THE INFLUENCE OF OPTICAL PROJECTION ON 17th CENTURY ART

Art and science from the fifteenth to the nineteenth century depended upon a keen observation of the natural world. Art and science were complementary. Artists employed scientific theories and tools in their work, and scientists used art to represent nature. The focus of this paper is how optical projection could have influenced seventeenth century art. The incentive was David Hockney's book "Secret knowledge: Rediscovering the lost techniques of the old masters." Hockney is an accomplished artist, famous for his photographic collages. He has an interest in art history. His thesis is that from the fifteenth to the nineteenth century European artists used optics to project the three-dimensional world onto two-dimensional media. Those projections involved mirrors, lenses, or a combination of the two. Some of the most famous artists of the time used projections to create hyper realistic, life-like drawings and paintings. Other artists emulated the look, if not the technique itself.

The narrative of the book is not linear. Occasionally it jumps back and forth in time. For example, it discusses Vermeer before van Eyck. This is a minor complaint though; the narrative is coherent overall. Hockney begins by presenting visual evidence of the evolution of realism from the fourteenth century (late Medieval) to the seventeenth century (Baroque). He compares specific details such as clothing, body armor, and musical instruments across time. He observes a progress toward ever-greater naturalism that is not gradual. Rather, he notes abrupt changes.

The first change was around 1420-30, in Flanders. Series of the same subject (e.g., man wearing a headdress) arranged chronologically over centuries reveal a radical shift in realism at about that time. This change suggests an invention that transformed painting. Although oil paint was introduced at about the same time, Hockney does not believe that oil paint can explain the abrupt shift toward greater realism. He speculates an early form of optical projection involving a concave mirror. The light rays from a scene pass through a window in a darkened room, they reflect off the surface of a mirror, and finally they form an image on the painting surface so that the artist can trace the scene.

Artists knew about mirrors since the Early Renaissance. In van Eyck's "Arnolfini Wedding Portrait" (1434) we see a convex mirror. In the "Conversion of Mary Magdalene" (1598-1599) a huge convex mirror gives away one of Caravaggio's trademarks, i.e., the use of a single, strong, directional source of light. The source of light is seen in the mirror. Caravaggio lit his subjects carefully to create deep shadows. Was the lighting for dramatic effect, or was it because the optics of the time required strong light to project an acceptable image?

Hockney claims that some artists reversed the silvering of a convex mirror, turned it around, and made a concave mirror. A concave mirror can project an image on canvas, much like a camera lens projects an image on photographic film. Unlike a lens though, a concave mirror is limited. The projected image is small (about 30 cm/1 ft in diameter). Therefore, the artist must collage several images together to complete a painting. These collages produce a serious artifact, namely that every object is painted as if seen head on. The chandelier in van Eycks' "Arnolfini

Wedding Portrait" (1434) is seen head on rather than from below. Still lives were popular because the objects were fairly small and did not move.

Hockney speculates that the second major break was at the turn of the seventeenth century. Sometime in Caravaggio's lifetime an event happened that radically transformed painting. Caravaggio's patron, Cardinal del Monte, knew enough about optics to advise Galileo. He could have advised Caravaggio. The breakthrough was the switch from a concave mirror projection to a lens projection. Mirrors have limited depth of field that was adequate for still lives where the mirror can be re-focused as necessary. They were not as effective for deep compositions with live models. Lenses have a wider field of view, so more complex compositions were possible. Unfortunately, lenses also introduced artifacts caused by distortion and the limited depth of field.

Unlike a concave mirror, a lens reverses the image left-to-right. Caravaggio's "Sick Bacchus" (1594) is right-handed, yet a year later his "Bacchus" (1595-6) is left-handed. Annibale Caracci's "Boy Drinking" (1582-3) is left-handed, and so is Frans Hal's "Drinking Boy (Taste)" (1628). Well into the seventeenth century, Hockney observes that many drinkers were painted left-handed.

Though Hockney's theory sounds plausible, it does not explain everything. Assuming that the use of optics explains the hyperrealism in seventeenth century painting, it does not explain the hyperrealism in sculpture, such as Bernini's bust portraits. I cannot see how optical devices can serve sculptors except indirectly, by providing accurate sketches.

Hockney does not claim that projections could make up for lack of talent. On the contrary, he believes that only the most talented artists could exploit the properties of the optical devices. Artists still had to make marks with their hands, and that required talent. Some innovators used the devices; others simply copied the "look" without implementing the technology.

Although lenses were more sophisticated than concave mirrors, they too had limited depth of field. Caravaggio's "Supper at Emmaus" (1596-1601) exhibits masterful foreshortening. Yet, there is a flaw with respect to the man on the right. The hand that is further from the viewer appears larger than the hand that is closer to the viewer. Hockney believes that, because of the shallow depth of field, Caravaggio had to re-focus the lens more than once. Because Caravaggio left no drawings, Hockney thinks that he painted directly with the aid of a lens. Because Caravaggio sometimes posed his models in awkward positions, he had to work fast. Lens projection would undoubtedly speed up his work.

I argue that just because Caravaggio left no drawings, this does not prove that he did not draw. I do not see any compelling reason why Caravaggio should have shared his drawings with anybody. Artists do not have to explain their technique. Some are secretive, others are self-destructive. In addition, much of Caravaggio's work did not require optical devices.

