manuel Franquelo, this system is the result of more than fourteen years of research in the field of recording the surface of paintings and low-relief objects.



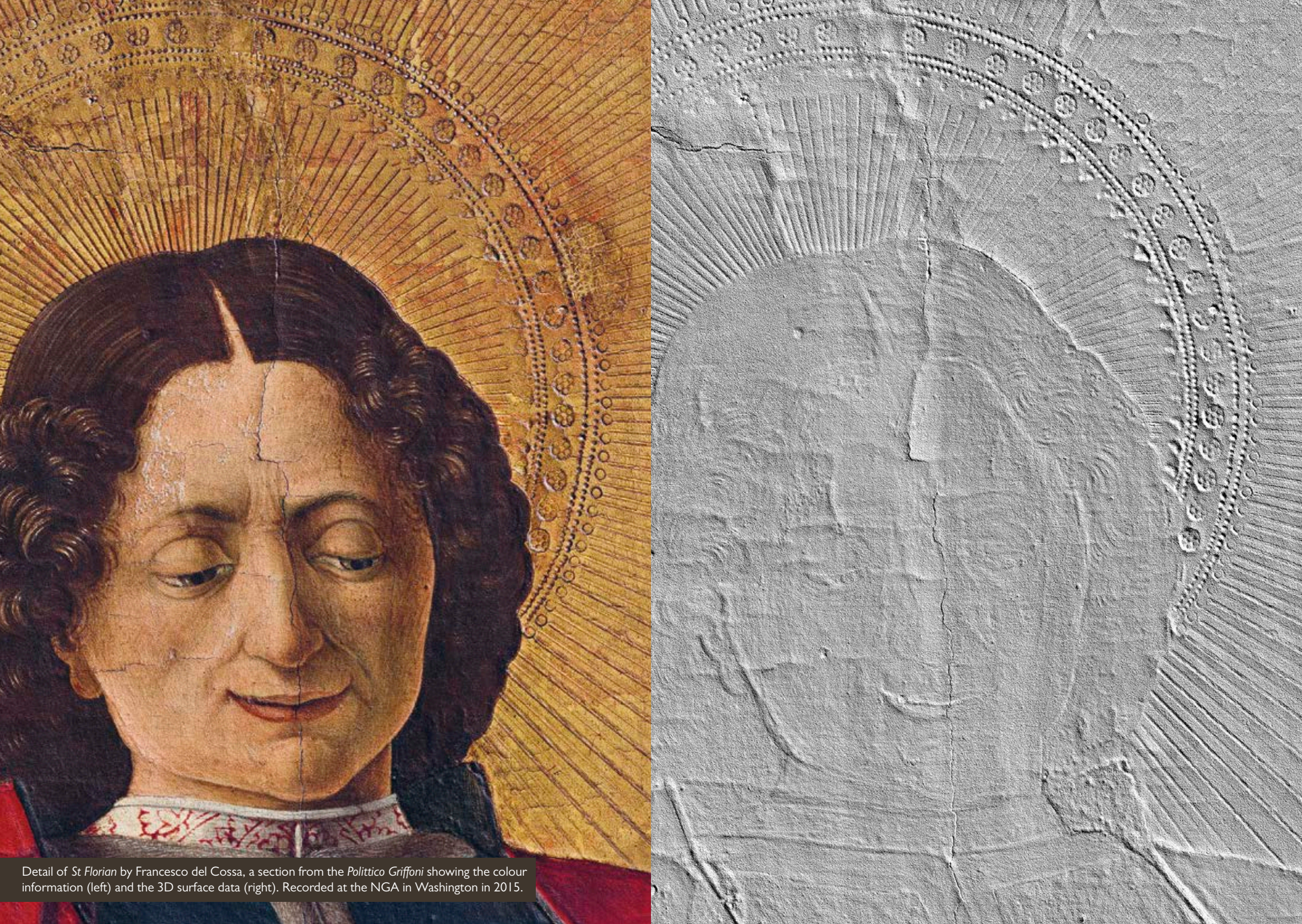
Detail from *The Miraculous Draught of Fishes*, one of the Raphael Cartoons at the V&A. Colour and 3D merged (left) and 3D surface data (right).

The Lucida 3D Scanner recording the surface of Goya's *The Drowning Dog* at the Museo del Prado, 2014.

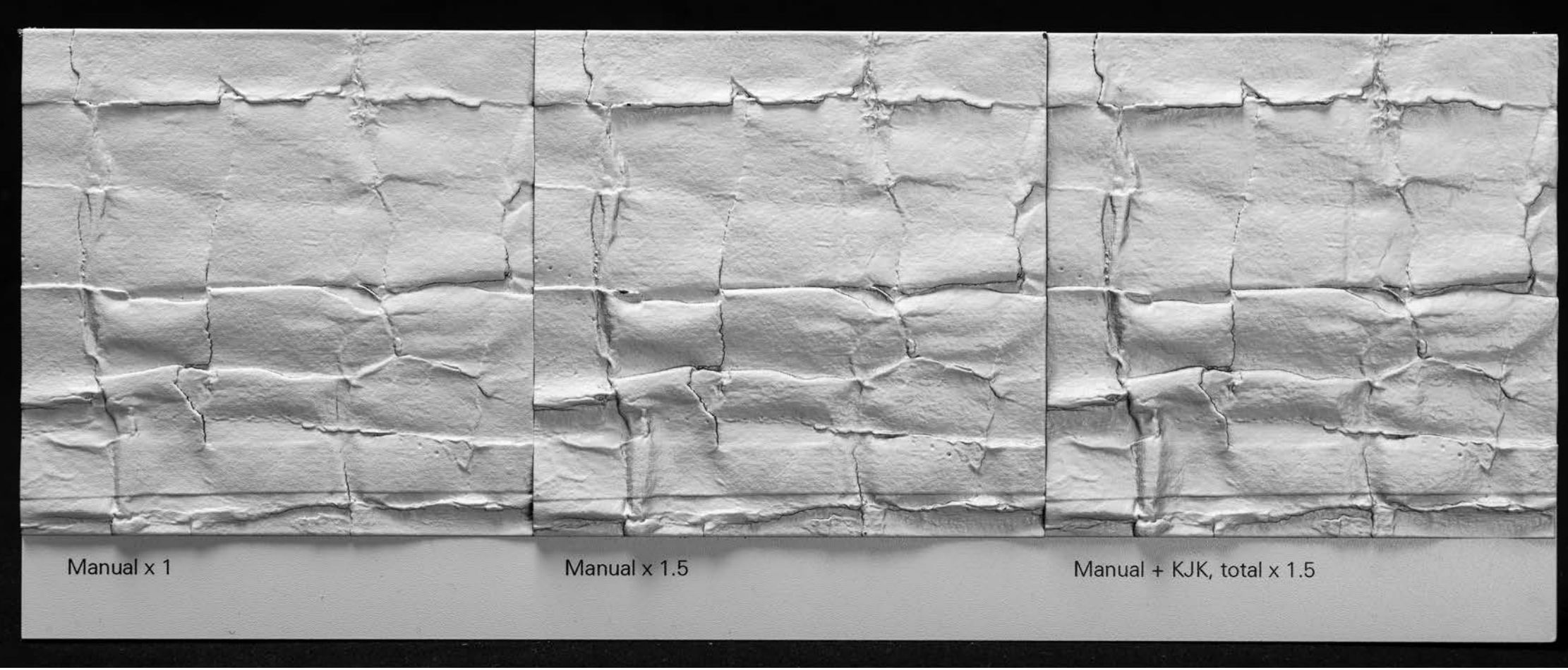
The Lucida 3D Scanner can be set up to record horizontally, seen there recording Michelangelo's *Epifania* cartoon at the British Museum, 2019.



War is the most compelling reason that custodians should have the surface of their paintings scanned and their sculptures correctly digitised.
Left page and top of this page: Historical photos of *Portrait of Cardenal Tavera* by El Greco. Courtesy of Archivo Rodríguez. Images from the blog Toledo Olvidado by Eduardo Sánchez Butragueño.
Bottom: 3D render of the relief of *Portrait of Cardenal Tavera* by El Greco. The white lines shows the restored fragments (scars).



Detail of *St Florian* by Francesco del Cossa, a section from the *Polittico Griffoni* showing the colour information (left) and the 3D surface data (right). Recorded at the NGA in Washington in 2015.

