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THE CAMERA WHO CHANGES ART FOR EVER

WHAT LIES BENEITH

Are art restorers unwittingly ruining the paintings they're trying to preserve? The inventor of a powerful new camera - capable of picking out Leonardo's thumbprint among the brushstrokes - thinks so. Alasdair Palmer meets the man breathing new life into Old Masters

"It's a revelation!", Mike Daley exclaims. An artist and historian of art restoration, he is asthonished by the reproduction on the giant screen in front of him.

'It' is a recently-developed digital camera whose primary use is to produce images of Old Master paintings. I can testify that its results are every bit as astonishing as Mr Daley's amazed reaction suggests. The reproduction is so accurate and the resolution so high that it is possible to magnify an image of the surface of a picture to produce details that no-one has ever seen before, and no-one suspected were there.

Mr Daley and I are in the office of Lumiere Technology in the Boulevard St Germain in Paris. Pascal Cotte, the camera's inventor, is demonstrating its powers. We're looking at an image of Leonardo Da Vinci's wonderful picture *The Lady with the Ermine*. The sitter was probably Cecilia Gallerani, who was only 16 or 17 when her portrait was painted; she was also the mistress of Ludovico Sforza, the Duke of Milan, then employing Leonardo on a variety of projects, the least important of which involved him in painting something. Mr Cotte focuses in on the

necklace that stretches round Cecilia Gallerani's throat and down her chest to her bosom. "Obviously, some of the necklace beads are not by Leonardo", Mr Cotte asserts. He increases the magnification – and lo and behold, we can all see that whereas some of those beads have exquisite definition and shape, others have been executed very clumsily, almost to the point where they are mere blobs of black paint.

Leonardo da Vinci's 'Lady with an Ermine': the digital image (right) shows that the original background was blue, not black.
Below: Leonardo's thumbprint, as revealed on the painting

"Leonardo would never have done that", comments Jacques Franck, who is also in the audience. Mr Franck is probably the world's greatest expert on Leonardo's technique. He has done what no-one else has managed to: he has himself painted copies of Leonardo's pictures which are almost indistinguishable from the originals, using the technique he believes Leonardo employed.

"But just take a look at this!", says Mr Cotte. An ebullient father of five, he has just turned 50 -- but he looks about twenty years younger. He increases the magnification higher still, and we investigate the delicate contours of the depiction of the exposed flesh between Cecilia Gallerani's neck and the start of her dress. We all gasp as we start to see, in unprecedented close-up, the subtlety of Leonardo's *sfumato* technique, which models the undulations of the surface of her skin by a series of almost imperceptible changes of colour and tone. As the magnification increases, the brush strokes begin to be visible -- but they are so fine, and they blend together so perfectly, that even at this level of magnification, they are very difficult to discern.

Lumiere Technology – Press Release Sunday March 16th 2008
Jean Penicaut & Pascal Cotte are at Tefaf Maastricht – Stand 527 Business Pavillon

1

Someone starts to rhapsodise about the marvels of Leonardo's technique. "No, not the *sfumato*!" Mr Cotte interrupts. "I mean this!" He increases the magnification further still, and we see something that resembles an imprint left by a thumb. "That is exactly what it is", explains Mr Cotte. "You are looking at Leonardo's thumbprint!"

The audience gives another collective gasp. But there it is, unmistakable now: the imprint of Leonardo da Vinci's thumb. "Leonardo used to smear paint very lightly with his fingers at this stage of his career", explains Mr Franck.

So 500 years after Leonardo used his thumb to smooth the surface of paint depicting Cecilia Gallerani's chest, the use of that technique is visible for the first time -- thanks to Pascal Cotte's camera.

But magnifying the surface to produce extraordinary details is not the only thing that his camera can do. . "And now I will highlight the paint which was not put on by Leonardo," announces Mr Cotte in the manner of a conjourer. We see an image with different coloured patches, concentrated mostly at the bottom and on the sides of Cecilia's figure.

A brighter, cleaner, clearer image of *The Lady with the Ermine* appears on the screen. "This is how it would look if you took off the layer of varnish, and re-touchings added in the centuries after Leonardo", Mr Cotte states. The background has changed colour from black to blue. "All of the background in this picture was added later, possibly in the 19th century", he explains.

