

From Magic to Mimesis

The artist's quest for a faithful representation of a natural object, through mechanical and lenticular aids, prior to the introduction of photography.

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From the prehistoric Lascaux and Altamira cave paintings, to the 2,000 B.C. Middle Kingdom Egyptian tomb paintings, through the 11th century Bayeux tapestries, until the Early Renaissance in Italy, images were concerned more with spiritual symbolism than with an exact representation of reality.

Suddenly, in the early 15th century, a new vision occupied man's mind. In the words of Mary McCarthy, "the vanishing point existed for all men." (1) While Columbus was sailing towards his personal vanishing point, painters became concerned with an all-encompassing system of perspective. Their goal was to organize the appearance of nature in terms of the human figure, to systematically reconstruct in two dimensions familiar objects and views with meticulous exactitude. For the first time the artist's concern was to reveal the objective appearance of reality with a one-point perspective rendering of mathematical precision. To quote Erwin Panofsky, the renowned art historian: "the Renaissance established and unanimously accepted what seems to be the most trivial and actually is the most problematic dogma of esthetic theory: the dogma that a work of art is the direct and faithful representation of a natural object." Magic was becoming mimesis; art as ritual was becoming the reproduction of nature.

Although some of the basic ideas of linear perspective had cropped up in the 14th century it was not until the 15th century that a complete, fully articulated system was developed - by Filippo Brunelleschi. (Donatello's relief of "Feast of Herod" is probably the earliest work of art constructed by this method.)

Brunelleschi invented a geometric arrangement for projecting three-dimensional space onto a two-dimensional surface, in much the same way that a camera lens system projects a perspective image onto the film plane. The central idea of reconstructing solidity on a flat surface is that all parallel lines will converge towards a single vanishing point, marking the diminishing sizes of objects as their distance from the viewer increases. Brunelleschi's discovery was scientific rather

than artistic but it had profound repercussions in Renaissance art, the vibrations from which are still being heard. Unlike the perspective practices of Medieval art, Brunelleschi's ideas were objective, rational and mathematically precise. Space became measurable from its image. But with this advance came a problem. The scientific implications of the new perspective demanded consistent application, mathematical skill and consideration of esthetic problems previously irrelevant. For example, the painting would only appear accurate in perspective if viewed from a single point and at a fixed distance from the surface. The painter who knew in advance that his work would be viewed from below should construct his perspective lines and vanishing point with the viewing distance and angle in mind.

Brunelleschi produced an experimental painting which remarkably demonstrated this fact. On a small panel about 12 inches square, he made a highly detailed painting of the baptistry of San Giovanni in Florence. He depicted as much of the subject as could be seen at a glance from 6 feet inside the door of the cathedral facing the subject. Brunelleschi's biographer, Manetti, states that the painting was completed with such accuracy that no miniaturist could have done better. The sky area was not painted but covered in highly polished silver to give a mirror finish. The viewer of the painting was required to stand in exactly the same position as occupied by the artist when he made the image. A hole was pierced in the painting "where the eye would naturally be if he (the viewer) had portrayed the painting" i.e. at the vanishing point. The viewer held the painting in one hand, looking through the hole from the back of the panel, while holding in his other hand a mirror. He looked at the mirror through the painting, seeing in its surface a reflection of the image, plus the actual sky with moving clouds reflected in the polished silver. Manetti was impressed: "It seemed as if the real thing was seen; I have it in my hand and can give testimony."

This extraordinary experiment powerfully illustrates the new concern for an illusion of reality. One of the great artists of the Early Renaissance was Piero della Francesca whose memorable images were, on his own admission, a result of his passion for perspective. He believed, more than any other artist of his age, in a scientific perspective system as the basis of painting. This mathematical precision permeates all his work and in a rigorously logical treatise he explained how the rules of linear perspective could be applied to the human body as well as architectural shapes. This feeling for the solidity of forms is vividly demonstrated in his "The Discovery and Proving of the True Cross" (c. 1455). Piero's commitment to perspective was shared by his mid-15 century Florentine colleague Paolo Uccello. His "Battle of San Romano" (c. 1455) reveals the

painter's concern for stereometric shapes. The foreground is littered with weapons and implements forming a perspective grid.

In the "Sacred Allegory" (c. 1480) by Giovanni Bellini the entire foreground is occupied by a squared and patterned marble floor, surrounded by a balustrade, which strictly obey the rules of linear perspective.

A French monk, Jean Pelerin (known as Viator) made clean, spare perspective drawings of his bedroom in Toul, France, in about 1509 which are extraordinary for their precision.