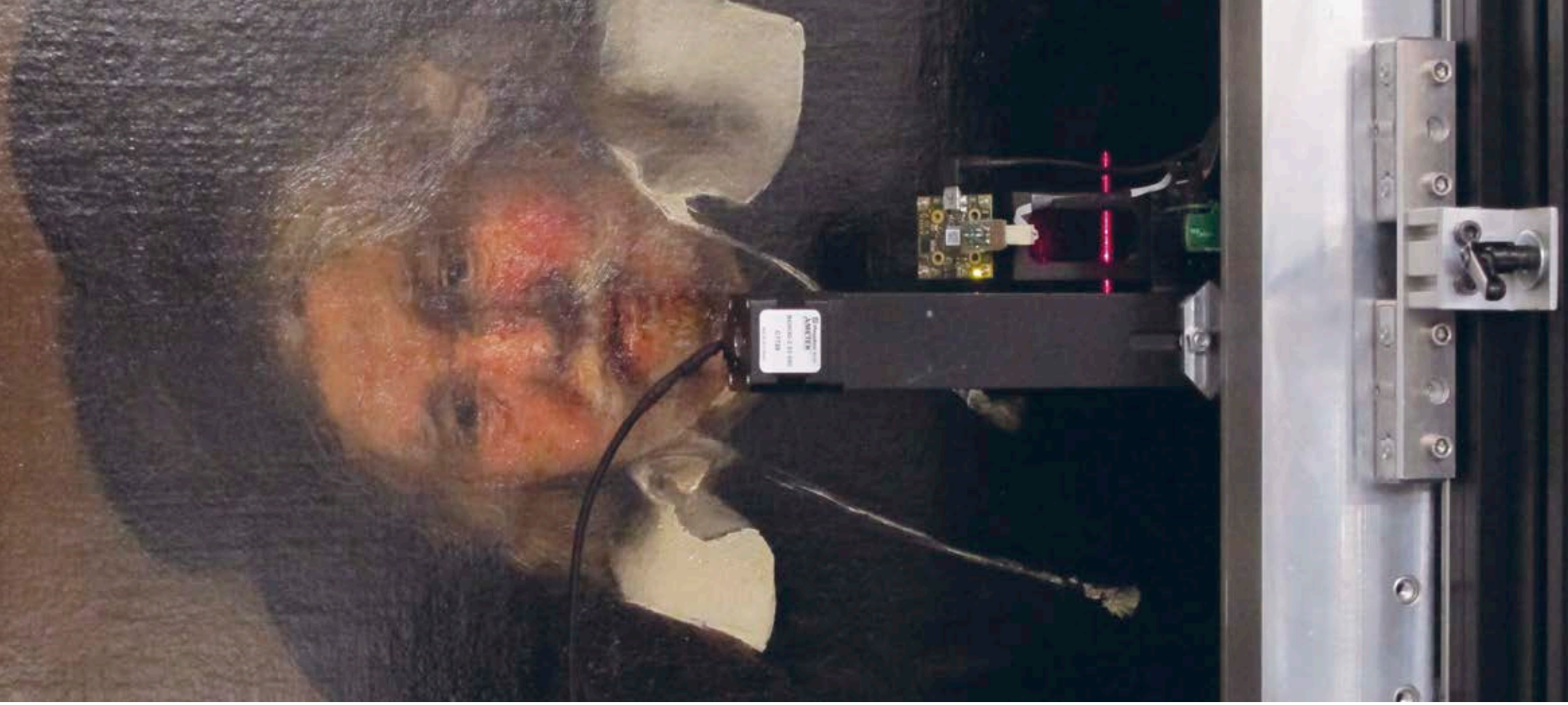


3D print of a detail from *The Miraculuous Draught of Fishes*, one of the Raphael Cartoons at the V&A.

Actual surface (left); enhance surface x 1.5 (centre); enhance surface with low-frequency relief removal filter, total x 1.5 (right).

Why is 3D scanning important?

In recent years, high-resolution 3D recording has become part of a coherent non-contact approach to documenting and preserving works of art. This process creates new opportunities for presenting culture in both virtual and physical ways. It also gives the custodian of an artwork a resource which adds value to the physical object, and assists in its condition monitoring, acting as digital evidence of its material state at the time it was recorded.



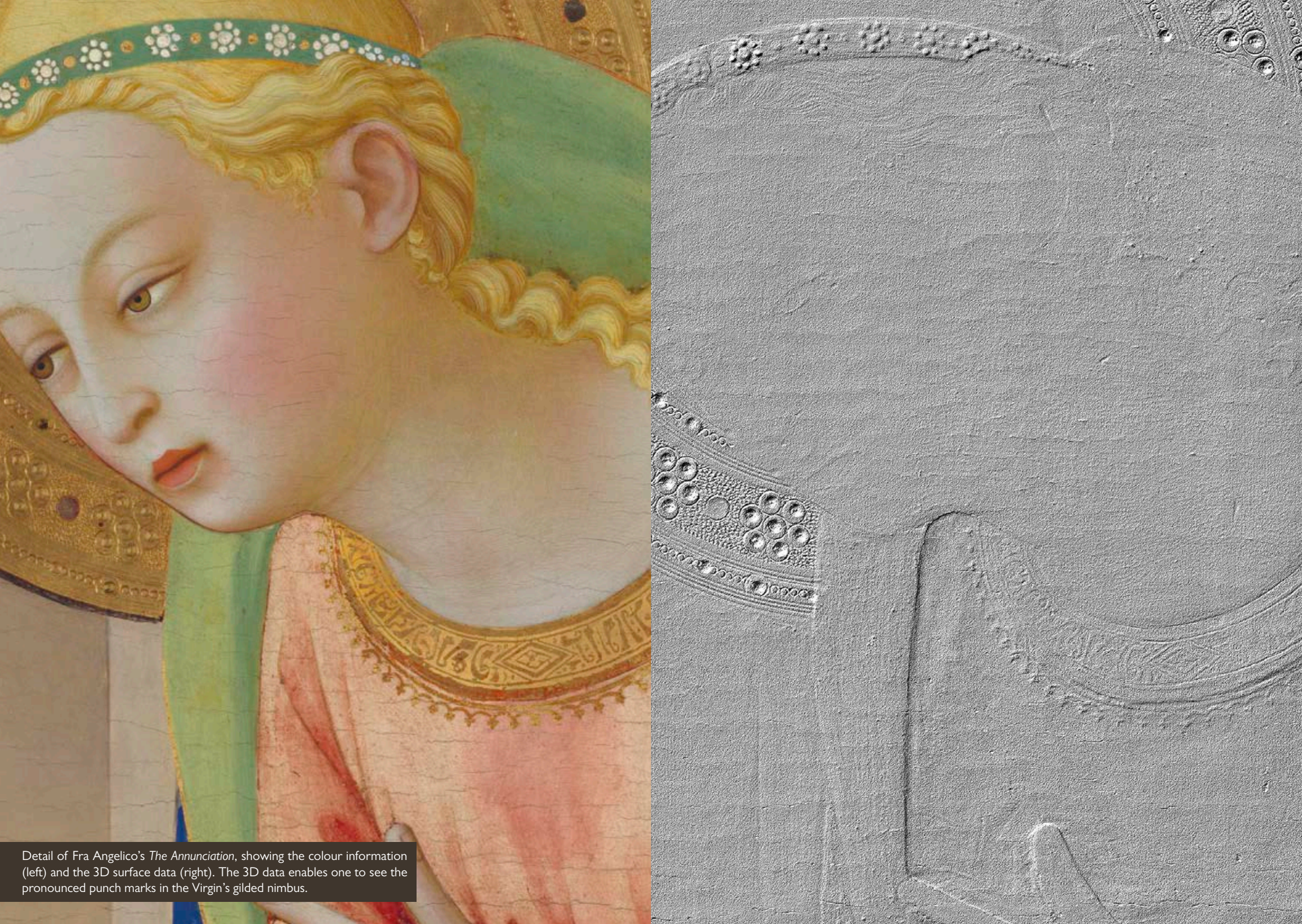
The Lucida 3D Scanner digitising the surface of Rembrandt's *Portrait of an Elderly Man* at the Mauritshuis Museum. Photograph by Clemens Weijkamp, Océ.

What is the digital passport?

