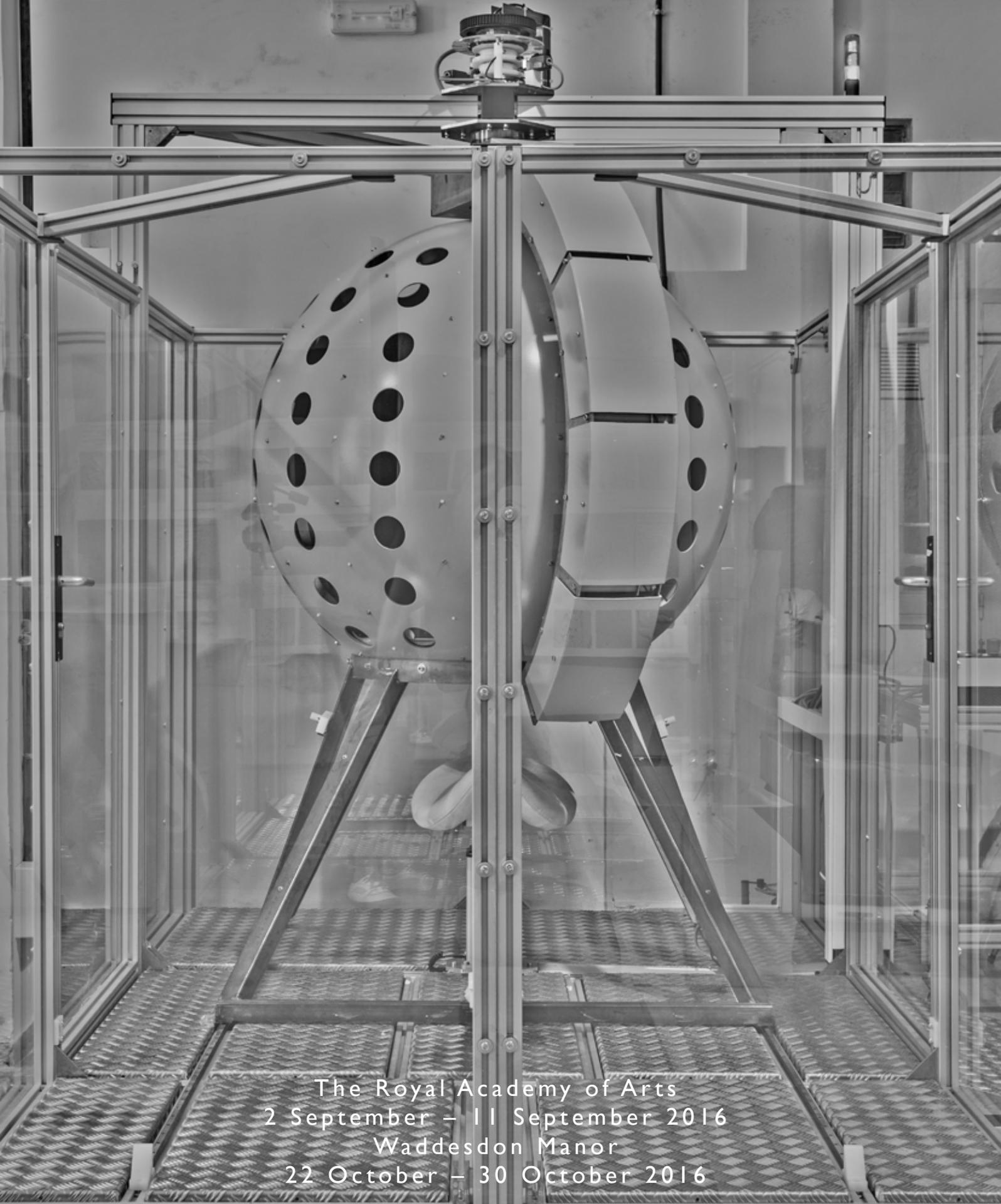


THE VERONICA SCANNER LIVE 3D PORTRAITURE



The Royal Academy of Arts
2 September – 11 September 2016
Waddesdon Manor
22 October – 30 October 2016

VERONICA CHOROGRAPHIC SCANNER

Veronica is a portmanteau of the Latin word *vera* (truth) and the Greek word *εἰκὼν* (image). In the history of printmaking 'Veronica's Veil' has often been used as an image to stress the transformational nature of the medium.