One other example will suffice to illustrate the 15 century concern for perspective. Andrea del Castagno's "The Last Supper" (1447) is set in an alcove, painted with a perspective precision that perfectly presents the illusion of depth. The painting was designed for the refectory of a convent. Positioned on an end wall the painting must have seemed an actual extension of the refectory.

The Renaissance painter's new goal of creating an objective, factual, measurable illusion of depth and space in a painting continued to be a major concern of artists until the 19 century. The world was no longer defined in terms of symbols but of visible facts. The desire for the exact and scientific copying of nature had replaced the fundamentally different philosophy of medieval artists. It was natural, and symptomatic of the sudden closer link between science and art, that painters should begin to use mechanical and lenticular devices to assure the artist of a mathematically correct representation of visual reality. In Alberti's Treatise on Painting (1435) there are descriptions of several mechanical devices, such as the *velo* and *reticolato*, as aids to artists in their accurate delineation of perspective. These are the predecessors of the *machines 'a dessiner* which became increasingly popular, complex - and absurd - until the early 19 century. During the Renaissance artists' discovery of perspective they became aware of the *camera obscura*, which up to the 15 century had been more the concern of astronomers and scholars in optics, than of painters. As we will discover, the closer the date of photography's invention the more complex became the *machines 'a dessiner*, and the more camera-like became the *obscura*.

Machine 'a dessiner:

Probably the first published account of a mechanical aid for painters was Leon Battista Alberti's "intersector", invented in 1435 and described in his Treatise on Painting. The intersector was merely an instrument for drawing by means of a squared frame.

Leonardo da Vinci (1452-1519) also describes a *vetro*, or glass-plate, in his notebooks. Although these crude devices were first described in the 15 century it is reasonable to assume that they had existed for centuries in the back rooms of studios and academies where these devices were used and passed down from master to student, only surfacing as objects of concern and importance as the interest in, and demand for, accurate perspective increased during the Renaissance.

Albrecht Durer produced woodcut illustrations of four of these mechanical devices as aids to accurate representation of reality in his Underweysing in 1525. Only one of his *machines 'a dessiner* (as they became to be called in France in the 17 century) was in fact invented by Durer. This device produced an image by mechanical means. A lute was used as the subject in the woodcut. A string is attached to a wall, the point of contact being the spot at which the viewer sees the lute. The string is placed on successive points of the lute while a second man marks where the string passes a vertical frame by placing dots on a hinged drawing board which can be swung out of the path of the string. The result, as Durer recognized, was a scientific experiment, not a work of art. But his interest in perspective was not an isolated fad; Durer spent a great deal of time during his later years studying Piero della Francesca's discourse on perspective.

Many of these mechanical devices survived for three or four centuries without undergoing substantial changes. Slightly modified and improved *machines 'a dessiner* are found in many treatises on perspective, such as Jean Dubreuil's Perspective pratique (1642). In his illustrated engraving, a man sits at a table on which is placed the drawing paper, ruled into squares. The landscape is viewed through a vertical glass sheet, also ruled into squares. A "sight" ensures that the artist always views the scene from the identical spot when transferring the scene onto paper, square by square. A similar device appears in an illustration to Abraham Bosse's Divert manieres de dessiner et de peindre (c. 1667).

Christopher Wren was not only familiar with these mechanical drawing devices but refined and adapted a type first described by Ignazio Danti in 1583, which was a direct descendent of Alberti's, Leonardo's, and Durer's *machines 'a dessiner*. Wren's device, "for drawing the Out-lines of any object in Perspective" was published in the Philosophical Transactions (2) but probably constructed several years earlier. He called his machine a Scenographe or Perspectographe.

As these mechanical devices developed so they became increasingly complex

and unwieldy, culminating in Carl Schmalcalder's hideous monster, the Profile Machine, patented in London in 1806. It is significant that at about the same date a magazine published a caricature ridiculing an imaginary *machine 'a dessiner* "by which the usual objections to the Art, viz. Time, Trouble, and Expence" were eliminated by the "Portrait-Grinder." (3)

There was an unprecedented demand for cheap portraits by the rising middle classes of the 18 century. Mechanical devices which eliminated the need for artistic skill or lengthy training proliferated. The silhouette (named after the French minister of finance, renowned for his stinginess) was a cheap, simple, quick method of recording a person's profile. These shadow tracings were immensely popular and a professional silhouette artist still practices on Brighton pier, England.

The physionotrace, invented by Gilles Louis Chretien in 1786, was a shade more sophisticated in its results but demanded no more skill than the silhouette. The sitter's profile was traced on a sheet of glass held up in front of the face. A stylus was connected by levers to an engraving tool which scratched into a copper plate, at a reduced scale, the movement of the stylus.

