In his recent book Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters [1], David Hockney proposes that the “optical quality” of Flemish art of the early 1400s arose because the artists, van Eyck in particular, suddenly began to use optical devices to create precise projections onto the canvas of the scenes they wished to depict. In presenting this case at a 2001 symposium on the issue [2], Hockney described one particular painting as the “Rosetta Stone” of his argument, because it was the one that allowed the details of the optical hypothesis to be examined most accurately. That painting was Lorenzo Lotto’s Husband and Wife (1523–1524, also known as Portrait of a Married Couple) (Fig. 1). In it is depicted a tapestry tablecloth with a distinctive octagonal feature at the center of the table. This feature has the curious property that it seems to go out of focus as it recedes from the viewer. Hockney argues that this blurring is “proof” that Lotto copied the detail of this pattern from an optical projection of a real tapestry in his studio, validating the idea that optical projection was in widespread use during the Renaissance (long preceding the well-known 18th-century use of the camera obscura by such artists as Canaletto and Joshua Reynolds).

Before considering the plausibility of Hockney’s specific claim about the Lotto painting, we should consider that the single patch of blur on this tablecloth makes a weak case for the widespread use of optics, because it is the only Renaissance painting (in southern or northern European art) that exhibits this particularity. In the art of the early Renaissance, both the geometric-perspective works of the Italians and the Flemish works exploring optical and light effects are renowned for the precision of their outlines. When a freer style appeared with Titian, Tintoretto and Rubens (for an example, see the Rubens painting Bathsheba at the Fountain [c. 1635], available online at <http://www.abcgallery.com/R/rubens13.html>), a blurring extended throughout the painting, as opposed to the appearance of a region of sharp focus spreading into blur. Even if Lotto had used optical projection, this isolated piece of evidence would not support a case for its widespread use.

These considerations call into question the concept of an “optical look” that plays so great a role in Hockney’s account [3]. He associates this optical look with the high accuracy and strong shadowing of such artists as van Eyck and Caravaggio. In fact, however, Hockney’s own demonstrations (with David Graves), both for the book and at the 2001 conference presenting these ideas [4], made it clear that the kind of optics available to Renaissance artists would have had a narrow depth of focus and a large degree of blurring in objects slightly outside the focused region. The look of an optical projection would thus consist of a pronounced fluctuation between sharp focus for objects in the focal plane and soft focus elsewhere throughout the image [5]. To create a true “optical look” would indeed have entailed painting this fluctuating focus, which is typically seen in the photorealist works of our own times. No such fluctuating focus is seen in any other Renaissance works; it seems to first appear in the 17th-century paintings of Vermeer [6]. Moreover, many of the arguments in Hockney’s book can be shown to be questionable under critical examination, as specified in the accompanying material on the Leonardo web site [7].

To address the above discrepancy, Hockney and his collaborator Charles Falco, an optical specialist at the University of Arizona, propose that the artists who used optical projection frequently changed the position of the lens to refocus on each Viewer. Hockney argues that this blurring is “proof” that Lotto copied the detail of this pattern from an optical projection of a real tapestry in his studio, validating the idea that optical projection was in widespread use during the Renaissance (long preceding the well-known 18th-century use of the camera obscura by such artists as Canaletto and Joshua Reynolds).

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Tyler, because the projection’s small field of view would have required the projection to be refocused multiple times both laterally and in depth. To make his case, therefore, Hockney would have to establish the joint occurrence of accurate local and discordant global perspective in the same painting. This conclusion, incidentally, precludes the idea that optical projection was extensively used during the Renaissance, since most Renaissance perspective paintings are geometrically accurate both locally and globally.

The painting that Hockney and Falco choose as their prime example, Lotto’s *Husband and Wife*, which was painted a century after the supposed transition to opticality, exhibits perspective only in the central region of this pattern must, using Falco and Hockney’s hypothesis, have been painted without readjustment of its optical projection [14]. This region of the painting should therefore have been copied to exactly match the optical projection. It follows that the geometry within this pattern element should be perfectly coherent, exactly adhering to the laws of perspective projection. Technically, these laws imply (1) that each set of parallel lines within this octagonal pattern should project to a single vanishing point and (2) that all the different vanishing points should lie at the same horizon level. This alignment of vanishing points along the horizon is a geometric rule of perspective that must be followed by any undistorted optical projection.

If the central rosette of the octagonal figure was copied from an optical projection, it is just the kind of local patch that should have accurate perspective construction. Indeed, although the complexity of the octagonal rosette provides the only plausible rationale for Lotto having chosen to use optical projection for this otherwise rather simple pattern, one look at the projections of the two sets of oblique parallels within the rosette shows that they inconspicuously fail to adhere to any consistent horizon (Fig. 3). The projections intersect in at least four vanishing points, all at different heights. Two of the pairs of lines do not even converge, but diverge away from the others in a manner that would be impossible in a

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**Fig. 2. Husband and Wife, detail of the octagonal design on the tapestry, with ellipses showing Hockney’s estimate of the size of the largest clear zone of optical projection superimposed at three successive locations on the design. (Imposed lines © Christopher Tyler) All features within one of these clear zones should have coherent perspective.**
projection onto a vertical canvas. The geometry of the rosette therefore refutes the idea that it was constructed by tracing an optical projection.