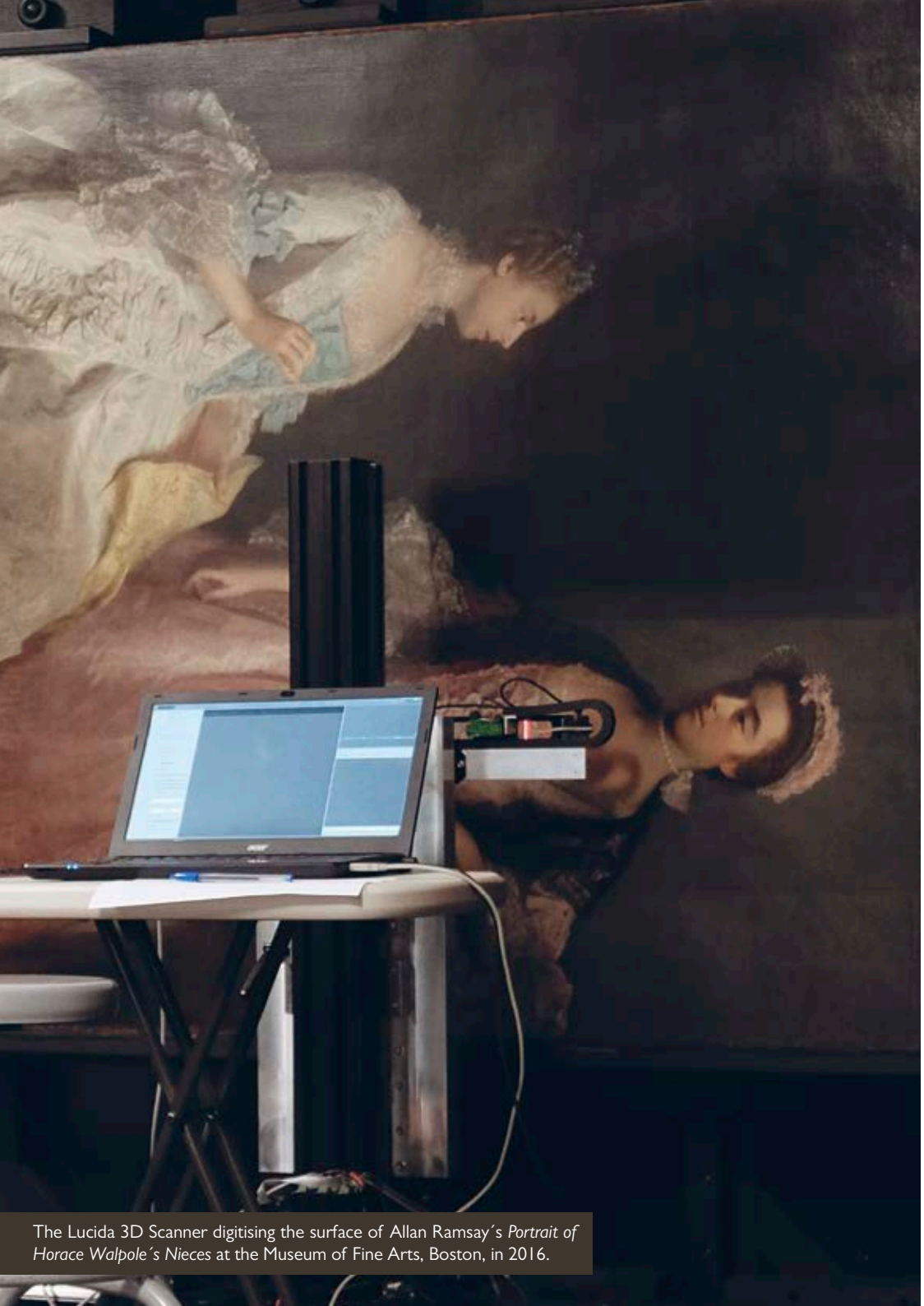
The digital passport of a work of art is a set of digital data that contains its material characteristics, at high-resolution, accessible at any time from any internet enabled device. The digital passport contains information about the surface and the colour of the artwork. Other layers can be added as desired. Our aim is to add forensic accuracy to the value of the work of art. The digital passport will enable detailed and objectively accurate condition monitoring, assist with long term preservation, record loans and changes that occur when works of art are moved and facilitate a new approach to sharing.

How do we record paintings?

A basic **COLNAGHI** & FACTVM recording will consist of high-resolution composite colour photography and high-resolution 3D recording of the surface texture with dimensional accuracy. To this we can add infrared, x-ray, historic photographs and other data considered important by the owner(s). The size of the painting will determine the time required for the recording.



Detail of Fra Angelico's *The Annunciation*, showing the colour information (left) and the 3D surface data (right). The 3D data enables one to see the pronounced punch marks in the Virgin's gilded nimbus.



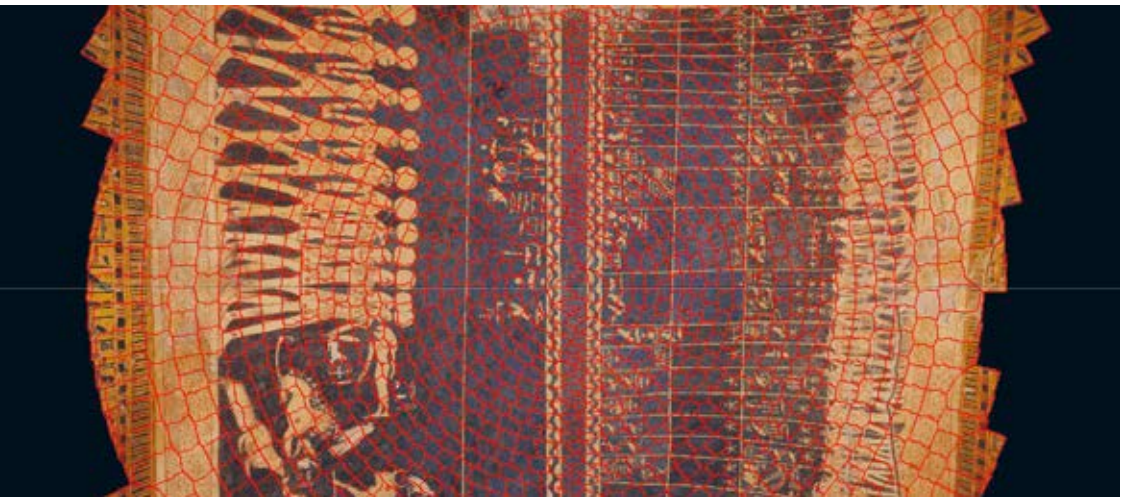
The Lucida 3D Scanner digitising the surface of Allan Ramsay´s *Portrait of Horace Walpole´s Nieces* at the Museum of Fine Arts, Boston, in 2016.

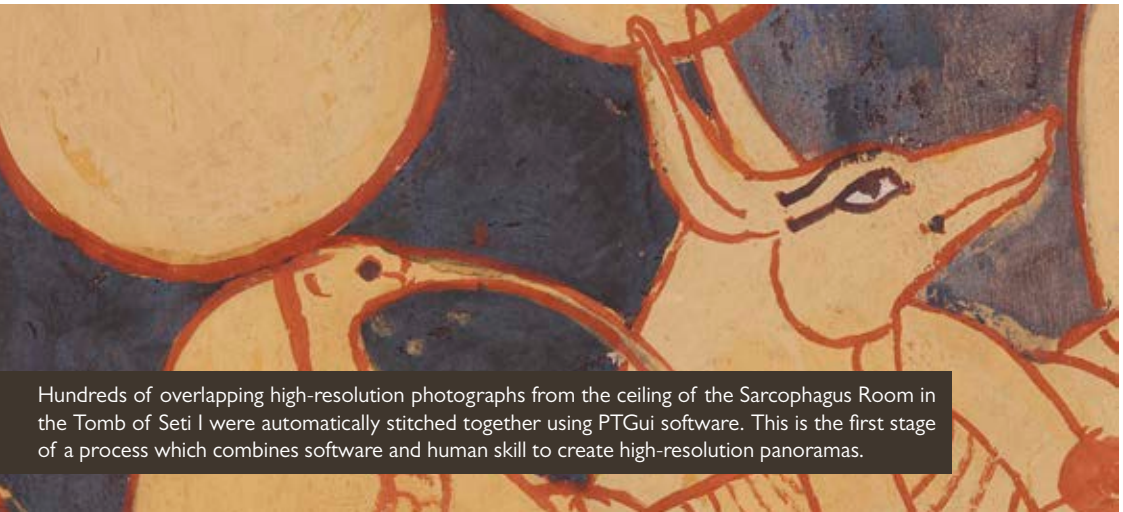
What is "close-range recording" and why is the distance important?

Close-range 3D scanning can refer to any recording system working close to (but not in contact with) the surface of the painting, to obtain data at the highest possible resolution. The system used by **COLNAGHI** & FACTVM never makes contact with the painting during the process, recording its surface from a constant distance of 8-10 cm. The aim is to record in an objectively accurate and uniform way, with no visible joins or artifacts and minimum noise, producing a precise map of the surface. The surface is a landscape of undulations and features that must be recorded with forensic accuracy; the relationship of information to noise when recording subtle surfaces is critical. Changes of tone, darkness, reflections and thick varnish can all produce artifacts that focus on the recording method rather than the painting. The goal of **COLNAGHI** & FACTVM is to record a true map of the surface of paintings and ensure a close correspondence between the recorded data and the painting itself. This enables us to rematerialise the surface of the painting as a facsimile, should the client desire it, with or without colour.

How is surface recording done?

The Lucida 3D Scanner was developed over several years by Manuel Franquelo and the engineering and programming team from Factum Arte (the company from which Factum Foundation emerged). It is a close-range, non-contact laser recording system that captures high-resolution surface texture data for low-relief surfaces, such as paintings or bas-reliefs. The Lucida is unique in that it records the 3D surfaces without being affected by their colour or material properties. The scanner is as simple as possible, recording two black and white videos of the surface which are stored as raw black and white images. We use black and white cameras to reduce the noise generated by the separation of colours in the recording process.





