

Guest editorial

Where art, optics, and vision intersect

The human psyche thrives on conceptual intersections. In themselves, optics may reduce to desiccated formulae, art to superficial imitation, and vision to gratingology (I am focusing on past flaws here). Yet their concatenation has produced one of the liveliest debates in recent years. Spearheaded by our foremost contemporary artist, David Hockney, the role of optical projection in art through the past half millennium has undergone extensive re-examination. Optics has been brought to life by his demonstrations of the vivid quality found in projections of real still-life scenes. Renaissance painting has been revived by the scrutiny of the techniques that artists may have developed. And vision takes a central role in forming the theatre of consciousness in which these ‘productions’ are played out.

The core claim is that artists used optical devices to project and copy posed scenes over a century before the first historical reports of optical projection (by della Porta in the 1560s). Hockney and his physicist collaborator Charles Falco have envisaged a scenario in which unknown optics masters developed concave mirrors of sufficient precision to be used by artists to project scenes for accurate rendition of their details, and that this advance had springboarded the stylistic revolution in art of the 1430s. Nick Wade evaluates the claims in his sceptical review of Hockney’s recent book *Secret Knowledge* on page 1407. But this is just the skin of the many-layered onion in relation to the commotion that the hypothesis has generated over the past couple of years. Beginning with an article in the *New Yorker*, the controversy has been covered in numerous media sources and is on permanent display in at least two websites: <http://www.artandoptics.com> and <http://webexhibits.org/hockneyoptics/>.

The point where perception enters the debate is not the historical plausibility of the optical conspiracy or the manner in which painters might have used such tools, but the visual qualities of optical projection. Virtually all of the ‘optical’ paintings that Hockney features have lustrous highlights, deep shadows, rounded forms and impressive detail. These represent a ‘new look’ in painting early in the Renaissance, coinciding with the introduction of oil paint into fine art by van Eyck and others. We may think of such ultra-sharp images as ‘optical’, but in fact the paintings have an infinite depth of field (they are in focus everywhere), corresponding to an integrated version of our visual impressions rather than anything that can be delivered by physical optics.

The optical reconstructions provided by Hockney, on the other hand, have many properties that are strikingly discrepant from the paintings from which they were supposedly derived. His illustrations make it clear that the real optical image is dim and fuzzy, with a very narrow depth of field. There are a couple of examples of paintings with a plausible range of local blur, but it is evident that the ‘optical look’ of which Hockney makes so much is very different from the look of the actual optical devices that he proposes. In life, the optical projections have a vivid, glowing quality that seems largely attributable to the narrow depth of focus, which picks out certain regions for sharp focus but provides heavy blur to other parts of the scene extending away from the plane of sharpness. It therefore seems that the new look that started in Flanders in the early fifteenth century arose from different sources than the available optics, since it is almost entirely sharp throughout the image. Hockney’s case would be far more convincing if he had shown examples of sharp optical renditions of similar subjects, particularly the Laughing Cavalier, the distorted hands of St Peter, the Holbein globe, and so on.

One of the points that Hockney makes is that many artists, such as Caravaggio, left no preliminary drawings of their work. He uses this fact to argue that they therefore must have used optical aids to get such accurate paintings. However, his own reconstruction of the process of drawing a sketch with an optical aid explicitly involves a sketch, which is then proposed for use as a basis for the completed painting. Hockney nowhere explains how one would make a painting directly on the surface where the optical image was projected. It seems that the optical projection would make it very difficult to see the effect of paint per se. For example, if one painted purely in white under an optical projection, the result would look exactly like the optical projection. By the same token, the projection would tend to mask the effect of coloured paint and make it difficult to match the lustre of the optics when they were removed (like the loss of brilliance in a beachcomber's pebbles once they dry!). Moreover, the slightest twitch in the sitter's position would make it difficult to maintain the integrity of the design.

We can consider some of Hockney's specific claims, based on the treatment available at the WebExhibits website. One of the core ideas is that the perspective geometry of a painting can be used to uncover the methods used by artists to construct a painting. If the perspective is perfect, of course, it offers no clue as to the source of the perfection. The proponents of the optical theory argue that the available optics were limited, so that only small portions of the painting could be copied from a projection from any one position. "With mirror-lens projection, the usable image is never much more than a foot (thirty centimetres) across—this is an optical characteristic of all concave mirrors, no matter how big there are. Outside this 'sweet spot' it is impossible to get the image into sharp focus." This limitation would imply that the perspective, as revealed by its vanishing points, should be uncoordinated from one region of the painting to another. Hockney looks and finds such uncoordination—ergo, optics must have been used!