"Leonardo would certainly have graded the background", points out Mr Franck. "He never painted edges with sharp, ungraded contrasts of the kind that are now visible in *The Lady with the Ermine* between the sitter and the background behind her. Leonardo always painted a series of tones, with each tone blending into the other, even when he was depicting the edge of a white face against a dark background. That is part of what gives his figures their extraordinarily realistic look."

Pascal Cotte smiles and nods in agreement. His camera can't yet paint like Leonardo – but it can do a hell of a lot of the things, many of them of inestimable importance to art historians and restorers. A "virtual restoration", in which you can see what the painting would look like with the top layer of varnish removed, but which does not involve touching the original masterpiece itself *at all*, is a tool of enormous value.

The whole thing seems to be a kind of magic. What exactly is going on? How on earth does Mr Cotte's camera work?

"We used to take photographs", he explains. "Now we take measurements". His camera can take measurements of unprecedented precision: its lens focuses light down to six microns – and if you go any smaller than that, you run up against the law of optical diffraction which means the waves of light start interfering with each other.

The wavelength of the light reflected by each of those minute points is then analysed and measured by the camera. There are 240 million such points in each scan the camera does of any picture – and in order to capture the light from every part of the spectrum accurately, the camera scans each picture 13 times. The final image is constructed from the data from all of those billions of measurements. Its colours are determined by an equation, devised by Mr Cotte, which gives a numerical value for each pixel. That value is the function of a series of variables, including the kind of light the pigments are viewed under, for pigments will reflect differently under daylight than they do under candlelight or fluorescent light, which is why paintings appear to be made up of different colours in different lights.

The combination of the values generated each of those pixels is what makes the image of the painting produced by Mr Cotte's camera – and it is an image which can be magnified, with perfect clarity, to show extraordinary details such as Leonardo's thumbprint.

In order to "take off" the painting's varnish, Mr Cotte devised a piece of software that calculates the effect of varnish on the wavelength of light reflected by each colour pigment used by painters during the Renaissance. "That was very difficult and laborious", he explains. "It required us to identify every pigment they used, take some very detailed measurements, then compare the wavelengths reflected by each pigment with light reflected off a plain white surface covered with the kind of varnish used by painters in the past, aged appropriately by exposure to heat and ultra-violate light."
At the end of that process, Mr Cotte was able to subtract the effect of varnish on the wavelength of light coming from each point focused by the lens of his camera. That calculation produces an image of a painting, such as Leonardo's *Lady with the Ermine*, with the varnish taken off.

Lumiere Technology – Press Release Sunday March 16th 2008
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2

"We can't", Mr Cotte says with due scholarly caution, "say definitely that this represents the final truth of how the picture would look without varnish. We can only say that it is a much better guide – that it is much closer to the truth – than anything else."

That much is indisputable -- and it is going to have some momentous effects on the art world, not least upon the way paintings are cleaned. "For more than fifty years", says Mike Daley, "an argument has been raging about the merits of restoration. This camera is going to settle that argument. For the first time, we have an objective way of seeing what a painting looks like underneath the 'later additions' that the restorers always want to clean off."

The argument between restorers and their critics has been heated and at times vitriolic, which is not surprising considering that one side accuses the other of destroying much of the heritage of Western art. Restorers, at least in the Anglo-American world of galleries and museums, have insisted that everything they do is 'scientific', and that they merely remove paint and varnish added after the original master had finished or abandoned his work. The most they ever do, they say, is to take the picture back to the way it would have looked when it left its original creator's studio.

The restorers' critics – of whom Mr Daley is one – have a rather different view of their work. The critics say that restorers frequently destroy the pictures they get their hands on. "Restorers in Britain and America always say they're 'only' taking off varnish", maintains Mr Daley, "but only too often, they take off far more than that, and scrape or dissolve off the top layer of paint and glaze as well."

In common with other critics, Mr Daley charges that restorers simply cannot tell where the varnish added by later hands ends and the layers of glaze and paint put on by the original artist begin, for the two bond together over time. "When oil paintings emerge from the hands of restorers", he asserts, "many of them have lost all the grace and subtlety of the modelling of figures and landscape, as well as the colour harmony. The three-dimensional effects are gone. The result is frequently flat, lifeless, dull – and in my view, wrecked."

He says examples are only too obvious in London's National Gallery. "Just take one look", he adds sadly, "at *Bacchus and Ariadne*, whose surface has been scrubbed by restoration, and

compare it with *The Worship of Venus* and *The Adrians*, both of which are in the Prado in Madrid."