Hundreds of overlapping high-resolution photographs from the ceiling of the Sarcophagus Room in the Tomb of Seti I were automatically stitched together using PTGui software. This is the first stage of a process which combines software and human skill to create high-resolution panoramas.

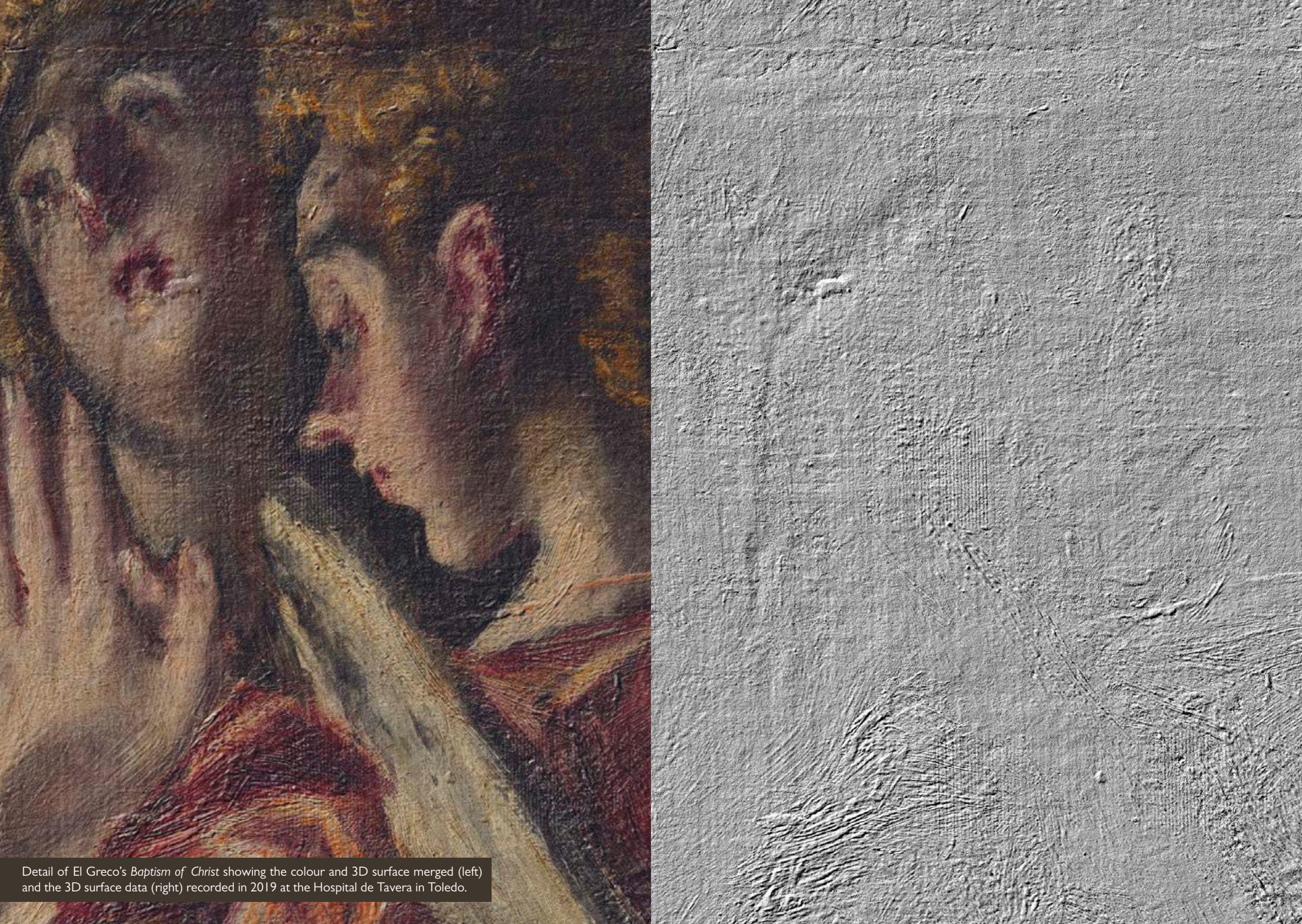
The scanner records continuous tone data from which depth-maps can be extracted. Factum has used it to record hundreds of artworks in the most important museums and collections around the world, from the Prado to the National Gallery of Art in Washington, among many more. Lucida is also being used in innovative training programmes to demonstrate the importance of 3D recording for the preservation of cultural heritage – from Columbia University in New York to the Valley of the Kings in Egypt.

How does the Lucida 3D Scanner work?

The Lucida records 3D data in 48 cm x 48 cm 'tiles' by projecting a moving strip of red laser light onto the surface of an artwork. The distortions in the light caused by the surface relief are captured by two video cameras positioned at 45° to the laser. The black and white video is automatically processed by the integrated scanner software to produce a 3D file and its associated shaded render - an 'image' of the 3D data. The video files can also be stored in raw formats for re-processing at higher resolutions when new hardware and software becomes available. This approach was designed by artists to record artworks and demonstrate the importance of their physical nature.

This flexible system can be adapted to record very large works on paper which need to be recorded vertically, or very fragile ones that must be kept horizontal. The Raphael Cartoons at the V&A were recorded in place, and Michelangelo's *Epifania* at the British Museum was recorded flat in the restoration studio. The Lucida was even used to record frescoes, wall paintings, low-relief carvings, maps on vellum and ceramic tiles, and the walls of the burial chamber of Tutankhamun and the whole tomb of Seti I, in the Valley of the Kings.

Two Lucida 3D scanners recording the surface of El Greco's *Annunciation* in the collection of Banco Santander, 2020.



Detail of El Greco's *Baptism of Christ* showing the colour and 3D surface merged (left) and the 3D surface data (right) recorded in 2019 at the Hospital de Tavera in Toledo.

Tomb of Seti, Room K, west wall, an area of 20,7 sqm. Left: the colourless 3D relief data for the wall. Missing areas correspond to niches and protrusions which cannot be recorded with the Lucida, or to missing overlaps still to be recorded. Right: the diagram shows the different tiles (100 in total) recorded using the Lucida 3D Scanner; lighter areas show where there is overlap between tiles.

3D scanning is controlled from a laptop through an intuitive user- interface that was developed with conservators and cultural heritage specialists. The software allows an operator to control the intensity of the laser light, which can be increased or decreased from within the application, depending on the nature of the material being recorded; dark surfaces absorb light and require stronger laser intensity. The Lucida can also capture glossy and even reflective materials like gold, which many other recording systems struggle to record in 3D.

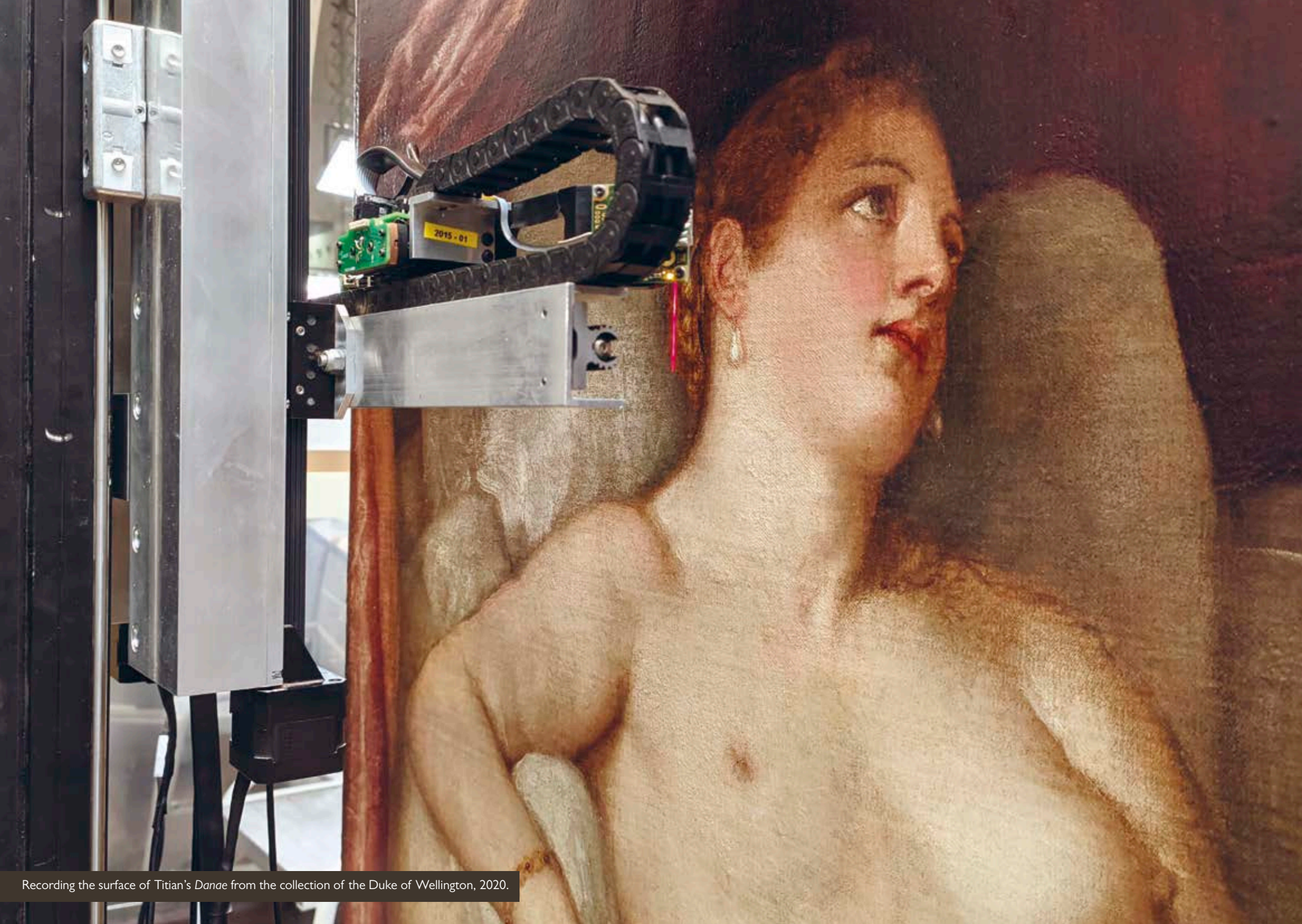
The Lucida scanner has depth of field of 2.5cm; the software application allows the operator to select specific sections of the target if 're-scanning' at different depths is required. Re-scanned data is automatically 'merged' with the main scan during post-processing. The z-axis, which enables movement toward/away from an object, is mechanical as an extra safety precaution. The recording process is always supervised by an operator.