The flaw in this argument is, of course, that uncoordinated perspective could equally arise from much more plausible sources. Medieval paintings are renowned for their wacky perspective, but nobody claims that they were painted with optics. Any lack of knowledge of or interest in the geometric rules of perspective would result in similar uncoordination. The real test, which Hockney does not apply, is to find coherent local perspective in regions in which the optics may have been used. If a painting fails this test, its perspective fails to support the optical theory. One can never say that optics were not used to draw one or two lines, but Hockney's whole case is that the paintings provide evidence of the use of optics at a time for which there is no other historical evidence. If the evidence is not in the painting, he has no case.

One of Hockney's key examples is the analysis of the vanishing points in Holbein's *The Ambassadors* (1520). This painting depicts a wide array of astronomical instruments, although, remarkably, none of them have any optical components (a century after optics were supposed to have been introduced into art, under Hockney's theory). The analysis of this painting for optical clues is misleading and incomplete because only three perspective lines are shown for each object. The book on the left with a set-square used as a book-mark, for example, has several other lines on the same horizontal plane that could be used to triangulate its vanishing point (figure 1, upper inset, black lines). If the construction of these edges are completed, it is obvious that this single small structure has a broad spread of vanishing points, not just one. This spread could not occur if this small object had been traced by means of optical projection after setting his supposed optical device to focus on this object. It must imply that Holbein sketched the lines of the structure freehand, and that he did not apply the rules of perspective geometry to its construction.

Commenting on another feature of *The Ambassadors*, Hockney asks "Was the painting constructed using a mirror lens? The globe seems to suggest this: it is incredibly

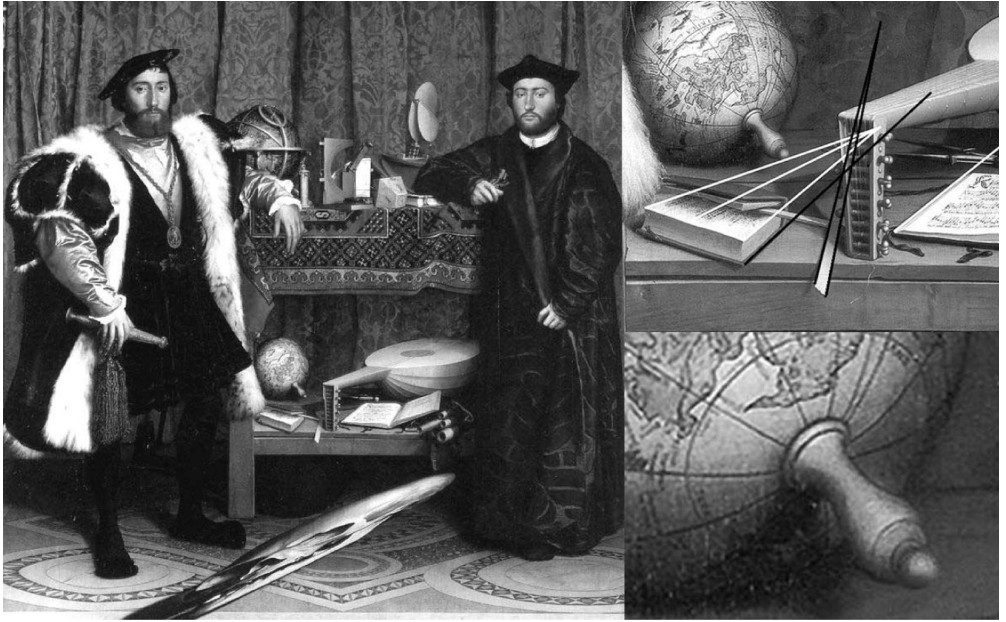


Figure 1. Holbein's *The Ambassadors*, one of Hockney's examples of an 'optical' painting. However, close examination shows divergent perspective in one local region and a series of non-congruent ellipses in the handle of the globe, both implying intuitive rather than optical construction.

accurate in its spherical surface, which is difficult to do convincingly." This claim demands a careful analysis of the accuracy of this globe, which is depicted with impressive care, on the same shelf as the book just mentioned. Even a cursory look reveals that the spacing of the longitude lines is implausible and that the handle looks askew both within itself and in the angle at which it meets the globe (figure 1, lower inset). Analysis of the ellipses forming the structure of the globe reveal that its geometry is also inaccurate. The answer to Hockney's rhetorical question is, therefore, no—the globe must have been constructed by eye, not by optical projection.