The system is identical to contemporary pantographs (still sold as childrens' toys). Six hundred physionotrace portraits were exhibited at the Paris Salon of 1797 alone. A French physionotrace, Fevret de St.-Memin, visited America and made over 800 portraits, including many of the founding fathers.

Camera Obscura:

The camera obscura was originally, as its name implies, literally "a dark room", with a small hole in one side, perhaps in a window shutter. The view outside the room was projected onto the interior wall or screen opposite the hole.

It is likely that the camera obscura had no single inventor but was a phenomenon that was successively observed, applied and described. The earliest extant description of the camera obscura (5) is by an Arabian scholar Alhazen (965-1038) who does not imply that his observations are in any way novel. From this we can conclude that the camera obscura was relatively well-known by Arabs of the period. Alhazen stressed the fact that an image is only projected if the hole is small in size. The subject of Alhazen's experiments was a solar eclipse, seemingly the prime use of the camera obscura for centuries. In 1279, 250 years after Alhazen, John Peckham, Archbishop of Canterbury, deals with the same phenomenon for the same reason: "When at the time of an eclipse of the sun, its

rays are received in a dark place through a hole of any shape, it is possible to see the crescent-shape getting smaller as the moon covers the sun.” (6)

Similarly, the French astronomer Guillaume de Saint-Cloud noted in 1290: “It happened that those who too intently observed the sun (during an eclipse) found their vision was impaired when they went into the shade again...In order to eliminate this and to be able to observe without danger the beginning, the end, and the extent of the eclipse, one should make in the roof of a house, or in the window, an opening towards that part of the sky where the eclipse of the sun will appear, and the size of the hole should be about the same as that made in a barrel for the purpose of drawing off wine.” (7) Guillaume de Saint-Cloud continues his advice on where to place the screen for maximum clarity, and notes that the image of the sun is reversed.

From the 14 to 16 century there are many descriptions of the camera obscura for observing solar eclipses, including those by: Levi Ben Gershon (1342), a Jewish philosopher and mathematician; Franciscus Maurdycus (1543), Professor of Mathematics at Messina; Erasmus Reinhold (1542), a German mathematician; and Gemma Frisius (1544), a Dutch physician and mathematician. Of these names, Gemma Frisius is the most interesting in that he published an illustration of the camera obscura--the earliest extant. (8)

The first mention of the camera obscura being used for observing not only solar eclipses but views and figures outside the darkened room was by Roger Bacon (c. 1267): “we may see whatever we desire and anything in the house or street, and everyone looking at those things will see them as if they were real, but when they go to the spot they will find nothing...those looking will run to the image, and think that things appear there when there is nothing, but merely an apparition.” (9)

Leonardo da Vinci (1452-1519) made two descriptions of the camera obscura in his notebooks, as well as the previously mentioned *machine 'a dessiner*. He advised that “the hole should be made in a piece of very thin sheet iron.” (10)

In 1550 a breakthrough occurred in the development of the camera obscura - Girolamo Cardano, a physician and professor of mathematics in Milan, suggested fitting a convex lens in the hole: “If you want to see the things which go on in the street, at a time when the sun shines brightly place in the window shutter a convex lens...you will attain the eagerly awaited result in a wonderful manner.” (11)

The first mention of the use of the camera obscura as a drawing aid by artists was by Giovanni Battista Porta in his book Magiae naturalis (1558). Innumerable editions were published and translations appeared in Italian, English, German, Spanish, French and Arabic. This immensely popular publication on natural science was instrumental in spreading the knowledge and use of the camera obscura among 16 century artists: "If you cannot paint, you can by this arrangement draw with a pencil. You have then only to lay on the colors. This is done by reflecting the image downwards on to a drawing-board with paper. And for a person who is skillful this is a very easy matter."

It is no coincidence that Porta's suggestion of using the camera obscura as an aid to artists occurred simultaneously with a sudden desire by Renaissance painters to depict the accurate representation of perspective. There is no doubt that the camera obscura was a familiar and widely used phenomenon before the 16 century, but now the aims of artists and the knowledge of science first combined to produce paintings - a tradition that has culminated in the 20 century association of photography and painting.

The cinema, as well as photography, finds antecedents in the camera obscura. Porta explained at length "How in a chamber you may see hunting, battles of enemies, and other delusions." He dressed actors in costumes and organized elaborate theatrical productions on a sunlit stage outside the dark room. The audience, unaware of the outside production, were amazed at the scenes projected onto a white sheet. The sight of tiny human forms cavorting upside down in the dark room sent them into a panic. Porta himself was brought before a Papal Court on charges of sorcery. Although he somehow wriggled out of trouble, he found it prudent to leave the country for a while.