A desire to create a 'true' representation underpinned Classical art and is at the core of icon painting. Within the early Judeo-Christian tradition images not made by human hand were called *Acheiropoietoi* – the absence of subjective interpretation was thought to give access to the divine.



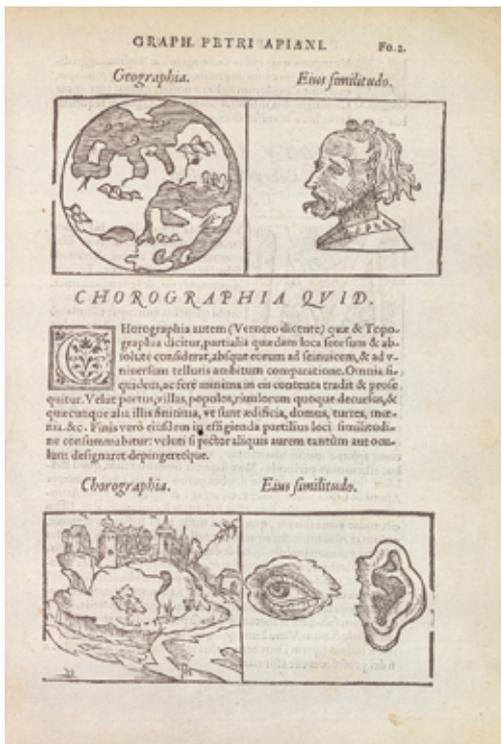
Claude Mellan (1598–1688), *The Veil of Saint Veronica, Formatur Unicus Una* (1649), engraving

In his great work *Geographia*, Claudius Ptolemy (100–170 AD) writes that geography is the study of the world we inhabit, but chorography is 'an impression of a part, as when one makes an image of just an ear or an eye'. The term chorography refers to a perceived place rather than a conceptualised representation of the whole world. As a graphic representation, chorography has similarities to photogrammetry. It is based on composite views that are added together rather than cartographic measurements (co-ordinates) that are plotted in relation to each other.

DIGITAL PHOTOGRAMMETRY

The theory behind the *Veronica* is based on multi-view photogrammetry. Photogrammetry – the science of taking measurements from photographs – requires multiple overlapping photographs taken from many angles. These images are then collated and aligned by finding corresponding features on more than two photographs. The feature-mapping is controlled by the algorithms of the software and advances in both programming and computer vision have resulted in the ability to merge thousands of high-resolution images into a 3D model formed from millions of polygons.

Generating the images that form the 'feature map' requires even, diffused light, avoiding shadow, to allow the software to accurately identify similar points seen from slightly different angles. The software then spatially relates each point to every other point in order to create an accurate 3D model that contains both information about the shape and the surface.



Peter Apian (1495–1552), *Cosmographia*, Antwerp, 1550. Woodcut. Courtesy of the Syndics of Cambridge University Library



Character portrait – a rendering of a 3D file of a face with extreme expression

INTRODUCTION



George Cruikshank (1792–1878), *First photographing*, 1841, pencil on paper. Preparatory drawing made in the first photographic studio at the Royal Polytechnic Institute in Regent Street, which opened in 1841

A feeling of excitement and curiosity surrounded the displays of science and technology at the Royal Institution in London in the nineteenth century. These played an important role in focusing and disseminating the potential of the new technologies that started to proliferate following Alessandro Volta's discovery in 1799 that electricity could be produced by chemical means. A similar frenzy accompanied the opening of the first photographic studio at the Royal Polytechnic Institute on Regent Street in 1841. Queues formed down the street to glimpse what was happening. George Cruikshank caught the mood in his cartoons of Richard Beard's studio with its complex paraphernalia and timing devices, producing small prints that took time to develop and required a magnifying glass to examine. The technology, which often malfunctioned, nevertheless provoked many to feel that this new art would undermine traditional artistic values.

