

*Leonardo* (Oct, 2004)

## **Critical commentary on Hockney's 'Secret Knowledge'**

**Christopher Tyler, Ph.D., D.Sc.**

[cwt@ski.org](mailto:cwt@ski.org)

Smith-Kettlewell Eye Research Institute, San Francisco

Hockney, in his book "Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters" (Thames & Hudson: New York, 2001) provides many lines of evidence in support of his contention that a wide range of classical artists made use of optical projection to improve the accuracy of their painting. However, he makes many statements in the book that are obviously false when subjected to critical scrutiny. Key issues are addressed in an article entitled "Rosetta Stone? Hockney, Falco and the sources of 'opticality' in Lorenzo Lotto's 'Husband and Wife'" (Tyler, C.W., *Leonardo* in press, 2004). The burden of this analysis is to point out the flaws in the predictions of Hockney's hypothesis in relation to the particular painting that he designated the "Rosetta Stone" of the hypothesis. There was space in the article to discuss only a few of the items offered in support of the hypothesis in the book as a whole, but in many of them are equally implausible when subjected to critical scrutiny, as is detailed in the following notes. Examples are given in sequential order, and are designed be read in conjunction with a copy of the book.

p. 7-10. Hockney opens with a four-page spread of the 800-year wall of paintings that he and his assistants constructed to evaluate the changes in artistic style over the centuries. The main point of the book is to offer an optical hypothesis to explain the sudden transition in style that Hockney sees in the early fifteenth century. On p. 67 he makes the timing explicit " - the big change occurred some time around 1420-30." However, the variously-cited evidence has a very fluid boundary. On p. 36, it is described as

occurring between 1438 (Pisanello) and 1553 (Moroni). On p. 41, it is specified between 1514 (Cranach) and 1560 (Moroni). On p. 42 the transition in depictions of armour occurs up to 100 years earlier, between 1450 (Pisanello) and 1460 (Mantegna). Apparently Hockney was unaware of the naturalistic depiction of armour by van Eyck in the 1430s. On p. 52 the boundary is set between 1475 (Melozzo di Forli) and Raphael (1514). On p. 54 it is implied as occurring between 1525 and 1595. By p. 71, the boundary has moved back a century to between 1423 (Fabriano) and 1436 (van Eyck). Incidentally, in making this latter transnational comparison, Hockney implicitly defines the transition as occurring at the same time in both Northern and Southern Europe. In summary, this "sudden transition" is variously attributed within decades as much as 100 years apart. Hockney makes no comment on the floating discrepancy in the timings of his evidence. One could suppose that different artists picked up the ideas at different times from each other, but all explicit statements of the hypothesis are that it was a universal transition that occurred suddenly (with subsequent evolution of the optical technologies).

p. 23. The initial point of the book is that Ingres, painting early in the nineteenth century, had availed himself of the recent invention of the *camera lucida*, an optical drawing device. The evidence for this claim is the compelling realism of his drawings, in one of which Hockney sees a disproportion between the head and the rest of the body. He reproaches this portrait of Madame Louis-François Goudinet to his own liking, neglecting the fact that real people come in a wide range of body proportions deviating from the commonly accepted ideal. In doing so, he sets the lady's hand to a size that would completely cover the features of her face, which is much larger than typical, as may be seen in Ingres' portrait of Madame Lablanc reproduced on p. 32, for example. Thus Hockney's attempt to correct the proportions of the body in the drawing violates the proportions of the hands.

p. 35. Hockney contrasts the complex folded fabrics in paintings by Moroni and Bronzino in the mid 1500s to the primitive style of Giotto in the early 1300s, attributing the change to the use of optical devices. But in so doing he neglects both 250 years of intensive development of the artistic culture and the classic work of Gentile di Fabriano ('The Adoration of the Magi', 1423) which incorporates fabrics even more complex than those shown on pp. 37, 39 and 41. Fabriano's fabrics are reproduced on p. 70, where Hockney argues that they remain "essentially flat" and are judged as non-optical. Yet the complexity of the design is just the sort of thing that Hockney is offering as evidence for the use of optical projection. Moreover, close inspection of the cape of the kneeling Magi Melchior reveals that the texture is indeed strongly folded, though not as heavily shadowed as the van Eyck painting with which it is compared. The Fabriano work thus shows that artists before the supposed transition could paint complex fabric patterns without optics, and tends to support the idea of a gradual evolution of the painting style for fabrics from 1300 to 1600 as opposed to the concept of a sudden stylistic change attributable to optics.

p. 57. Hockney claims that the globes in Holbein's "The Ambassadors" are "marvellously accurate in their foreshortening", "perfect" and "precise". Yet it is clear

from inspection of its handle region that the longitude lines of the terrestrial globe are distorted, and the reconstruction of this geometry on the website at <http://webexhibits.org/hockneyoptics> shows numerous inaccuracies consistent with brilliant painting 'by eye' rather than accurate optical projection.