Perhaps inspired by Porta's problems, charlatans, fortunetellers and magicians used the camera obscura up to the 17 century. By uncapping the lens, a miniature moving picture suddenly appeared in the moody, dark interior. People and animals popped up inside a glass of water, much to the mystification of the audience.

The more widespread its use - by astronomers, charlatans or artists - the more refined became the camera obscura. Daniele Barbaro, in his famous book on perspective (12) introduces a diaphragm to the lens in order to sharpen the image. Another Daniel, Schwenter, suggests replacing the lens with a scioptic ball or "ox-eye". This was a wooden ball with a hole bored through its axis and a

lens inserted at each end. The ball can then be rotated to greatly extend the field of view. Schwenter says that the painter Johann Hauer drew an enormous panorama of Nurnberg with this device. (13)

Hauer was lucky that the panorama was outside his window. With or without the scioptic ball, the artist was limited to the view from his home. Gradually, during the 16 and 17 centuries the camera obscura became not only more sophisticated but also portable. Friedrich Risner, in 1672, suggests that since the camera obscura is ideal for drawing views it should be constructed as a light wooden hut which could be dragged or carried into the countryside. Athanius Kircher described a much better idea in 1646, although the device was not his own invention. While travelling in Germany he saw a portable camera obscura. It consisted of two cubes, one inside the other. The inner walls were translucent paper, positioned at the focal length of the lenses in the outer frame. The artist stood inside the inner paper cube after popping up through a trapdoor in the floor. The normal boxes were carried on poles, like a sedan chair. (14)

The next step was to replace the walls of the camera obscura with fabric, producing a tent-like construction. This type was used by Christopher Scheiner for his observation of sunspots in 1612. Another astronomer's tent-type camera obscura, used by Johann Kepler in his survey of Upper Austria around the same date, was described by Sir Henry Wotton, (15) concluding: "I think there might be good use made of its for chorography (topographical drawings): for otherwise to make landskips by it were illiberal: though surely no Painter can do them so precisely."

By the 17 century the artist no longer needed to be inside the camera obscura, he could observe the image inside a small box by either inserting his head (covered in a light-tight cloth) or looking through a small hole in one side. Camera obscuras were disguised as books or drinking goblets, although Robert Hooke's device of 1680 looks more like a bomb sitting on the shoulders of a headless man.

These devices might have made the camera obscura more portable but they were useless for the artist who found it difficult to draw the image when only his head was inside the box! Fortunately, concurrent with its reduction in size, the camera obscura was fitted with a revolutionary refinement - a 45° mirror. Johann Christoph Sturm described and illustrated in 1676 a portable camera obscura for drawing, the first of its kind. The 45° mirror inserted in the box reflected the image onto a sheet of translucent paper fitted on the top of the box. A hood

around the image improved clarity. Several types of these neat little reflex camera obscuras were described by Johann Zahn, a monk of Wurzburg, in 1685. (16)

From this date artists could carry the camera obscura anywhere, at any time, producing faithful records of faces and places without a draughtsman's skill or an artist's lengthy training. It is a sobering thought that by 1685 the camera was ready and waiting for photography. No further development of the instrument was necessary.

Camera Lucida:

The first mention of the term camera lucida is by Robert Hooke in 1668 when he read a paper to the Royal Society. (17) His subject was “a contrivance to make the picture of anything appear on a wall, cupboard, or within a picture-frame, etc., in the midst of a light room in the daytime, or in the nighttime in any room which is enlightened with a considerable number of candles.” This device depended on the brightness of mirror reflections for its effect, and does not seem to have been very popular. It is of only academic interest in the history of lenticular aids for artists.

There is no connection at all between Robert Hooke's camera lucida and the instrument of the same name described in 1807 by William Hyde Wollaston. To confuse matters still further, Wollaston's lucida is not a camera, and probably was not invented by him.

The camera lucida was a four-sided prism by which artists could draw the outlines of scenes and objects in correct perspective. The prism is held above a sheet of paper by means of a thin metal column. The artist peers through the top of the prism and sees the subject and the paper superimposed. His pencil was guided by a virtual image, unlike a real image in the camera obscura. The image of the camera lucida was not visible to anyone but the artist.

Since the camera lucida was even smaller in size than the camera obscura, it was widely used by travellers who wished to sketch mementoes of the places visited.