Detailed close-range 3D recording facilitates meaningful monitoring of the condition of any surface. It is dimensionally accurate and does not have the problems of lens distortion associated with photographic recording. In the creation of layered archives that unify different types of data, all the information is mapped onto the 3D scan. The advantages of having these different layers of data at the same scale and aligned to each other, is of critical importance for inspecting the information. Some will be at higher resolution than others but the aim it to facilitate meaningful scrutiny and comparison.

Render comprising 3D and colour data from Room K in the Tomb of Seti. Marmoset Toolbag 3 was used for real time rendering, creating the effect of light and shade. The data was captured in 2001, but only recently has it became possible to visualise it at this resolution.

Detail of Rubens' *The Triumph of the Eucharist over Idolatry* showing the colour and 3D surface merged (left) and the 3D surface data (right).

Two of Murillo's masterpieces from Hospital de la Caridad, recorded using the Lucida 3D Scanner in 2018, in Seville's Instituto Andaluz de Patrimonio Histórico.



Recording the surface of Titian's *Danae* from the collection of the Duke of Wellington, 2020.

Composite photography in colour and infrared

COLNAGHI & FACTVM uses an approach to composite colour recording that can be fused with 3D recording. We shoot with a Canon 5DSR and a 300mm tele lens, mounted on a panoramic head fitted to a tripod. We use 2 studio flashes of 1000 watts with 180cm white umbrellas to bounce the light on both sides of the painting at 45° angles, depending on the surface of the painting. This results in a manually-shot panorama with at least 60% overlap between images (along the lines and between the columns). Each shot position is recorded 3 times: first with both lights, then with the light from the left and finally with the light from the right. We use an external trigger to avoid vibration. It is important that each shot is taken from exactly at the same position without any physical movement. If the surface is very reflective, we polarise the light and cross-polarise the lens. We then shoot a fourth panorama.

We use a colour-checker passport in each corner and one in the center. We also include some Pantone strips that are as close as possible to the difficult colours in the painting.

Infra-red photography can be done using a similar composite approach.

Processing requires skill and patience, and the methodology employed by COLNAGHI & FACTVM has been developed and perfected over the past 10 years. By processing TIFF files from the RAW pictures at 16bit colour depth on specialised softwares, and repeating the process for each lighting position, it is possible to produce a single merged panorama without highlights or shadows, that can be perfectly mapped over the relief surface. Colour is usually considered the most subjective part of the process: but once the final colour file is made, a colour profile is created using colour charts and colour references – thus making the process objectively accurate and repeatable.

When complete, the composite colour images are 'mapped' precisely and accurately onto the 3D data. The data can now be visualised in many ways – from projections to layered browsers, animations to virtual realities, Augmented- and Mixed-Realities and emerging technologies. Most importantly it can have an online presence and also be physically replicated as an exact facsimile.

This approach, keeping the colour and texture separate but perfectly aligned, is significant. The colour is recorded without shadows, without highlights and as uniformly as possible, often using cross-polarizing filters. We take 'multiple shots' to digitally capture the real colour minimising any interference from hardware, software, light, reflections and materiality. The aim is to record an objectively accurate ideal (or pure colour) separated from the surface and from the subjectivity of human perception. Contrary to traditional photographic values where balanced light and controlled shadows are used to describe form, we are trying to capture a flat colour image.

Multiple shots, directional light, focus stacking and an artisanal approach to different types of colour chart, Pantone strips and physical colour samples are all essential to get this level of control.

The final files have a resolution of at least 600dpi at actual size. This is sufficient to see the image at more than four times magnification without a significant loss of detail. With time, using macro photography and focus stacking we can achieve resolutions of about 5000ppi at 1:1.

Overlapping, high-resolution images of the surface of Sir William Allan's *Battle of Waterloo*, 1815-1843, at Apsley House, London, taken in 2020 from a single (static) point using a telephoto lens. In post-processing, the photographs are stitched together with the free software PTGui to create a single large image file. PTGui is used to correct geometric distortions arising from the fact that the camera is usually positioned in front of the middle of the painting, whose corners are therefore further away from the lens than the centre. Such distortion can be corrected by carefully mapping the colour onto a scaled 3D model to create a layered archive of information.

Recording the colour of the Raphael Cartoons at the V&A using panoramic composite photography.

Merging Colour and 3D

The last step of the digital process involves the registration of the colour (and eventually other layers of data such as infra-red, x-ray, etc.) onto the 3D data. This is dimensionally accurate and is used as a template to map other data sets onto. The registration of the colour panorama onto the relief panorama (in its shaded rendered version) is a delicate process. It involves working with image processing software like Photoshop to carry out small distortions in the colour layer, so each detail in the colour matches its correspondent detail in the surface relief. There is still no software that can handle the number of decisions required in this process.

Adding other layers of data

In theory it is possible to merge almost any type of data as long as the resolution is sufficient. X-ray, infra-red, ultra-violet, historical images and different forms of notation and written commentary can all be mapped onto the dimensionally accurate 3D data that has no lens distortion.

Archiving

The data can be archived in various forms, using cloud-based storage as well as being stored on a physical hard drive. Long term storage of data is a complex subject over which **COLNAGHI** & FACTVM can offer guidance, as well as secure archiving. Safe storage of the data is aligned with the safe storage of the artwork.

It is essential the data is stored as raw images or raw video, .JPEG depth maps and colour images, and that these files can be retrieved, reprocessed and shared easily. It is equally important it is preserved and that archives of digital data will last as long as libraries of books. **COLNAGHI** & FACTVM can advise and assist in ensuring secure archiving.

Recording Velázquez' *The Waterseller of Seville* at Apsley House, London, 2020.

The images of Boucher's *Portrait of Madame de Pompadour* taken during a recording are joined together into a single panorama using the software PTGui, which locates matching pixels across overlapping photographs.

Some frequently asked questions

Is it necessary to remove the frame and can it be recorded?

To record a painting in colour and 3D (surface), it is preferable to remove the frame and record the front, edges and back, if it contains historical data. Working with Colnaghi's experts, the recording will take place in the **COLNAGHI** & FACTVM studio, with the guarantee that both the painting and its frame are manipulated in a professional manner and in ideal conditions. If desired, the frame can be recorded by the studio's experts using photogrammetry. If the owner does not want to remove the frame - assuming it does not interfere with the movement of the scanner - the painting can also be recorded in its frame, but covered areas will not be captured. It is necessary to remove any protective glass so the surface is exposed.

How do we visualise the data and what can you do with it?

Different visualisation techniques make it possible to stream data safely so it can be accessed, studied and shared without any specialist software. Colour data captured with high-resolution panoramic photography is 'mapped' onto renders of the processed 3D data to create a 'digital passport' for an artwork that fully describes its surface condition. The easy-to-use, intuitive browsers enable anyone with internet access to visualise and compare different types of data with ease at high-resolution. It is presented in the form of a layered archive where different types of data, all at the same scale, can be seen superimposed one onto the other or viewed side by side to facilitate direct comparison.