Hockney interprets the anamorphic skull in this same painting as further evidence in support of his optical hypothesis. However, this anamorphism is not in the original form but was carefully overpainted from a deteriorated state by the conservators of the National Gallery, London in 1992, with the use of optical projection of a real skull. The form of Holbein's skull thus cannot be determined from the current state of the painting. The original anamorphic projection, by the way, could have been readily realized by viewing a skull in a slanted mirror and reaching out to outline the features of the skull on the mirror's slanted surface. The outlines could then be traced onto transparent paper and transferred to the painting without any understanding of the geometry of the optical projection. Even if the conservators had followed the lines of the original, its shape would not be evidence for optical projection, merely for the clever use of a plane mirror.

The other interesting feature of this painting is that, despite its central feature of a sideboard displaying numerous astronomical and geometrical instruments, not a single mirror, lens or optical device is depicted. This does not give us much faith that Holbein was enamoured with the use of optics for the depiction of difficult objects.

p. 60. The section of the tapestry in which Hockney claims a shift in the angle of the border is examined by transformation of the image to plan view in Tyler (Leonardo, 2004, p. ??). The 'Perspective' transform was applied in such a way that the trellis border motif on the two sides of the rug became parallel, then rotated to make the front edge parallel with the image frame. This operation left the edges in the form of an oblique parallelogram, which was then brought to right angles with the 'Skew' transform. There are no free parameters in these operations, and consequently no other way in which the central rosette could have been wrongly transformed. Scrutiny of the right border after this transformation reveals no hint of the break in angle claimed by Hockney. This display of its full length would be expected to make a break in the direction clearer, but it remains undeniably straight. (The slight deviation from parallelness on the right means that the global perspective transform fell slightly short of regularizing the local geometry on the two sides. However, each line appears perfectly straight, even as the two lines converge slightly.)

p. 62. The drop-off in the carpet at lower right in Hans Holbein's 'George Giszze' is offered as part of the evidence that Holbein used optical projection in local patches of the carpet. However, the drop-off is so extreme that it is obviously not due to the perspective inaccuracy of a supposed optical projection, as claimed by Hockney, but to depiction of a table with scalloped corners. The apparent distortion in the viewing angle of the coin box or inkwell at the same location is most likely due to the fact that such objects were commonly oval rather than circular. This oval geometry can readily be seen if the table-top is undistorted in the manner of Fig. 4.

p. 64. Hockney finds inconsistencies in the table-cloth depicted on the back of Hans Memlings' 'Portrait of a Young Man'. However, it is evident from his reconstruction that the inconsistencies occur not within local patches, as required by the optical hypothesis, but show globally consistent convergence across the width of the painting. (The inconsistency that he specifies is between the nearer and further edges of the tablecloth.) The global consistencies are contrary to the specific predictions of the optical hypothesis. Moreover, there are discrepancies from accurate local perspective that are again contrary to the optical hypothesis, but Hockney does not address these, either.

p. 82. As mentioned by David Stork<sup>1</sup> (2004), Hockney's claim that the mirror in Jan van Eyck's 'Arnolfini Betrothal' could have been turned round and used for optical projection is optically unsupportable, because its radius of curvature is about ten times too small to project an image the size of the painted one.

Moreover, Hockney describes the chandelier in this painting as "seen from head on (not from below as you would expect [from the direction of nearby vanishing lines])". This claim is obviously false, since the front arms of the chandelier are clearly much higher in the painting than the rear ones, in every feature from the candles to the lowest ornaments.

p. 87. Hockney similarly claims that the chandelier in Dirck Bouts' 'Last Supper' is seen from head on, even though the nearer candles are similarly shown above the rear ones (though not as much as for the Arnolfini chandelier). Reconstruction of the vanishing lines for this composition shows that they meet almost at the height of the chandelier (perhaps to give an elevated look to this religiously significant scene). The perspective of the chandelier is therefore very close to being geometrically correct for the perspective convention adopted by Bouts, although one can still find a residual discrepancy. Hockney therefore seems to be half right in this case in that, although the chandelier is not seen from head on, it is nevertheless slightly inconsistent with the vanishing point of the rest of the picture.