Photography started out as a two-dimensional medium and was soon developed into photosculpture and then film. Now traditional assumptions about photography are again being overturned.

PHOTOGRAPH AND PHOTOGRAM

Between the 1830s and the 1850s there was great interest in deciphering ancient Mesopotamian cuneiform writing. William Henry Fox Talbot, a cuneiform scholar and the English inventor of photography, was struggling to get accurate transcriptions of this unfamiliar script and required an objective method of capturing it visually. Eventually, after using the action of light to induce chemical change, he managed to fix silver nitrate onto 'salt paper' in a range of tones. He was not the first to observe that light turns silver nitrate black, but he was one of the first to find a way to fix the image. Fox Talbot played with John Herschel's word 'photography' – literally 'drawing with light' – when he called his invention 'the pencil of nature'. But imagine what might have happened if his interest

had been in sculpture rather than writing. Instead of converting light into a mark or tone he may have used his curiosity to find a way transform it into a form. The pencil of nature could have been a chisel.

Within a few years of the invention of photography, François Willème, in Paris, was using his 'ingenious devices' to create photosculpture. He placed his sitter on a circular platform and surrounded them with 24 equally spaced cameras which, when triggered at the same time, created 24 silhouettes that together described a complete head. The *Veronica Chorographic Scanner* is a digital variation of Willème's setup.



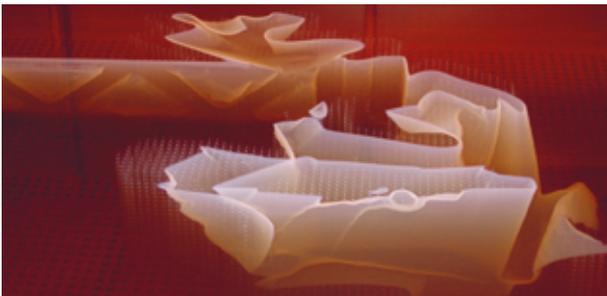
François Willème (1830–1905), *Unfinished photosculpture – portrait head of a woman*, c. 1865. Oak maquette on base. Courtesy of George Eastman Museum



Claudius and Xavier Givaudan, *A relief portrait of Louis Lumière*, 1920s. Courtesy of Musée Nicéphore Niépce, Ville de Chalon-sur-Saône

OUTPUT

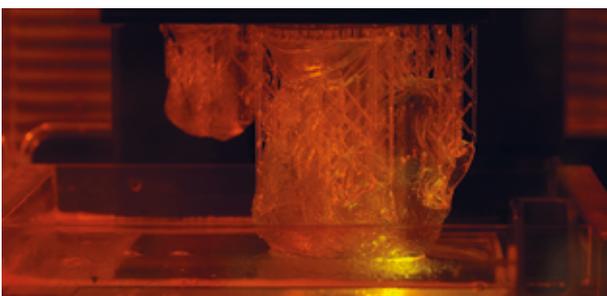
Veronica's data can be used by a whole host of output devices that print in layers, harden liquids, carve or use other methods to materialise volume from a polygon mesh or a cloud of points. The data can be printed using additive rapid prototyping technologies to produce a physical positive. This positive can be moulded and cast in wax that can be used in the 'lost wax' process to convert the printed material into bronze, brass, stainless steel, cast iron, silver, gold, silicate glass (Murano glass), lead crystal glass, and more ephemeral materials like jelly, chocolate, sugar and salt. Using subtractive systems (CNC milling) it can be carved into any stone. Alabaster and soft sandstone or limestone are easier to work but marble and other harder stones are possible. The data can also be carved into a range of polyurethane and synthetic materials. Using laser etching it can be materialised as a form inside a block of glass. Each process has its size limitations, strengths and weaknesses. We are now at a point where there is an explosion of technology – it will be interesting to watch the rapid developments over the next few years as new ideas and applications emerge.