Copyrights: who owns the data recorded by COLNAGHI & FACTVM?

Data collated using the Lucida 3D Scanner or any other recording method will remain the property of the custodian/owner of the work of art, who will own all rights related to the data for all current and all future applications. **COLNAGHI** & FACTVM will not retain any commercial rights on the data, but request that it can be used for academic study and issues related to preservation.

Colour tests and prints of Boucher's *Portrait of Madame de Pompadour* for the facsimile exhibited at Waddesdon Manor, 2019-2020.

No surface

Actual surface

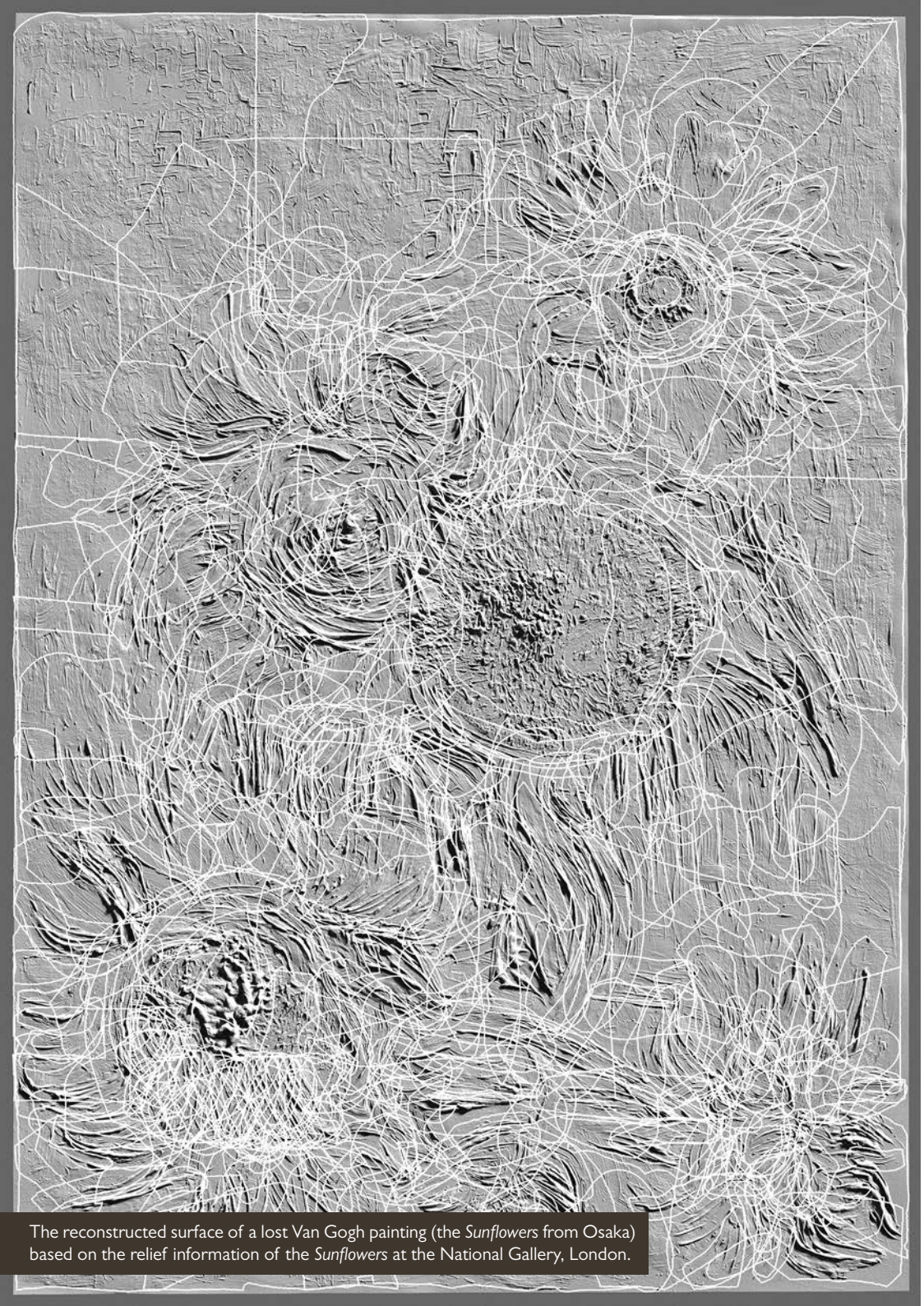
Enhance surface x 2

Enhance surface x 3

Enhance surface x 4

Enhance surface x 5

Facsimile and original of an oil sketch of *Madame de Pompadour* by Boucher, exhibited at Waddesdon Manor in 2019. The central caption invites viewers to decide which is which before lifting the flaps on the covered captions to either side. Exhibition design by Charlotte Skene Catling.



The reconstructed surface of a lost Van Gogh painting (the *Sunflowers* from Osaka) based on the relief information of the *Sunflowers* at the National Gallery, London.

What will you get back?

If you record a painting with **COLNAGHI** & FACTVM, you will receive a browser – a method of viewing your painting that is intuitive and easy to use. High-resolution colour data, a 3D render (tonal image) of the surface without colour and a mix of colour and relief can be viewed as a layered archive or with the information side by side for direct comparison. Further layers of data can be added depending on what is available, its resolution and the required use. Digital connoisseurship has now come of age: the next steps will be culturally and financially significant. Additionally, you will receive the original and final colour and 3D files in various digital formats.

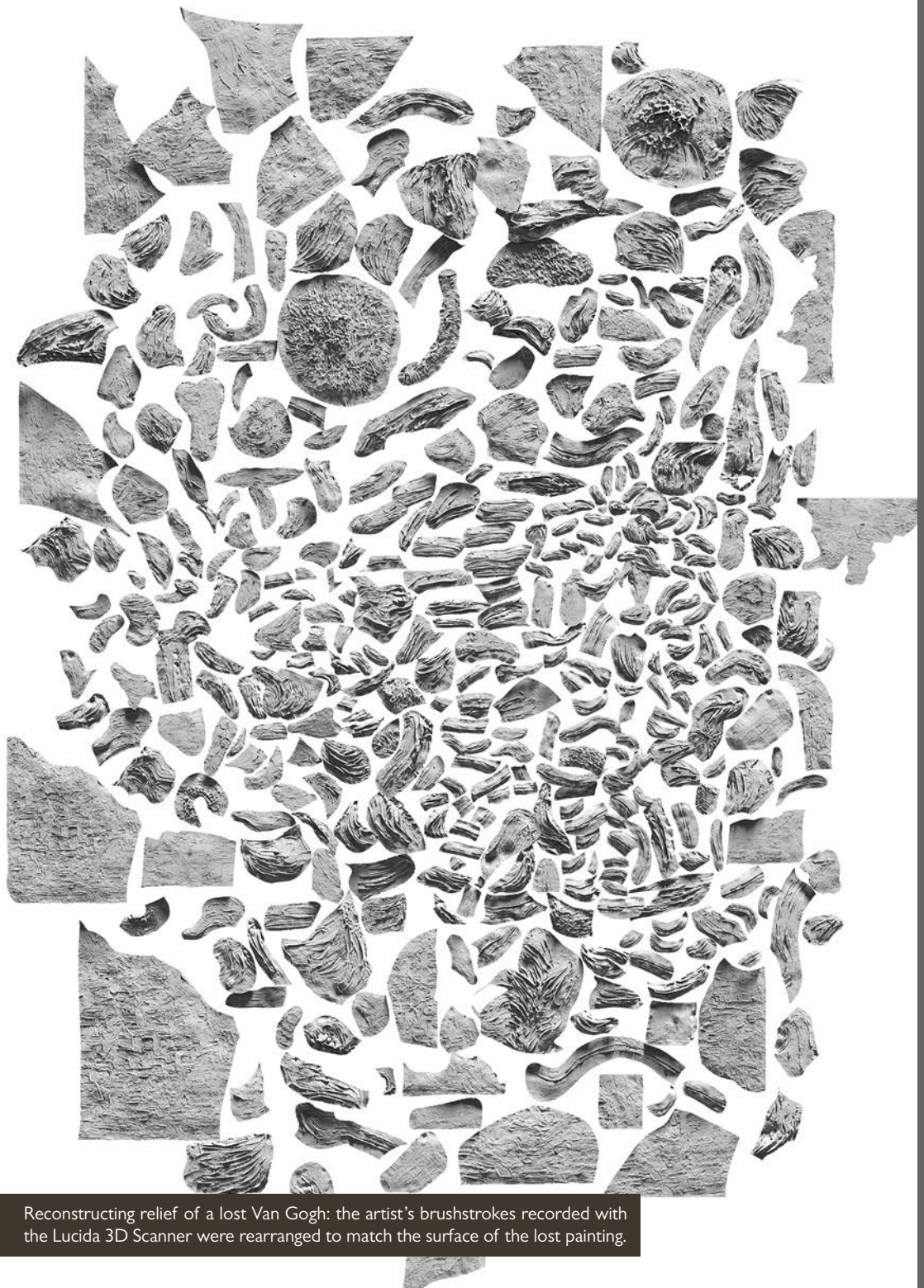
What can you do with the data?