To clarify my remark to the effect that Wollaston did not invent the camera lucida, I should like to quote Heinrich Schwarz (Pantheon, May 1966):

There are but few sources which do not assign the invention of the camera lucida, which plays a certain role particularly in the last decades of

prephotographic time, to William Hyde Wollaston (1766-1828) and Giovanni Battista Amici (1784-1863). Actually these two men introduced and improved for practical use the camera lucida two hundred years after it had been invented and clearly described by Johannes Kepler. In his Doptrice, first published in Augsburg in 1611, Kepler gives an exact description of the camera lucida...But Kepler's invention of the camera lucida fell into almost complete oblivion so that two hundred years later Wollaston's and Amici's claims were not challenged although they were published as innovations in several scientific journals and languages.

However, both Beaumont Newhall and Helmut Gernsheim - the most respected authorities on the history of photography - are quite explicit, affirming: "...the camera lucida, invented by the Englishman William Hyde Wollaston in 1807" (19) and "William Hyde Wollaston's camera lucida, introduced in 1807..." (20) respectively.

The true origin of this device is a discussion for another occasion. Suffice to say that the camera lucida was a valuable aid to artists even though it played no part in the service of photography. However, it is significant that both the inventors of photography, Louis-Jacques Mande Daguerre and William Henry Fox Talbot, used lenticular devices as aids to draughtsmanship and these instruments played a major part in the development of their inventions.

Daguerre painted his gigantic Dioramas with the aid of the camera obscura; Talbot was using (unsuccessfully) a camera lucida on his Italian holiday when the idea "occurred to me - how charming it would be if it were possible to cause these natural images to imprint themselves durably, and remain fixed upon the paper." (21)

Cameras used by artists:

There is no doubt that mechanical and lenticular devices aided painters to a great extent after the 16 century. By the 18 century the camera obscura had become a craze. Its image never failed to captivate an audience. It was, in the words of John Harris (22), "one of the finest sights in the world." Descriptions of the wonders of the camera obscura litter encyclopedias, textbooks on optics, treatises on painting and manuals of popular science and entertainment. As an aid to artists its use was widespread. "Everything is represented with such exquisite exactness as far surpasses the utmost skill of any painter to express." (23) Such extravagant praises constantly recur throughout the period, fanning the flames of a passion for accurate perspective and exact

representations of nature.

Heinrich Schwarz has written that “the few facts, which could be easily expanded in various directions show how much these instruments occupied...scientists and amateurs, as well as their painter friends in the 17 century...a truly thorough investigation of the work and lives of many artists will have to include the history of science, particularly when dealing with post-medieval periods.” (24)

Charles Seymour Jr. writes: “There is a great deal of the history of the development of the viewing camera and its application to art still to be explored and unraveled...’ (25)

Daniel A. Fink makes a similar point: “Certainly the use of drawing devices was much more pervasive than is currently generally recognized...Given the high interest in naturalism in most quarters in the centuries prior to the invention of light-sensitive materials, it seems unreasonable to assume that men would not investigate any available avenue leading toward the creation of a more believable realism, above all the camera obscura and other drawing devices.” (26)

If contemporaneous literature is full of accounts showing how artists used the camera obscura, and if such respected art historians as the above believe that these devices were indeed employed by great painters of the various periods, why is it that so little documentation has been discovered to link the final works with a mechanical or lenticular drawing aid?

Daniel A. Fink answers the question in these words: “Historians and art critics are generally reluctant to acknowledge the widespread use of drawing or viewing devices among artists, especially the most revered painters, because the stigma of a non-artistic practice might dull or demean a brilliant reputation (as if a drawing device equals an objectifying device and paintings so produced require no artistic skill).” (27)

This feeling may not be very generous, and I see no reason why it should still be true. Perhaps a more reasonable attitude is that there is little reason why a painter, then or now, should record the methods or devices by which the work materialized. Who knows what equipment was used by many 19 century photographers? Who cares? The means to an end, in this case, seem irrelevant. Similarly, if we do not know the type of brushes used by 16-18 century painters, there is no reason why their use of the camera obscura should be documented,

except by pedantic biographers. Too close an attention to the mechanical or lenticular aids used in the production of the works can detract from an appreciation of the art for *what it is*, rather than *how* it was made.

Daniel A. Fink hopes “that an indiscriminating search will not be initiated which looks for optical phenomenon under every suspicious circular blob of paint,” a sentiment with which we can only agree. “But,” he continues; “more widespread investigation of the experimentation with, and subsequent acceptance or rejection of, the camera obscura and other drawing devices by painters will reveal more accurately the limits and scope of this activity.” (28)

In general terms it is obvious that cameras became standard equipment for artists. Count Francesco Algarotti, in his Essay on Painting (1764), devotes a chapter to the camera obscura: “The best modern painters among the Italians have availed themselves greatly of this contrivance; nor is it possible they should have otherwise represented things so much to life.”