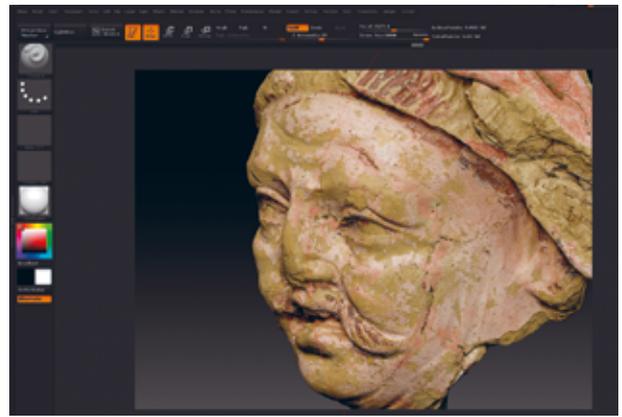
Stereo-lithographic printing. Mammoth Printer made by Materialise, Leuven



Factum Arte's concrete printer at work in Anish Kapoor's studio, printing one of his sculptures that was shown at his exhibition in the Royal Academy in 2011



Printing using a Form 2 Desktop 3D printer made by Formlabs, Massachusetts, United States



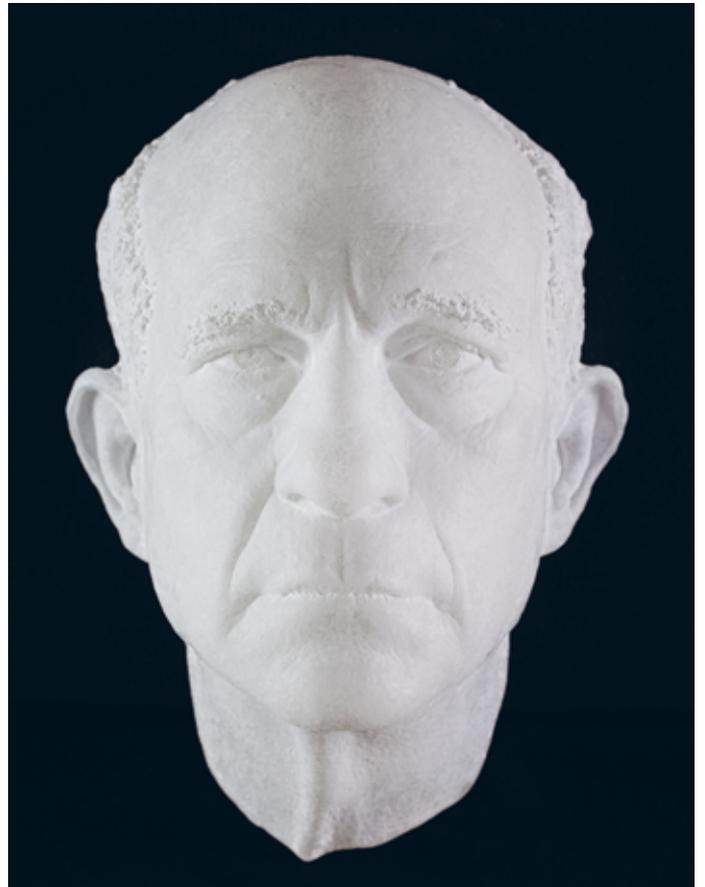
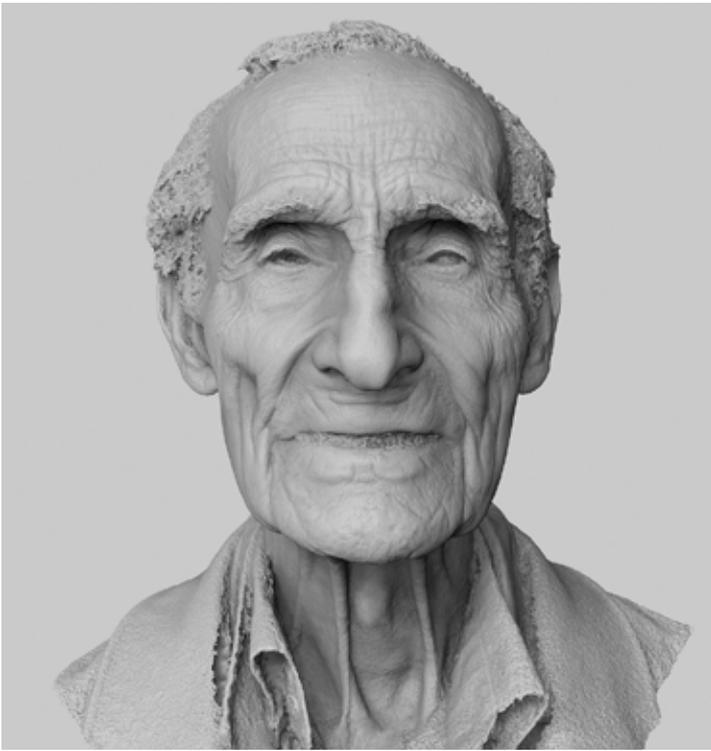
A colour rendering of a 3D scan of an unfired polychrome head from northern Pakistan. The head was recorded on the *Veronica* and will be archived while its original location is being identified.