Once the data is at a suitable resolution and in the correct format there are many applications on screen or using an interactive web browser. It can be easily shared (both publicly and privately), analysed with either forensic or aesthetic scrutiny and used for condition monitoring. This data can be used to carry out non-invasive digital restorations and to inform conservation decisions. In the case of objects being loaned, it provides an objectively accurate reference that can have significant insurance implications. In the event the work is stolen, will contain patterns and features that have not been previously observed which can help identify the work.

Augmented-, Virtual- and Mixed- Reality are other possible uses of the data recorded by **COLNAGHI** & FACTVM. There are many other practical applications, from inventories, records, marketing and communication strategies which the data can also be used for.

How long will the process take?

The recording time is directly dependant on the area of the painting. It will be possible to record 1.5 sqm/day with the Lucida 3D Scanner for the surface relief. Or 1 sqm/day if both 3D relief and colour recording are needed.



Reconstructing relief of a lost Van Gogh: the artist's brushstrokes recorded with the Lucida 3D Scanner were rearranged to match the surface of the lost painting.

Colour and shaded render of Grinling Gibbons' *Crucifixion*, recorded using photogrammetry and the Lucida 3D Scanner at Dunham Massey, UK, 2021.

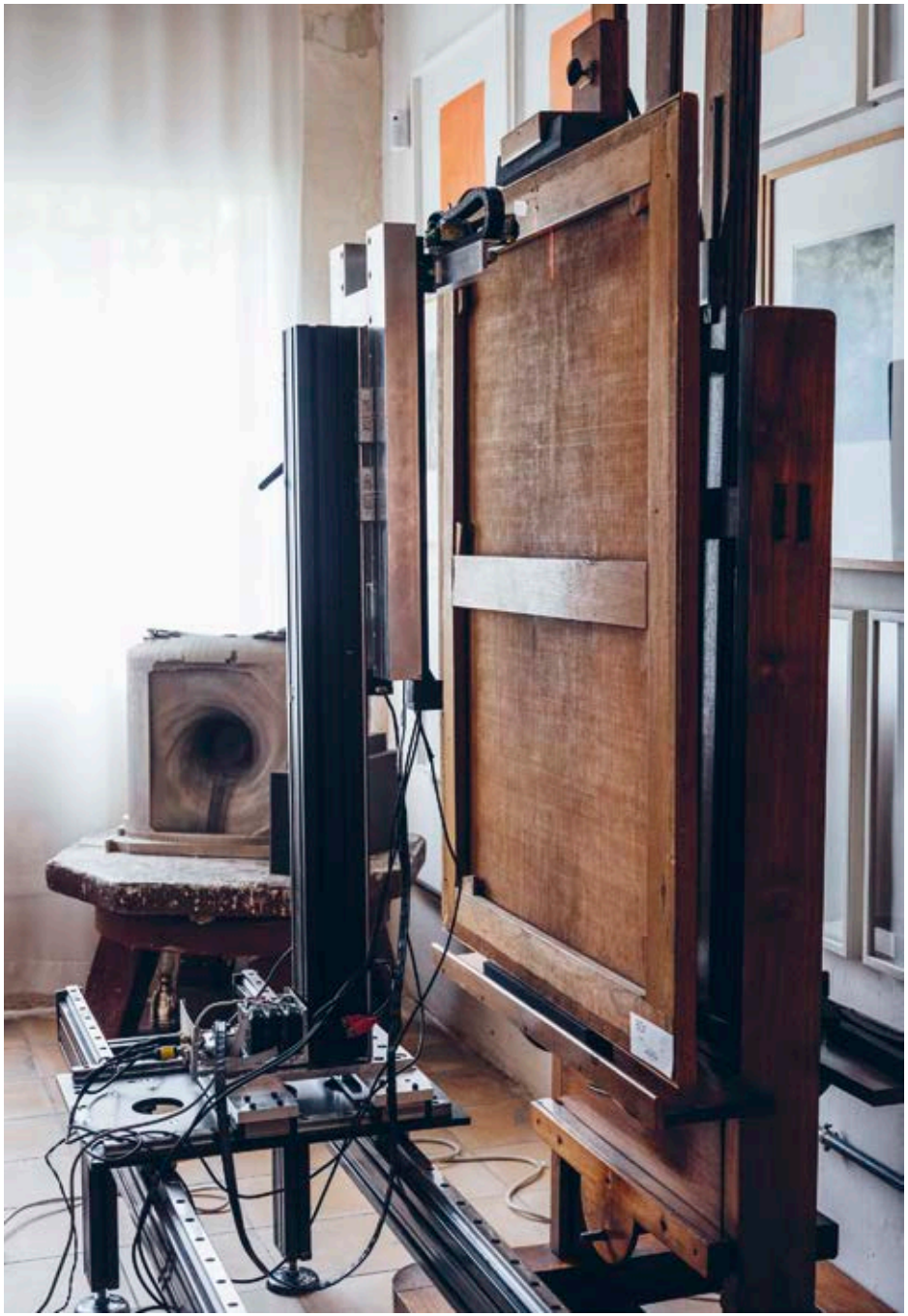
COLNAGHI & FACTVM also has the capacity to record low relief carvings and fully three-dimensional sculptures.

The studio in London't St James's is equipped with all the specific technology and expertise to offer non-contact, high-resolution digital documentation of individual artworks or entire collections. A team of experts will carry out the recording and processing.

COLNAGHI & FACTVM represents a celebration of the new materiality that digital technology is bringing to our understanding of art.

3D model of Donatello's *San Lorenzo* (c. 1440) recorded with photogrammetry by Factum Foundation at Colnaghi's gallery.

COLNAGHI & FACTVM recorded a painting attributed to the circle of José de Ribera, considered to be one of the best artists working in a Caravaggesque manner. It now seems possible that the painting is by Caravaggio. **COLNAGHI** & FACTVM created a digital passport for the owners of the painting after which it underwent a light restoration and consolidation by a team of experts at Museo del Prado.



The Lucida 3D Scanner recording the back of the *Ecce Homo*, Caravaggio, 1604.

"Colnaghi consistently aims to uphold our historic firm's commitment to connoisseurship, through the degree of academic research we are able to offer. This new partnership with Factum Foundation adds a degree of technical analysis which both aligns with this mission, and enables it to develop even further. **COLNAGHI** & FACTVM *is a company whose common goal is to bring our private and institutional clients the highest degree of academic and technical analysis into their works of art. With our respective bases in Madrid and London,* **COLNAGHI** & FACTVM *will focus on revealing the secrets of works of art from remarkable collections, many of which have fascinating stories waiting to be told. We are excited to begin telling them."*

Jorge Coll, CEO of Colnaghi

Panoramic colour recording of the painting's front.

A facsimile of Giuseppe Salviati's *Dispute between Minerva and Neptune*, now in the Musée Jacquemart-André, Paris, was recontextualised in Palazzo Grimani, Venice, 2019.

Facsimiles

By merging aesthetics and technology, **COLNAGHI** & FACTVM can create facsimiles of paintings, low-relief carvings, frames and sculptures.

The facsimiles are created by rematerialising each of the layers of recorded data into a replica that is identical to the original under museum conditions. The relief data is prototyped with the elevated printing system developed by Canon Production Printing who have worked closely with Factum Foundation for many years. This 2.5D printing method is capable of building up a relief in 10-micron layers of UV-curable ink. This physical output is then used to make a mould of the surface of the painting at actual size. This is then made as a flexible, printable skin that has the exact characteristics of the surface of the painting.

The colour captured with composite photography is then printed onto this skin, using a specially designed flatbed digital printer. The control of materials and exact registration is crucial for a successful result. The aim is to replicate the surface qualities of the original.

Although the resulting facsimile is made with different materials, it is indistinguishable from the original in normal viewing conditions and will last many years in climate-controlled conditions.

Digital restoration

Traditional conservation involves material intervention to the object in question – sometimes in order to prevent it from deteriorating any further, sometimes in order to return it to a former, 'original', state. In contrast, digital conservation does not change the object or involve physical contact. Any interventions take place entirely in a digital space, although the processes and findings can be used by traditional conservators to inform physical conservation.

At its simplest, digital conservation can mean the creation of a digital record of an object. A high-resolution recording provides an authoritative record of the work's appearance – a vital document given the extent to which objects change over time. Conservators or painting owners may wish to create a record like this before conducting physical conservation, allowing them and their successors to look back at what the object looked like prior to intervention.

