

Optics and the old masters

David Hockney*) and Charles M. Falco**)

*)7508 Santa Monica Blvd. Los Angeles, CA 90046-6407

***)Optical Sciences Center, University of Arizona, Tucson, AZ 85721-0077
phone: 520/621-6771; FAX: 520/621-4356; E-mail: falco@u.arizona.edu

Abstract: We have discovered a wealth of optical evidence within a variety of paintings produced as early as c1425 that artists such as Jan van Eyck used optical projections as aids for their work. These discoveries demonstrate that optical instruments were in use over 150 years earlier than is widely thought possible.

©2004 Optical Society of America

OCIS codes: (000.2850) History and philosophy; (120.4640) Optical instruments; (110.2960) Image analysis; (330.5020) Perception psychology; (330.0330) Vision and color; (080.3630) Lenses

One of us (DH) recently observed certain qualities in the portraits of Jean-Auguste-Dominique Ingres that suggested the artist had used some sort of optical instrument as an aid. This observation developed into an extensive visual investigation of a large number of European paintings of the past 1000 years to determine whether this quality appeared in earlier work. The results of this visual investigation are presented in detail elsewhere along with a discussion of its significance for an understanding of the art of the past 600 years.[1]

During this study we began to examine paintings for the presence of optical artifacts that could serve as supporting scientific evidence for these visual observations. Briefly, we discovered a wealth of such scientific evidence in a variety of paintings that demonstrate lenses were in use by certain artists to project images as early as c1425.[2,3]

Experimentally, we have reproduced all of the optical artifacts we have identified in these various paintings to an accuracy of better than 2% (in one case, to within 0.2%). We fabricated metal concave mirrors of the type described in numerous Medieval treatises[4], using only grinding paste, and found the measured resolution of images projected by these simple spherical mirrors to be as good as the finest detail in work by van Eyck. In other experiments, we produced paintings of various sizes and complexities ourselves using projected images.

Although our discoveries show that lenses were used as early as c1425, we emphasize that the evidence we have found in these paintings shows that *some* features of *some* paintings were produced with the aid of lenses. Since the artist's aesthetic judgment is intimately involved in the process, these discoveries do not imply that paintings are essentially photographs whose images have been fixed by the application of paint. The implications are more complex, and more interesting, than that. In experiments described on p. 74–77 of Ref. [1] we explain how “*After making the measurements [from the projected image], I take down the paper and complete the drawing from life.*” Also, useful as it is as a tool, a lens does not arrange a composition, fill in the colors or shadings, or make any of the many other artistic decisions that are needed to create a painting. More information on the optical aspects of this topic can be found in Ref. 5.

Acknowledgments:

The authors gratefully acknowledge David Graves (London), Ultan Guilfoyle (Solomon R. Guggenheim Museum), Martin Kemp (Oxford University), Masud Mansuripur (University of Arizona), José Sasián (University of Arizona), Richard Schmidt (Los Angeles), and Lawrence Weschler (*The New Yorker Magazine*) for a variety of valuable contributions to our efforts.

References:

1. David Hockney, *Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters* (Thames & Hudson, London, 2001).
2. David Hockney and Charles M. Falco, *Optics and Photonics News* **11**, 52 (July 2000).
3. David Hockney and Charles M. Falco, Technical Digest of the 87th Annual Meeting of the Optical Society of America (OSA, 2003).
4. D. C. Lindberg, *A Catalog of Medieval and Renaissance Optical Manuscripts* (Pontifical Institute of Medieval Studies, 1975).
5. <http://www.optics.arizona.edu/ssd/FAQ.htm>