p. 99. Further compounding his curiously blinkered view of perspective, Hockney goes on to claim that the objects in Messina's 'St Jerome in His Study' are "all seen head on," despite the fact that all the bowls have visibly elliptical openings, the books have converging perspective, and the birds are shown in the round so that one cannot judge whether they are painted "head on" or not. Thus, none of the objects shown on p. 99 support the "head-on" claim. Moreover, he admits that the perspective in this painting is globally accurate, which is a violation of the optical hypothesis.

p. 100. Here Hockney returns to Holbein's 'Ambassadors' to point out that the vanishing points of two books are inconsistent. What he does not point out, however, is that the vanishing points of other details within the books are also inconsistent. I find at least five different vanishing points in the book on the left, for example, which contradicts the notion that Holbein used optical projection to get the local perspective correct. The discrepancies are, of course, consistent with the idea that Holbein just constructed the geometry by eye, and made minor errors in the directions of some of

the vanishing lines that are invisible in normal viewing but are revealed by a perspective reconstruction.

p. 104. Here is where Hockney shows the true “optical look” obtained by projection of a still-life scene through a (modern) optical lens. It seems odd that he does not offer a reconstruction of the concave mirror proposal on which the real claim – that optics were used 150 years earlier than previously suspected – is based. Even with the lens, the scene has a depth of field of only an inch or so of sharp focus. All the rest of the objects are heavily blurred. In fact, Hockney implicitly acknowledges the soft focus implication of the optical projection in his claim, on p. 136, that the soft focus of the ‘Mona Lisa’ in contrast to the sharp detail of his ‘Ginevra de Benci’ is due to Leonardo’s experience with optical projection. His analysis here is therefore contradictory with that on p. 71, that the accuracy of detail was attributable to the use of optics.

On the Art and Optics web page (<http://webexhibits.org/hockneyoptics>) Charles Falco and David Graves provide commentary on my criticisms of their theory posted on the same web page. On the issue of the discrepancy between the soft focus of primitive optics and the almost hypnotic clarity of the early Renaissance paintings, they say “Here Tyler makes an incorrect inference that is at variance with what we would expect from understanding human vision. Since humans automatically refocus their eyes as they scan across a scene, an out-of-focus feature does not look at all natural, except to modern people who have been inundated with such images on TV, movies, magazines, and in the viewfinders of their own still and video cameras. In fact, out-of-focus features must have looked especially unnatural to people who had never before seen projected images. Only if patrons were interested in paying for paintings containing features that appeared to them unnatural would artists have deliberately left in such out-of-focus features. Like the actual Rosetta Stone, there is every reason to expect the Lotto example to be the exception, not the rule.”

Falco & Graves here argue in opposition to Hockney, who maintains strenuously that the compelling quality of the new optical image is what inspired the artists to change their style around 1420. Indeed, Hockney argues explicitly that it is precisely the characteristics of the projection of the optical image, including out-of-focus regions, that should have appeared in paintings at the time that optical projection first came into play. (In fact, it first appears in Leonardo’s ‘Mona Lisa’, half a century after the stated time of the transition.) This argument is quite different from the Falco/Graves proposal that the optics were used as a tool to enhance the “visual look” of a scene viewed by the patrons. This visual look has little in common with the “optical look”, since the visual look is, as stated, clear everywhere in the image. This property of ubiquitous clarity had, in fact, been characteristic of paintings since Greek and Roman times. It was nothing new. Conversely, as one can see from the example on p. 104 of the Hockney book, the true “optical look” is extremely fuzzy, and would have been more likely to have inspired French Impressionism than the Renaissance precision. In fact, there have been compelling suggestions that the looseness of the late paintings of Impressionists such as Monet and Degas was due to the reduced optical quality of their own eyes over time.

A third aspect of the issue of clarity is that it is easily confounded with the issue of contrast. An image of higher contrast appears to be in sharper focus than one of lower contrast, even if the focus is physically identical. One acknowledged fact is that the use of oil paint became widespread in the 1430s, just at the time that Hockney is pointing to the dramatic change in style in the early Renaissance, particularly in the hands of the van Eyck brothers. One reason for the immediate appeal of oil paint is that it allows for much darker blacks, greatly enhancing the contrast range of the painting. Much of the "optical look" that Hockney and Falco attribute to increased *sharpness* is actually attributable to the increased *contrast* consequent to the introduction of oil paints. This historical association with oil paint removes much of the rationale for the optical hypothesis.

p. 120. Hockney considers the similarity in size of St Peter's hands, which are outstretched in depth toward and away from us, in Caravaggio's 'Supper at Emmaus', as attributable to "deliberate artistic decisions, or may be a consequence of movement of lens and canvas when refocusing because of depth-of-field problems." He fails to note, however, that there are no examples in classical art of perspective scaling being applied to the human body. The head and feet, which are about the same extent in males, provide an indicator of whether perspective scaling was applied. The foreshortened soldier from Uccello's 'Battle of San Romano', which he cites as one of the best-known examples of Renaissance foreshortening, is typical in that the head and feet are the same size on the canvas, leading to the impression that the feet look too small because they are closer to us.