Varnishing act: Titian's 'Bacchus and Ariadne' (left), whose 'subtlety has been destroyed'; and his better-preserved 'The Andrians'

All three pictures were painted by Titian, at the same time and for the same room in the palace of the Duke of Este of Ferrara. "But the National Gallery's *Bacchus and Ariadne*", insists Mr Daley, "has had 'just' the varnish taken off, while the Prado's *The Worship of Venus* and *The Adrians* have not. *Bacchus and Ariadne,* post-restoration, is now much brighter. But I defy anyone to fail to notice how the colour harmony, the modelling and the subtlety of the National Gallery's Titian has been destroyed. When it was shown next to the Prado's paintings in the Titian exhibition at the National Gallery in 2003, the comparison was shocking."

Restorers counter that critics such as Mr Daley do not understand the "science and technology" of restoration. They can, they say, prove scientifically that they only remove later re-paintings, and never take off anything added by the original artist: their critics, they insist, don't know what an 'original' painting would have looked like, and are attached to versions of Renaissance works (for instance) which are covered in much later additions.

So who is right? The restorers or their critics? Pascal Cotte's camera has already begun to provide critical evidence that will resolve the matter. The Musee des Beaux Arts in Lille has a painting of a mother with her child and baby, probably by Hans Holbein the Younger. Restorers decided the picture needed cleaning, and got to work: they took off what they said was merely "later varnish" from the baby. The restored figure of that baby now looks very different to the rest of the picture. The baby is full of bold pinks – but the modelling is crude and crass, and the baby seems flat and one dimensional in comparison to the two other figures.

Lumiere Technology – Press Release Sunday March 16th 2008
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3

Is the result of that restoration simply the exposure of the reality of the painting that is underneath the varnish? Or have the restorers unwittingly removed some of the painted surface?

The image of the whole painting minus varnish, produced by Mr Cotte's camera, provides the answer: it seems to show very clearly that the restorers had stripped away some of the original paint during their restoration. For the modelling of the other figures underneath the varnish has, according to the image created by the camera, all the richness and three-dimensionality that the restored baby so obviously lacks.

The image has already had an effect on the Musee des Beaux Arts' restoration policy. Alain Tapie, the Chief Curator, took one look and decided to halt the restoration of the Holbein indefinitely. During the Last European Heritage Day 2007 the half-restored picture was exhibited in the Musee des Beaux Arts – and along side it is the image from Pascal's camera of what is underneath the varnish in the rest of the painting.

Cleaning of Hans Holbein the Younger's portrait has left the baby looking one-dimensional (left); a digital image of the original painting, underneath the varnish, reveals a much richer picture

"If Pascal's camera is used, as it should be, to record images of paintings in collections around the world", maintains Mr Daley, "it will change the way restoration is done, and may prevent much of it from being done at all." Museums and galleries, he insists, will no longer be able to claim that they alone "know" what a painting looks like underneath what are alleged to be later additions, and then assert that their own restoration merely reflects that original state. Mr Cotte's camera will provide a publicly accessible, objective image against which any museum or gallery's claim can be checked. As Jean Penicaut, his partner at Lumiere Technology, explains: "in future, you will only need access to the internet to be able to call up images from the camera. We hope to be able to provide, on line, a secure data base of pictures we have photographed."

Restoration will not, however, be the only discipline dramatically affected by Mr Cotte's new camera.

The authentication of paintings and the identification of fakes and copies is going to be transformed as well. Every great artist had a unique way of applying paint: each of them had an idiosyncratic style of brush-stoke. But at present, it is almost impossible to identify that brush "signature", at least at the level of detail at which the human eye can see. By magnifying the painted surface with such perfect accuracy, Mr Cotte's camera can make visible the brush "signature" of each great artist. It should make it possible to show, definitively, whether a painting is by, say, Rembrandt or Raphael or Titian – or whether it is not.

But that is in the future. For the moment, the camera's images simply inspire wonder and astonishment. In Lumiere Technology's office in the Boulevard St Germain, we seem to be looking, not at a reproduction of *The Lady with the Ermine*, but at the original itself. The revelation generated by Mr Cotte's camera is here now. As Mike Daley puts it, his jaw dropping ever lower, 'It's a revolution... no, it's a revelation and a revolution!'

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