One could apply the some sort of analysis to most of the examples provided by Hockney, all with equally negative results. A final example is the painting that Hockney describes as the "Rosetta Stone" of the theory, from which the whole argument could be decoded. This role is played by Lorenzo Lotto's *Husband and Wife* (1543), a strange and uninspiring painting to this critic's eye. In it is depicted a tapestry tablecloth with a distinctive octagon feature at the centre of the table. This feature has the curious property that it seems to go out of focus as it recedes from the viewer. It is argued 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 (as opposed to the well-known eighteenth-century use of the camera obscura by artists such as Canaletto and Joshua Reynolds).

Before considering the plausibility of the specific claim about the Lotto painting, it may be pointed out that the patch of blur on this tapestry makes a weak case for the widespread use of optics, because it is the only Renaissance painting (in southern or northern art) that exhibits this particularity. Hockney's simplistic analysis isolates two unconvincing angles in features that appear to form single straight lines in the tapestry pattern. However, the WebExhibits website shows that the octagonal emblem that he proposes to have been copied through optical projection has vanishing points with several different perspective geometries within this local feature. It follows that the design cannot have been simply traced optically in a single view as Hockney proposes. It must have been simply a freehand attempt to capture the receding view of this complex pattern.

It is important to realise that Hockney's proposal of vast conspiracy was a conspiracy of inspiration rather than of execution. "I am not suggesting that all these artists [of an array of fifteenth and sixteenth century portraits] used the mirror-lens themselves, or even that they know about it, but once one had used it other would try to recreate the look." Hockney seems to judge that the artists had succeeded, since he says of the portraits that "They are remarkably similar in scale, composition and lighting." It becomes clear, then, that any influence of optics on art is stylistic rather than technical, and that he views the majority of artists as being capable of such vivid and refined effects *without* optical aids. In fact, when asked at the New York conference on his ideas why he showed only pencil tracings in the camera obscura that he set up as a test of his theory, Hockney said "It's not that easy to trace them ... I realized ... you couldn't do it this way. So what I did, within 10 minutes, I put up *another* canvas. I looked at the projection and actually copied it. Now, if I did this within 10 minutes I'm sure [other artists] did this within 10 minutes 600 years ago" (my italics).

What does this weakened version of the hypothesis imply about the structure of paintings? Simply copying by eye from a nearby projection might have improved the perspective (along with the rendition) but it would not have ensured its accuracy. Indeed, it might have given the artist confidence that he could proceed with the construction by hand, since if it looked the same, it should be right. The problem with this weakened approach is that it no longer supports the use of perspective accuracy as evidence for the use of optics. If the perspective is inaccurate, it is because they copied by eye; if it is inaccurate, it is because they did a pencil tracing from the projection and transferred it to the painting. The weakened hypothesis becomes untestable, although the image of the artist tracing from an optical projection has become embedded in our minds and may be hard to shake, despite the dearth of evidence.

The alternative view, of course, is that the appearance of accurate perspective at this time (1420s) is documented by Vasari as arising from intense discussions on geometry between Brunelleschi the architect and Toscanelli the geographer (who is credited with drawing the world map used by Columbus on his voyages). Contrary to common assertion, there is no evidence that Brunelleschi understood the concept of vanishing points or explained them to his colleagues, especially for the difficult oblique cases analysed by Hockney. In fact, his lifelong friendship with Donatello, during which they were reputed to have devoted much time to the discussion of perspective, did not result in a single accurate perspective construction from Donatello's hand. While he employs perspective extensively as a thematic element, its geometric construction remained loose and inaccurate throughout his long life. How the accurate perspective construction arose is another (and long!) story. But Hockney follows the common misunderstanding that perspective was perfectly understood by artists of the early Renaissance, and that almost any deviation from accurate perspective should be attributed to the use of optics. It seems much more plausible to assume that the artists of the time were struggling with the multiple approaches to accurate perspective construction (there are at least four different construction techniques), or even the need to use an accurate construction for a given artistic commission. Virtually all the evidence presented by Hockney (and his collaborator Charles Falco, who has lectured extensively on this topic) is compatible with a stylistic shift from religious expression to naturalistic representation, coupled with an incomplete attention to the details of perspective construction by the busy Renaissance artists.

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