WHAT CAN YOU DO WITH THE DATA?

The *Veronica Scanner* has evolved over a period of two years into a fully integrated package that can go from a sitting to a processed 3D file in a matter of hours. The resulting 3D file can then be turned into a physical object at any size and in many materials using both 3D printing systems or CNC carving.

Some uses include:

- Documenting and recording artistic and cultural objects in order to archive the data for further study or for re-materialisation as required. The idea of 'open museums' with free access to digital archives is emerging as the most productive way of encouraging educational uses and stimulating interest in the history of the objects and the collections they belong to.
- Annual recordings of children as they grow.
- Portraiture. Celebrities, royalty, politicians, Royal Academicians and everyday characters are recorded in exactly the same way, without judgement.
- Raw material for sculptors. Using the *Veronica*, a sculptor can start with an exact likeness in wax or clay and change the details and expressions as desired.
- Recording for statistical analysis and to monitor change. This is an important use for conservation and heritage preservation. Monitoring the rate of change of works of art is essential to the long-term survival of objects.
- Recording for medical purposes. Everyone could have their head scanned every 5 years and keep a file with them for when it is needed, such as for facial reconstruction following an operation or an accident.
- Recording for anti-ageing purposes to facilitate 'before and after' analysis. A 3D scan made with the *Veronica* provides an objective reference against which treatments can be compared.
- Providing accurate portraits for virtual animation.



Top left: A 3D scan of Justo Gallego (b. 1925), known for his lifetime work at the Church of El Pilar in Mejordada del Campo, Spain. Top right: Daniel Wolf, one of the first people to be scanned using a prototype of the *Veronica Scanner*, materialised in a block of glass using laser-engraving technology. Middle left: Justo Gallego cast in silver from a 3D-printed form, 4 cm high. Middle right: Portrait of Elisabeth Lalouschek made using the *Veronica Chorographic Scanner* with some retouching of her hair using ZBrush software. Bottom left: A portrait of Stephen Rubin in gold-plated bronze and alabaster made from a 3D print of data recorded with the *Veronica Scanner*. Bottom right: A mask of Daniel Wolf CNC-milled from a block of alabaster.

RECORDING PEOPLE – RECORDING THINGS

Portraiture helps us think about who we are and what we value. The process of digitising, mediating and re-materialising a face without manual intervention raises many questions about art and representation. The *Veronica Chorographic Scanner* produces objectively accurate sculptures and the technology is developing fast in both the image capture and in the image output. But is it art? Greek sculptors and icon painters aspired to objective accuracy without the evidence of human intervention, but for most of art history since the Renaissance, it is the act of physical intervention that has been considered artful.

One of the applications that is emerging for photogrammetry (the science of taking measurements from photographs) is in the field of digital preservation, where it is starting to play an important role in the preservation of cultural heritage. Factum Foundation is devoted to recording the surfaces of paintings, tombs, sculptures and buildings at the highest resolution possible in order to help in the complex task of preserving the past and monitoring the condition of artifacts. The application of 3D recording used to focus on capturing shape. While the *Veronica Chorographic Scanner* is still evolving, it demonstrates that it is possible to capture both the shape and surface of objects that are about the size of a human head, as long as they stay still.