The alternative to the optical projection hypothesis is that Lotto drew the pattern casually, with only sufficient accuracy to give the impression of a deep-pile tapestry as a background for his portrait, and was not concerned with a geometric accuracy that might withstand examination half a millennium into the future. On this interpretation, the locations of the vanishing points would be haphazard and would not conform to any particular geometric rule. The further alternative that the tapestry itself did not have accurate geometry is highly implausible, based on this geometric analysis. Although it is difficult to show directly, to state this alternative would be to imply, for example, that the octagonal motif on the rug itself was drastically distorted, in order to account for the steep convergence of the construction lines. While some misalignment is possible, such a pronounced deviation from parallel is highly unusual in Persian rug designs.

Detailed examination reveals another curious feature of the octagonal pattern—lines connecting symmetrical corners of the pattern are not parallel to each other. To evaluate this issue clearly, the reader is invited to view the perspective on the tapestry transformed to show the pattern in plan view [15], as if seen from directly above the table (Fig. 4). The degree of distortion entailed is visible in the anamorphic shape of the man’s hand at left. The configuration of the octagonal element now becomes clearly visible. Despite the rectangularity of the pattern around it (dashed lines), the octagonal motif is severely distorted. The projection lines reveal a substantial convergence to the right in the upper and lower parts of the motif, although this is inconsistent with the central section remaining parallel. The bottom of the “stem” of the octagon meets the edging at two discrepant levels (dashed lines). None of these geometric misalignments would be possible if the pattern was copied from an optical projection. It is clear that this octagon is heavily distorted, making it quite unlikely that either optics or perspective geometry were used in the depiction of this tablecloth.

The implication of this geometrical analysis is that Lotto simply “eyeballed” the pattern of the tablecloth, to use Hockney’s term [16]. Unlike some of his contemporaries, such as Hans Holbein, Lotto did not appear to pay particular attention to geometric accuracy. His paintings rather emphasize the emotional interplay among the characters depicted. It makes sense that he would have given only cursory attention to the details of the tablecloth on which his sitters are leaning, approximating the details of the pattern rather than using multiple optical projections. If Lotto’s painting is the core of their evidence for the early use of optics, one would have to conclude that the case advanced by Hockney and Falco is weak at best [17].
When it comes to painting, Hockney does not appear to believe his own proposal that optics were used for slavish copying zone by zone. For his book [18], Hockney went to great lengths to set up a camera obscura with the optical device of a concave mirror and make some sketches of a sitter in Renaissance garb to demonstrate the feasibility of the optical approach to artistic representation. The resultant drawings are reproduced in his book. At the New York conference discussing these issues, however, Hockney was asked why the book did not show any paintings generated by this method. His reply was that he had tried painting with his camera obscura, but had abandoned the effort “within 10 minutes” because it was far too impractical. He very soon turned to copying the projected image by painting onto a separate canvas rather than trying to mirror the details directly on the plane of projection. He was sure that any Renaissance artist would have had the same experience, turning to the copying approach within 10 minutes. His own attitude to the plausibility of the optical hypothesis is, therefore, much more ambiguous than his writings would imply.

It is obvious that, once he relies on his eye to match the painted and the projected images, Hockney is in very much the same situation as the traditional artist setting up his easel in the direction of a scene to be copied. Perhaps the framing and optical qualities could be enhanced by setting up an optical projection booth in which the particular region of interest could be isolated from its background [19], but the use of an optical device to project the image directly onto the canvas on which he was painting seemed unworkable according to Hockney’s report.

It is hard, therefore, to integrate the optical precision with which Falco supports the hypothesis with the aversion to the use of optical aids described by Hockney as the artistic practitioner.

We are left with the implication that artists relied on native skill and intensive practice to achieve their lifelike effects. Indeed, the typical apprenticeship of a Renaissance artist was to spend the decade from ages 10 to 20 copying from the works of a master and from sculptures.

This kind of intensive training would have developed a fine sense of intuitive construction that would have allowed the painter to capture any gesture or expression with ease. Positive evidence for this view may be obtained from paintings in which the subject is caught in motion. Although easy enough to achieve with a camera, such a depiction was a tour de force in the days before photography. A striking example is available from the work of Lotto himself: his painting of the Angel of the Annunciation, who was often depicted at the moment of landing on earth, with garments aswirl (Fig. 5).

To attempt to set up this scene for optical projection with a model would clearly have been impossible. The figure is off-balance and the garments are clearly floating in a rush of wind. Even if the model could have approximated this pose by leaning against a support, the diaphanous fabric would have hung limply by her sides. The spectacular dynamism of the action captured by Lotto in this scene must have been purely a product of the artist’s observational memory and painterly skill in rendering the fluidity and freedom of the fabric in motion. In our age of high-speed photography, it is easy to forget that at that time only the painter could capture time in flight in this way. Lotto’s angel illustrates that an ill-considered appeal to optical devices does disservice to the wide-ranging abilities of the Renaissance masters of Hockney’s subtitle.

Acknowledgments

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References and Notes


3. Hockney [1].

4. See Ref. [2].


7. Tyler [5].


The widths of the estimated projection zones are based on the 118-cm width of the painting. The depth of the zones is set so as to provide for the degree of defocus evident in the painting. It should be noted that the region of defocus occurs at the center of the octagonal design in the tapestry. It would seem evident that, if Lotto had needed to use the optical projection technique to obtain an accurate representation of the design in the tapestry, he would have naturally centered one of the projection zones on the most complex feature of the design, which is this octagonal rosette. It therefore seems paradoxical that this would be the one feature of the painting that is out of focus. The accurate rendition of the perspective projection of this complex design would form the principal rationale for the use of optical aids in the layout of this painting.

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