Caravaggio followers such as Georges de la Tour carried light-dark contrast to its extreme. The painting "St. Joseph the Carpenter" (1645) has incredible light-dark contrast, apparently created by a single candle. Hockney speculates that de La Tour painted his models in full sunlight.

Cagnacci's "The Death of Cleopatra" (1658) has a photographic look. All the figures are virtually on the same plane and there is no sense of depth. Hockney claims that the shallow depth of field of the lens necessitated the compositional arrangement.

In 1602, Cotán paints two still lives ("Still Life with Game Fowl") in which some objects are identical. Hockney suggests that the artist used an epidiascope to copy images from one painting onto another.

Optical projections require strong light. Hockney notes the intense shadows in Velázquez's paintings, "Musical Trio" (1617-8), "Luncheon" (1618), "Woman Frying Eggs" (1618), and "Peasants at Table" (1618-9). Only sunlight could produce those shadows. Yet, all of these scenes are placed indoors. Perhaps sunlight was necessary to produce an acceptable projection.

Hockney points to a series of portraits with "fleeting expressions," such as a smile (Velázquez's "Democritus," 1628-9; van Honthorst's "Merry Musician with Violin under his Left Arm," 1624). Because fleeting poses cannot be sustained for long, he speculates that they were captured quickly through a lens.

More evidence for the use of lenses in seventeenth century art is the out-of-focus highlights in Vermeer paintings. A good example is the breadbasket in "The Milkmaid" (1658-60). Out-of-focus highlights would be visible if Vermeer painted through a lens.

The implications of lens projection in the seventeenth century are far reaching. If optical projection was as common as Hockney suggests, then painting shares roots with photography and cinematography. The compositional arrangements in painting and early photography had to be relatively shallow to minimize artifacts caused by the shallow depth of field. Modern photographers still face issues of depth of field. Drawing and painting have always been an important component of filmmaking, in set design, special effects, and animation. Maybe these arts share more than previously thought. Ironically, digital modeling and digital animation must re-introduce some of the lens artifacts that may have plagued seventeenth century painters. Digital landscapes often look unconvincing because they are too perfect. This is in part because they have infinite depth of field. Modeling software cannot easily replicate out-of-focus highlights such as we see on the breadbasket of Vermeer's "The Milkmaid" (1658-60). Fascinated by the implication that painting and cinematography evolved from similar origins, the American Society of Cinematographers devoted an extensive article on Hockney (Zone, 2001). In it, Hockney explains how he replicated optical projection on the Panavision soundstage in Woodland Hills, California.

Another implication of optical projection has to do with the evolution of modern art. Hockney argues that modern art emerged as a reaction to the hyperrealism caused by optical projection. Manet and Cezanne returned to the awkward composition and intuitive perspective of Campin and van der Weyden, thus coming full circle. Modern art ended a progress of naturalism that started in the Early Renaissance and peaked during the seventeenth century.

I do not think that Hockney conclusively proves the use of optical projection in seventeenth century art. The evidence is circumstantial. Hockney says that artists' guilds carefully protected their trade secrets. If the church perceived the use of

lenses as sorcery, dire consequences awaited the perpetrator. Finally, the models were unaware of the projection from where they were sitting, so they could not give an account. The book certainly poses fascinating questions for art historians. Hockney indicts art historians that have "no concern for teachable techniques." He says that if science did not pass its knowledge to the young, we would be in the dark ages. Likewise, it is criminal neglect if art historians fail to study the history of optical projection and pass it on to the young. Kemp (1990) offers a different view; he says that art historians refuse to take on the question lest they reveal that their favorite artists were "cheating." There is a modern stigma associated with cheating, although I suspect it was not such a big issue in the seventeenth century.

I think that it is too much to ask of art historians to find evidence for everything. Most motion pictures have been lost because they were printed on non-archival materials, they were stored improperly, or they were deliberately destroyed (Cook, 2004). Although cinema was the dominant art of the twentieth century, most of the evidence is already lost. I do not see how art historians are supposed to dig up unshakeable evidence for events that transpired 500 years ago.

The main problem that I see with Hockney's thesis is that the evidence is indirect, i.e., based on a study of the works themselves. He offers no sketch or narrative account of a painter using an optical projection. Hockney proves that optical projection was possible. However, the availability of a technology does not guarantee that it is practical or desirable. Kemp (1990) stresses that the use of optical devices entirely depended on the aesthetic attitudes of the artists. He offers hard evidence that magicians and religious charlatans in seventeenth century Rome used the camera obscura. On the other hand, direct evidence of artists using the camera obscura is almost lacking, and the visual evidence in the paintings is inconclusive.

Finally, Hockney focuses on one of many technologies available to seventeenth century artists. There were other tools that helped artists to achieve extreme naturalism. These tools must not be underestimated. In the seventeenth century, mathematical perspective had become very sophisticated. Perspective can achieve tightly compressed foreshortening of complex shapes, even human figures, with strictly geometrical tools (Kemp, 1990).

Hockney shows how seventeenth century artists could have used optical projection to achieve extreme realism. His evidence is fascinating, though inconclusive. If anything, he poses interesting questions that can be taken up by art historians.

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