Photogrammetry that records both shape and surface can be done with only a camera (in some cases a mobile-phone camera can produce good results), tripod, flash and the right software – and it can be done on a large scale. This approach has recently been used to record the Arch of Bacchus at Baalbek and all the antique stele at Nahr el-Kalb near Beirut in Lebanon, the façade of a Nabatean tomb in Little Petra in Jordan, and the site of Kala-Koreysh in Dagestan. It is currently being used to record the tomb of Seti I in the Valley of the Kings in Egypt, and the Sarcophagus of Seti I in Sir John Soane's Museum, London. Before the end of the year it will have recorded petroglyphs in Chad, monoliths in Nigeria and the Cochno Stone in Glasgow. The *Veronica Chorographic Scanner* is one of the recording systems that have been developed by Factum Foundation in response to the urgent need to use digital technology to record the past in meaningful ways.



3D rendering of the Stelae to Esarhaddon (688–699 BC). Recorded by Alex Peck on 15 May 2015 using only a 35 mm camera and a tripod

I never liked being photographed. It is more than the general insecurity shared by all mankind that manifests in the way we feel about how we look. I don't like the way I look in photographs because I don't think I look that way. The camera is a brutal distorter... everyone knows what I looked like except me. And looking in a mirror didn't help much – the image was flipped, and instead of looking at a convex image, I was looking at a flat image... Now (with the Veronica Chorographic Scanner), at least I know what I look like.

Daniel Wolf, *The Chisel of Nature*,
catalogue published by Marlborough Gallery, New York, for
Manuel Franquelo's exhibition *Things in a Room*, February 2015

THE ROYAL ACADEMY OF ARTS

The Royal Academy of Arts was founded by King George III of England in 1768. It has a unique position in being an independent, privately funded institution led by eminent artists and architects, whose purpose is to be a clear, strong voice for art and artists. Its public programmes promote the creation, enjoyment and appreciation of the visual arts through exhibitions, education and debate.

The RA is currently undergoing a transformative redevelopment which will be completed in time for its 250th anniversary in 2018. The redevelopment will reveal the elements that make the RA unique, sharing with the public the historic treasures in its Collections, the work of its Academicians and the RA Schools, alongside its world-class exhibitions programme.

THE ROTHSCHILD FOUNDATION

The Rothschild Foundation is a UK charity chaired by Lord Rothschild. In addition to its ongoing commitment to Waddesdon Manor, it undertakes major projects and provides financial and other support across a range of interests, in particular arts and heritage.

FACTUM FOUNDATION

Factum Foundation was founded in 2009. It grew out of the experimental work of Factum Arte's workshops in Madrid. Factum Arte is committed to developing new technologies and building bridges between digital mediation and traditional craft skills in the creation of contemporary works of art for many artists from around the world. Factum Foundation is devoted to applying these technologies to the preservation of cultural heritage and demonstrating the important role technology has to play in deepening our understanding of the importance of the evidence of the past.

VERONICA CHOROGRAPHIC SCANNER

The *Veronica Chorographic Scanner* is a bespoke 3D scanner. The high-resolution 3D recording system has been focused in the hands of artists, mechanical and electrical engineers, artisans and fabricators working under one roof at Factum Arte in Madrid. The design and development of the scanner was made possible by the Factum Foundation. The Rothschild Foundation provided the funds to make the model that is on display.

Designed by Manuel Franquelo Giner and built by Enrique Esteban, Pedro Miró, Manuel Franquelo Lerín, José Sánchez, Quinner Baird, Andrew Hennessey and the engineers and electricians at Crevi, Madrid.

The operating software for the scanner was designed and programmed by Enrique Esteban.

Software to process the data was provided by Capturing Reality and Autodesk (cloud processing).

THE SPONSORS

Capturing Reality
Autodesk
iMakr (MyMiniFactory)
The Bartlett School of Architecture
Tomasso Brothers Fine Art

Exhibition design by Charlotte Skene Catling.
Lighting design by Neal Taylor, Spectron London.
Text written by Adam Lowe.
Leaflet design by Blanca Nieto.