Perhaps the dichotomy between the obvious widespread use of the camera obscura, and the paucity of information concerning its use by the most respected artists, is explained by the fact that the majority of users were amateur 'Sunday painters', travellers who wished to record memory-jogs of their visits, and illustrators of textbooks.

For example, Dr. William Cheselden, surgeon to Queen Caroline, states in the preface to his Anatomy of Bones (1733) that the illustrations were drawn with the aid of the camera obscura, finishing “with more accuracy and less labour, doing in this way in a few minutes more than could be done without in many hours, I might say in many days.” The title-page to the book is illustrated with an engraving of a man drawing a skeleton with a camera obscura - the skeleton is hanging upside down to produce an image the right way up in the camera.

Travellers using the camera obscura and the camera lucida flooded Europe, Asia and America. In striving for increased portability, the cameras were incorporated into sedan-chairs, tents, books and even in the heads of walking sticks. With the camera lucida Basil Hall documented his American travels.

In the preface to Forty Etchings Made with the Camera Lucida in North America in 1827 and 1828, he praised the instrument which freed the amateur “from the triple misery of Perspective, Proportion and form,” concluding that although its inventor had not discovered the “Royal Road to Drawing”, he had “at least

succeeded in Macadamising the way already known.” (29) Similarly, Frederick Catherwood made pencil drawings with the camera lucida, while his colleagues, Dr. Cabot and John Lloyd Stephens, made daguerreotypes of Maya remains for their publication Incidents of Travel in Yucatan (London, 1843).

Traveller Edward Dodwell found the camera obscura extremely useful in more ways than one. While sketching the Acropolis in 1805 for his Classical and Topographical Tour through Greece (London, 1819), the Turkish Governor, Disdar, constantly put difficulties in his way, which were only removed after Dodwell had given the mercenary Turk a succession of gifts. Disdar was eventually restrained from interfering in an amusing and remarkable way; he was shown the image of the camera obscura:

The Didar no sooner saw the temple instantaneously reflected on the paper in all its lines and colours, than he imagined that I had produced the effect by some magical process; his astonishment appeared mingled with alarm... He again looked into the camera obscura. At that moment, some of his soldiers happening to pass before the reflecting glass, were beheld by the astonished Disdar walking upon the paper: He now became outrageous, and after calling me pig, devil and Buonaparte he told me that if I chose I might take away the temple and all the stones in the Citadel, but that he would never permit me to conjure his soldiers into my box. When I found that it was in vain to reason with his ignorance, I changed my tone, and told him that if he did not leave me unmolested, I would put him into my box, and that he should find it a very difficult matter to get out again. (30)

Dodwell continued his drawings in peace.

Goethe tells of an Englishman who always took a camera obscura on his travels and his collection of drawings never failed to arouse admiration. (31) It is difficult to believe that such an incredible number and types of drawing aids would have been designed and built, and discussed, without being used. We can only assume that the cameras obscura and lucida were commonly employed by amateur painters and travellers of the 16, 17 and 18 centuries. Goethe's Englishman was one among millions.

But what of the more serious artists; did they employ mechanical and lenticular aids to better draughtsmanship? Heinrich Schwarz states that “in the eighteenth century the camera was an almost indispensable part of many artists’

equipment.” (32)

Occasionally, the camera itself was included in the content of the picture. It appears in the mezzotint portrait of the German court painter Joachim Franz Beich (1665-1748), as a balancing motif to his palette and brushes.

A camera obscura is also included in “The Magic Lantern”, a portrait of the artist's children, by Charles-Amedee-Philippe Van Loo (1764).

Jurrian Andriessen (1742-1819) produced a pen and wash drawing around 1910 depicting an artist at a doorway, operating a camera obscura.

Paul Sandby (1725-1809) made a watercolour and gouache painting of Rosslyn Castle, North Berwick, and included in the lower right foreground a woman using a portable, but bulky, camera obscura.

But these are exceptions. More generally, the camera obscura was the 'sleeping partner' in the painting enterprise, indispensable but unnamed. In the USA we know that Benjamin West and his tutor, William Williams, were among respected artists who used this device, and so were Gilbert Stuart and his tutor Cosmo Alexander.

