Engineer Pascal Cotte in front of scans of the *Mona Lisa* made using his 'layer amplification method'.

ART

Under *Mona Lisa*'s smile

Philip Ball is intrigued by an analysis of Leonardo's iconic painting.

Like Michelangelo's *David* or the music of The Smiths, Leonardo da Vinci's sixteenth-century masterpiece *Mona Lisa* is one of those cultural icons that leave me cold. I can think of a dozen Renaissance portraits I'd rather spend time with. So *Mona Lisa*, a new analysis by Leonardo authority Martin Kemp and economist and amateur historian Giuseppe Pallanti, presented a challenge. Could it persuade me that the fuss is justified?

Kind of. Like the painting itself, the story of the *Mona Lisa* has many layers, and as more are revealed, one is drawn deeper into those appraising eyes and that dreamlike landscape. You begin to understand that in creating it, Leonardo performed an act in some ways baffling even now, with a technique verging on the miraculous. "He knew that no one had ever done anything like it before," Kemp and Pallanti write. "We now know that no one has ever done anything quite like it since." To probe that feat, they marshal meticulous research into the family histories of painter, patron and subject; deep knowledge of the traditions and allusions of Renaissance art; and scientific analyses of the venerated object.

What results is something of a jigsaw puzzle. Pallanti has diligently traced the stories of the people behind the portrait, although there's nothing particularly striking about the Florentine merchant Francesco del Giocondo, who commissioned it, or his wife Lisa. The detective work on Leonardo is more interesting, pointing to the orphaned teenager Caterina Lippi as the mother of the artist,

Mona Lisa: The People and the Painting

MARTIN KEMP & GIUSEPPE PALLANTI
Oxford University Press: 2017.

"poured his powers as a painter. It became his personal expression of what the 'science of painting' could accomplish."

That "science of painting" too often boils down to anodyne assertions about the Renaissance unity of science and art. But as the book explains, it entailed more than the artist's use of scientific principles such as perspective to create a humanistic realism. Leonardo felt that art could reveal truths with something like the authority of a scientific demonstration. And, crucially, this revelation was shaped by the artist, whose task was to emphasize correspondences in natural form and structure.

Thus, Kemp explains how the strange, out-of-kilter landscape behind Lisa encodes beliefs about analogies between the earth and the body, a relationship of microcosm to macrocosm. The cascading fabric of her dress reflects Leonardo's idea of universal flow

born out of wedlock in 1452. But the story really comes alive in its methodical unpacking of Leonardo's intent.

The works of Renaissance artists were generally meta-physical statements, and the *Mona Lisa* more so than most. The "smallish panel" (79 by 53 centimetres) was, the authors write, a "supreme vehicle" into which Leonardo

forms. In his notebooks, he writes of drapery in terms of how "nature makes it flow", and draws parallels between the flow of water and the fall of hair. The bluing of the landscape with distance, which Leonardo called "aerial perspective", was based on a detailed theory of light and air, informed by the classical theory of atomism. Leonardo's writings and drawings — on engineering, anatomy and geology, for instance — are informed by the same sense of a dialogue between observation, perception, representation and creation (see M. Clayton *Nature* **484**, 314–316; 2012).

Leonardo studied geometric optics through meticulous observational records and in texts such as Ibn Al-Haytham's eleventh-century *Book of Optics* (see J. Al-Khalili *Nature* **518**, 164–165; 2015). But although he felt that artists should know these rules, he did not follow them slavishly. Leonardo altered to suit his purposes: the *Mona Lisa* is, Kemp and Pallanti write, "veiled by the optics of uncertainty". Leonardo saw painting as a "subtle invention", in which the artist's sensibility remakes laws to disclose a deeper truth about how, as well as what, we see.

That uncertainty demands forensic examination of the painted surface, where much is illusory: "the apparent contours of Lisa's face dissolve into indefiniteness". The subtle skin tones are created by glazes so fine that modern techniques such as X-ray fluorescence spectroscopy struggle to distinguish them. Shadows are conjured from repeated glazes of burnt umber, exquisitely blended. The authors examine new insights into Leonardo's techniques revealed by ultrahigh-resolution scanning at different wavelengths — the 'layer amplification method' developed by engineer Pascal Cotte. But even here, it isn't always clear how to interpret what is seen.

To fully understand the *Mona Lisa*, we also have to relate it to the conventions of Renaissance portraiture. The enigmatic smile, for example, can be traced to conceptions of femininity represented by Beatrice in Dante's *Divine Comedy*. Even these rules were made to be broken: Lisa's direct gaze defies expectations of a demure female portrait. That smile and those eyes were meant for Francesco, not ogles in a gallery. Yet as the painting progressed, Leonardo seems to have lost sight of his patron's requirements. He knew he was making a bold, personal statement, which is perhaps why he held on to it all his life.

Now that it's no longer possible to contemplate the painting closely enough to develop a proper relationship with it, I don't have high hopes that I will grow to love it. But this book gives me a chance. ■

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