Because conservation techniques change with every generation, preserving a record of the pre-conservation state of objects has become an indispensable part of the conservation process, and 3D digital recordings offer a more complete visual representation of an object's surface than any other method.

Sir Joshua Reynolds' *Unfinished Portrait of an Unknown Woman*. Colour data as recorded in its current condition (left) and the result of a digital restoration process (right).

Screenshots showing different details of Valdés Leal's *In Ictu Oculi* (1672) as seen through Factum Foundation's multi-layered online viewer. Different layers of data, including high-resolution colour and relief, can be inspected independently or in combination.

16th-century ceramic tiles from Casa de Pilatos, recorded in 2018 as part of a project with Columbia University's GSAPP. (Left) Colour and (right) 3D surface data.

COLNAGHI
Est. 1760

Colnaghi

Founded in 1760, Colnaghi is the oldest commercial art gallery in the world and one of the few to specialise in works of art from antiquity to the modern era. Since the late-nineteenth century, Colnaghi has been a leading dealership in Old Master paintings and sculpture, prints and drawings, selling masterpieces to the greatest collectors and museums of the Gilded Age. With galleries in London, New York, and Madrid, Colnaghi deals in rare objects from the Ancient World, the finest Old Master and Modern masterpieces, providing its clients with expert advice and opportunities to build collections. Colnaghi is directed by CEO and owner Jorge Coll. Carlos A. Picón oversees Colnaghi New York.

FACTVM
FOVNDATION
FOR DIGITAL TECHNOLOGY
IN PRESERVATION

Factum Foundation

Factum Foundation for Digital Technology in Preservation is a not-for-profit organisation established to demonstrate the importance of documenting, monitoring, studying, recreating and disseminating the world's cultural heritage. Through the rigorous development of high-resolution recording and re-materialisation techniques, Factum aims to break down the barriers between traditional and digital arts and apply the outcomes to the preservation and sharing of cultural heritage.

Founded in 2009 by Adam Lowe, Factum Foundation was created with the aim of using Factum Arte´s innovative processes and technologies for preservation, education and the development of thought-provoking exhibitions.

Factum Foundation develops new techniques in digital recording and processing to record artworks of many different types, from paintings and manuscripts to monumental sculptures and caves. The Foundation always records at the highest possible resolution and works to ensure that all commercial rights to the data recorded remain with the object.

Digital file obtained from 3D scanning. Front of tapestry.

Digital file obtained from 3D scanning. Reverse of tapestry.

Detail of the front of the C18th *Verdure tapestry* at the Museo Cerralbo. High-resolution composite photograph after cleaning in 2015.

The front of the tapestry with the re-coloured threads based on the evidence extracted from the image of the back of the tapestry.

Factum's recreation of a leather wallpaper (left), installed in the Camera dei Venti at Palazzo Te, Mantua, March 2022.

For the new Spanish Gallery at Bishop Auckland, Factum Foundation and Skene Catling de la Peña created 'In Ictu Oculi', an exhibition design encompassing various elements of Spanish art and architecture. Between 2018 and 2021, a number of ceilings, tiles, floors, plasterwork (*yeserías*) were recorded in high-resolution and recreated in by Factum's technicians and artisans in Madrid.

The recreation of El Greco's gold tabernacle for *The Risen Christ*, one of his few sculptural works (right), installed in front of a facsimile of *The Baptism of Christ*. Both works are from the Hospital de Tavera.
The floor was made at Factum Arte in simulated terracotta after recording the original tiles in Casa de Pilatos.

The 'lapidarium' of *yeserías* is composed of facsimiles of different carved plaster elements, recorded in Toledo (Convento de Santa Clara, Sinagoga del Tránsito and the Salón in Casa de Mesa) and Seville (Palace of Pedro I in the Alcázar).

The room dedicated to Cardinal Tavera displays facsimiles of his marble sepulchre, two portraits by El Greco and Alonso Berruguete, and his death mask.

The final room of the exhibition displays facsimiles of two paintings by Valdés Leal: *In Ictu Oculi* and *Finis Gloriae Mundi*, from the Church of San Jorge in Seville.

A painting is never just a flat image. Regardless of the "gigapixel" quality available to reproduce colour on screen, there will always be something missing if the surface relief is not adequately documented and communicated.

The focus at **COLNAGHI** & FACTVM will concentrate on exploring how art should be appreciated and studied, as well as documented, archived, reproduced and shared in the coming years.

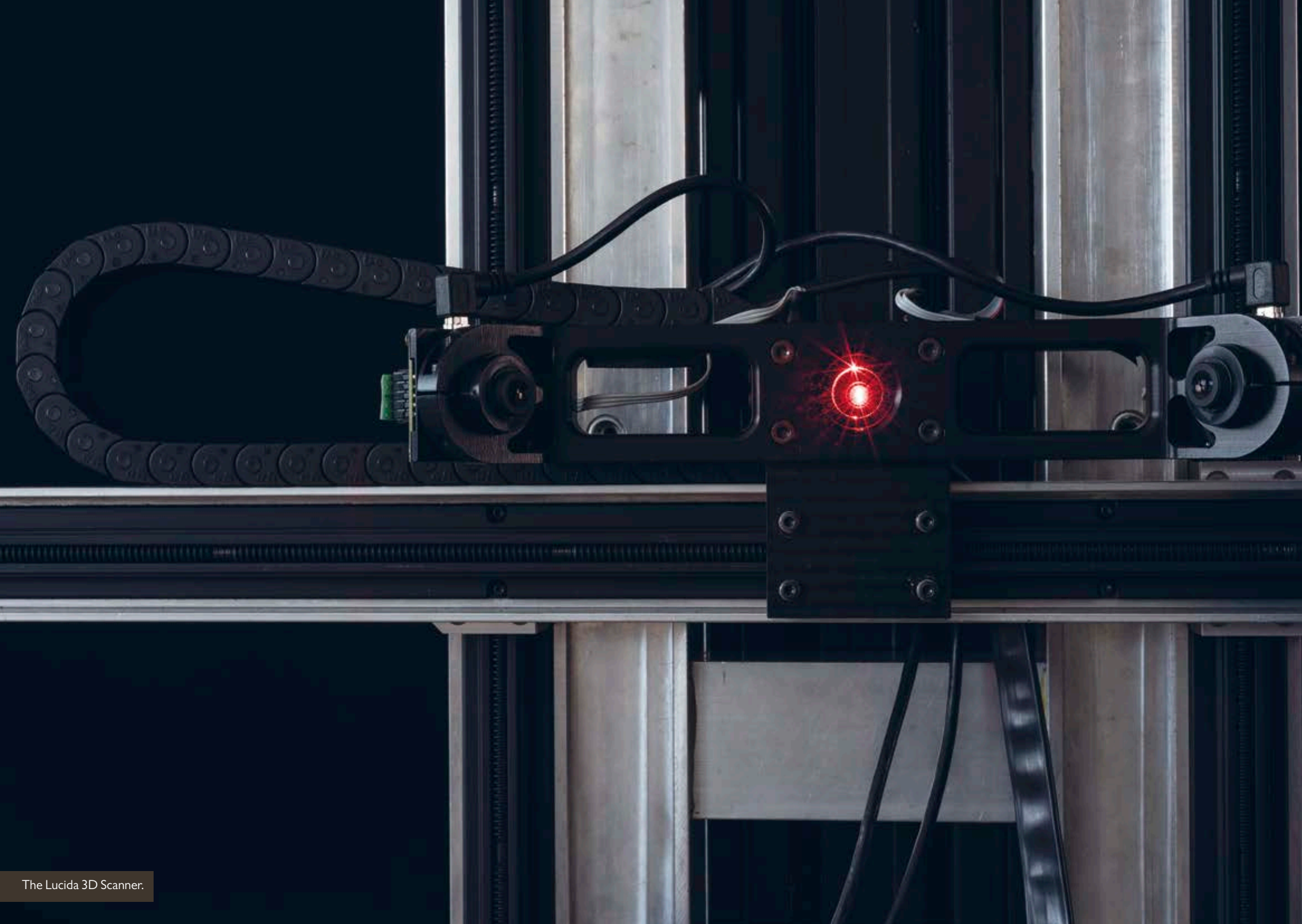
Cutting-edge digital technologies and traditional craft techniques are combined to expand the capacity of art to inspire and remain relevant.

The **COLNAGHI** & FACTVM studio
is open by appointment at

COLNAGHI & FACTVM

LONDON
contact@colnaghifactum.com
+44 20 7491 7408

In addition to the 3D and colour recording studio, there are displays and information about the work **COLNAGHI** & FACTVM are undertaking. Both individuals and institutions are encouraged to request a visit and experience the possibilities of this ground-breaking technology.



The Lucida 3D Scanner.