Preserved at Monticello, Virginia, is a camera obscura used by Thomas Jefferson. Even after the introduction of photography, American artists still had their uses for the camera obscura. An example of this instrument was included in the inventory of effects of the painter William Sydney Mount when he died in 1868. (33) The camera obscura was particularly popular among serious artists and amateurs in England, where Sir Joshua Reynolds was the outstanding advocate of the instrument. His personal camera obscura is now in the Science Museum, London. The major French painter of the 18 century to use the camera obscura was Claude-Joseph Vernet. Among the baroque and rococo Italian painters who used the camera obscura for rendering panoramic views of the countryside were Guiseppe Maria Crespi, Guardi, Bernardo Bellotto, Zuccarelli and Vanvitelli. Jan van der Heyden seems to have made extensive use of the camera in painting his city views with their sharp foreshortenings. Van Deren Coke notes that “such factors as compressed perspective, exaggeratedly wide foregrounds, somewhat limited sense of depth, and selective focus indicate that their paintings were prepared in a number of instances with the aid of a camera obscura.” (34)

It is such distortions, or differences between camera and human vision, which are telltale clues of the possibility that the painter used a camera obscura from which to draw the image. M.A.J. Gravesarde warned artists not to be deceived by camera vision:

several Flemish painters (according to what is said about them) have studied and copied in their paintings the effects of the camera obscura and the way in which it presents nature. It cannot be denied that certain lessons can in fact be drawn from (the camera obscura) of chiaroscuro and light: and yet too exact an imitation would be a distortion, because the way in which we see natural objects in the camera obscura is different from the way in which we see them naturally. (35)

The reason for this difference in camera and human vision is that camera obscuras were usually equipped with lenses featuring wide angles of view. Placed close to foreground objects these lenses produced steep perspective, at odds with the Renaissance concept of proper proportions.

Among all the names of painters who did use, or could have used, the camera obscura two major artists deserve special mention: Johannes Vermeer (1633-1675) and Giovanni Antonio Canal, known as Canaletto (1697-1768).

The source literature concerning whether or not Vermeer used a camera obscura is so dense that it is difficult to hack through the arguments to reach the conclusions, if any. Charles Seymour Jr. has written: “for over thirty years the literature on Vermeer of Delft has included first hints, then suggestions and, finally, all but direct statements that Vermeer used the forerunner of the modern photographic camera, the camera obscura, as an aid in making his paintings.” (36)

In fact the discussion had been going on a great deal longer than that. Over 83 years ago Joseph Pennell, an American etcher and lithographer, thought it “extremely likely” that Vermeer used a lenticular aid. Perhaps significantly his belief was expressed in the pages of a photographic magazine; perhaps, too, this is the reason it has been ignored by art historians. Pennell wrote:

...That this perspective may be correct is possible since architecturally trained draughtsmen who have not drawn from nature to any extent render objects with photographic perspective. There was a notable example in the last exhibition of Old Masters at the Academy, in Vermeer's "Soldier

and Laughing Girl." But I think it extremely likely that Vermeer used the camera lucida, if it was invented in his time, for it gives exactly the same photographic scale to objects... (37)

We have already seen (38) that, contrary to general belief, the camera lucida was available in Vermeer's time, but it is more than likely that he used the camera obscura, not lucida. Pennell may have been mistaken on this minor point but what is significant is that he sensed that some sort of lenticular device had been employed by the painter.

In the late 1920s Wilenski had noted the exaggerated perspective of foreground objects in Vermeer's work and made the absurd statement: "perhaps one of the ironies of art history (is) that with a Kodak any child might now produce by accident a composition that a great artist like Vermeer had to use all his ingenuity...to achieve." (39)

A more reasonable attitude was taken by Hyatt Mayor in 1946. He thought it likely that Vermeer had used a mechanical or optical aid, noting not only the size distortion of foreground objects, but Vermeer's colour "blended as perfectly as the ground glass of a camera", and of the highlights which "break up into dots like globules of halation swimming on a ground glass." (40)

There seems little point in examining in detail the arguments in favour of Vermeer's use of a camera obscura, or any other mechanical or lenticular viewing devices. I would refer the reader to three lengthy and closely reasoned essays dealing with the problem:

1. Charles Seymour Jr. "Dark Chamber and Light-filled Room: Vermeer and the Camera Obscura" which appeared in The Art Bulletin, XLVI. Number 3, September 1964, pp-323-331. Seymour concludes: "I think that the means by which they (logic and emotion) were brought together into the focus of the painter's eye was the dark chamber trained on the light-filled room."
2. Heinrich Schwarz. "Vermeer and the Camera Obscura." Pantheon, May 1966. pp. 170-180.
3. Daniel A. Fink. "Vermeer's Use of the Camera Obscura - a Comparative Study." The Art Bulletin. December, 1971, pp. 493-505.

Whereas Schwarz's arguments are academic and circumstantial, Fink's are

based on a series of practical experiments with a camera obscura to determine “if the effects achieved by it correlated with other aspects of Vermeer's paintings that do not readily appear as optical phenomena. Ten points of correlation were discovered between data from the paintings and data gathered during laboratory experiments...”