p. 124. Hockney implies that Caravaggio's 'Calling of Saint Matthew' was painted by projection with a single strong source of light, staging the actors to pose in the strongly shadowed style for which he is famous. This staging would be irrelevant to the book if it did not support the idea that the scene was then projected optically for Caravaggio to capture the realistic detail, although Hockney does not make this point explicitly. David Stork, in his lecture at the New York symposium, points out that the light source could not have been the sun because the upper boundary is angled upward and diverges from the lower boundary - both impossible for sunlight shadows - and the sun would be continually moving, so copying from a sunlit projection would introduce continual distortions. The lantern sources available to Caravaggio in 1600, which are the only possible sources of the light as painted, would not have been bright enough to cast a visible projection even in a darkened cellar, being too dim by a factor of about 1000.

p. 126. Here Hockney makes a similar point, including the anachronistic suggestion that Caravaggio would have needed a "theatrical spotlight" to project the scenes in several paintings. These lighting devices did not exist at the time, so Hockney is actually providing compelling evidence against his thesis in citing this need.

p. 143. Hockney comments on the naturalism of Dürer's watercolor "Large Turf," a close-up of a grassy bank. One look at the background of the still life in Hockney's projection on p. 104 makes it obvious that the high focus and extended depth of field in

Dürer's painting would have been impossible to obtain with the kind of optical projection available to him. He must have achieved this marvel of precision by eye alone (despite Hockney's comparison with a photograph made with the high-resolution capabilities of the modern multiple-component lens by Hamilton Finlay on p. 145).

p. 147. Here Hockney suggests that Frans Hals used optics to obtain the detail and strong shadowing effects in the portrait of a woman, again neglecting the fact that such detail is not obtainable in the optical projections available at that time. This suggestion is one of the many examples in which Hockney is guilty of "20/20 hindsight" in the literal sense of assuming that the resolution of modern cameras would have been available with these early crude optics.

pp. 166 and 176. The idea that optics would facilitate the capture of the lines of a dynamic movement such as a laugh or the motion of a swing "in just a few seconds" seems quite implausible, because the fleeting expressions in a laugh or the swirling movement of the clothes in Fragonard's girl on a swing take the depicted configurations for considerably less than a second. As is well known, camera shutter speeds need to be held to less than 1/20<sup>th</sup> of a second in order to obtain a sharp image in such moving scenes, as much as a hundred times faster than Hockney's estimate.

p. 201. The section entitled "the textual evidence" contains no mention of any evidence that artists used optical projection of images in the fifteenth century, the early years of which are the time that Hockney identifies a widespread change in artistic style that he attributes to the use of optics. The only possible exception is some notes late in the century by Leonardo, on projection by the (non-optical) pinhole method, in which he emphasizes how much smaller the visible image is than the original scene.

## **Conclusion**

Although the arguments offered by Hockney for the optical hypothesis of the style change in the Renaissance of the early fifteenth century seem plausible on their face, detailed examination reveals many of the arguments to be deeply flawed, self-contradictory and narrowly presumptive. In the latter case, the arguments presume the existence of optics and point to evidence that is consistent with this presumption without critical examination of alternative hypotheses. The main alternative is the historical assumption that the artists could have been skillful enough to have achieved the compelling effects that they did by eye alone. It is implicit in Hockney's argument that the achievements of the Renaissance and subsequent epochs in naturalistic representation are so exquisite that they could not have been done by purely artistic means. For example, inconsistencies in perspective are regarded as evidence in favor of the optical hypothesis, whereas such inconsistencies could be equally considered to be evidence in favor of careless or intuitive construction of the perspective as contrasted with a meticulous approach to its geometry. Hockney does not pit the two hypotheses against each other. Moreover, the optical hypothesis needs to be considered in the context of the fact that artists of the Renaissance typically spent their apprenticeship from age twelve concentrating on representational copying of the works of the masters, that only a handful of artists of any era achieved the pinnacle of quality that we

associate with those eras, and that only a few of the works of many those artists survive the depredations of history (presumably among the best of their output). On top of this is the need for any artists who wishes to stand out from his or her fellows to reach new heights in realism or a distinctive style. This motivation is one factor that has propelled continuous changes in style through the eras. With such a variety of styles and genres in evidence, it is hard to see the relevance of the dim, blurry projections that would have been obtained with the optics available early in the Renaissance.

## References

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