The experiments were conducted in a laboratory similar to a room used by Vermeer, illuminated by north light, favoured by painters for centuries and using a typical camera obscura of the period. Fink examined 27 Vermeer paintings which “all exhibit optical phenomena.” His conclusions at the end of the experiments are unequivocal: “Vermeer was unique in his employment of the camera obscura because he left for us the evidence of his use of the instrument in his paintings.”

The other major painter of the 18 century who used a camera obscura in the production of his paintings was Giovanni Antonio Canal (1697-1768), known as Canaletto. The biographers of this painter seem much more willing to commit themselves to a Canaletto/camera obscura decision than those of Vermeer. Yet it is strange that in all the arguments by biographers about the possibility of Canaletto employing such a device, few that I have read (an exception is F.J.B. Watson's Canaletto, London, 1949) quote what is seemingly an irrefutable source:

Il Canal taught the correct way of using the camera and how to understand the errors that occur on the picture surface when the artist follows too closely the lines of the perspective, and even more the aerial perspective, as it appears in the camera itself and does not know how to modify them where scientific accuracy offends against common sense.
(41)

If for some reason unknown to myself, Zanetti is a doubtful source, all timidity should be dispelled by a recent discovery, at the Correr Museum, Venice, by Dr. Terisio Pignatti, of a camera obscura which (almost certainly) belonged to Canaletto. It consists of a square wooden box, in one side of which is mounted a lens which can be pushed in and out for focusing. The image is reflected from a 45° mirror, inside the body, onto a sheet of ground glass set in the top of the box. A hinged lid covers the glass when not in use. On the outside of the lid is the inscription: *A. Canal*.

This fact seems to justify W.G. Constable's view: “that Canaletto used some form

of optical apparatus to assist him is reasonably clear...Concerning the type of apparatus he used, and the extent of that use, there is a difference of opinion. As regards type, it seems clear...that the apparatus was more than a piece of glass, sometimes squared up, which artists use to select a composition. Evidently, it included some form of lens; but how elaborate it was it is hard to say....If we look at Canaletto's work as a whole, it seems that his use of the camera ottica [obscura] was chiefly confined to the period of the thirties, and then was spasmodic." (42)

It is important to remember, however, that these two artists - Vermeer and Canaletto - are not isolated figures. They are merely the most outstanding names among a large number of painters who flourished throughout the 18 century and who employed mechanical and/or lenticular devices until well into the 19 century, when the development of photography gave them cheap, permanent images as visual references.

When Francois Arago was asked by the French government to secure testimony on the value of Daguerre's invention, he turned to the respected painter Paul Delaroche who obliged by writing a statement on the value of photography to artists:

Mr. Daguerre's process completely satisfies art's every need, as the results prove. It carries some of its basic qualities to such perfection that it will become for even the most skillful painters a subject for observation and study. The drawings obtained by this means are at once remarkable for the perfection of details and for the richness and harmony of the whole. Nature is reproduced in them not only with truth, but with art. The correctness of line, the precision of form, is as complete as possible, and yet, at the same time, broad energetic modeling is to be found in them as well as a total impression equally rich in tone and in effect. The rules of aerial perspective are as scrupulously observed as those of linear perspective. Color is translated with so much truth that its absence is forgotten. The painter, therefore, will find this technique a rapid way of making collections of studies which he could otherwise obtain only with much time and trouble and, whatever his talents might be, in a far less perfect manner... In conclusion, M. Daguerre's wonderful discovery is an immense service rendered to art. (43)

The two giants of French painting during the early years of photography - Delacroix and Ingres - were arch protagonists professionally, yet were united in

their appreciation of the new medium.

Delacroix, although clearly recognizing its mechanical shortcomings not only welcomed photography but used its imagery in many ways, writing in his Journal in 1854: "How I regret that so admirable an invention comes so late, at least for my purposes!"

Ingres, who was already producing a painting style "which at first glance looks like a kind of 'super-photograph,' (44) is a less surprising champion of the new art. He exclaimed: "This is the exactitude that I would like to achieve!"

The Renaissance dream of an exact representation of reality had been realized - after 400 years, and in a new medium.

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For 25 years, beginning in 1974, I taught university courses on the history of photography, for art history credit, comprising approximately 30 three-hour lectures. These notes comprise the introductory lecture which was illustrated with slide illustrations of the paintings and devices mentioned.

Interest in the mechanical and lenticular devices used by painters has increased in recent years due to the “controversial” writings and observations by the painter David Hockney.