## 1 Screen, window and world

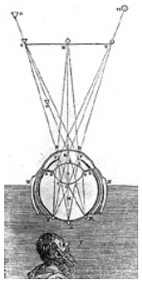

Figure 6

René Descartes Plate from *La Dioptrique* 1637

I want to begin by looking at a few relevant historical precedents concerning 'picturing' in order to propose some models for thinking about three dimensional space, its representation and the viewer's relation to such visual representations in the light of computer technology. As the thesis develops, I will refrain from continually relating my observations to this technology but want to stress at this stage that it has served as a lens or filter through which the historical, theoretical and practical or material issues have been viewed.

In *La Dioptrique*, Descartes draws an analogy between the action of light on the eye and the movement of a blind man's stick as it probes the surfaces of objects in its path and goes on to discuss the formation of *images* in the back of the eye. In order to better understand the phenomenon of vision, the "noblest of the senses" as he puts it, he describes an experiment in which the disembodied eye of an animal is placed in the aperture of a camera obscura. The layers of tissue covering the rear portion of the eyeball corresponding to the position of the retina, are removed and some translucent material is placed over the fragile membrane to act as a screen onto which light entering the eye is focused naturally. The interior of Descartes' room being light-tight, this strategically placed eye is the only source of illumination. The description is accompanied by a schematic engraving (figure 6) which depicts a cross section of the eye straddled across the border of the room with its iris and lens facing out towards the light. A bearded man, a portrait of Kepler as Martin Jay maintains, can be seen perusing the area on the outer surface of the eye which corresponds to the makeshift screen and, in Descartes' account, if the spectator positions himself likewise behind the retina, they "will see there, not perhaps without wonder and pleasure, a picture representing in natural perspective all the objects outside..."[1] As an account of vision, the demonstration has obvious drawbacks in that it posits another *eye* behind the first as the 'perceiver' of the miniature image and so on, thus implying an infinite regress. Indeed, Descartes later quashes the assumption that vision is caused by this 'perfect' image in the eye, warning that "we must not think that it is by means of this resemblance that the picture causes our sensory awareness of these objects - as if there were yet other eyes within our brain with which we could perceive it."[2] Rather, it is the 'movements' of light which initially compose the image that 'ordain' the sensation of sight. Just as movements in the blind man's stick (figure 7) enable his sensory awareness of objects without any degree of resemblance between the two (movements and objects, that is) so variations in shape and intensity of light or colour act on the perceptual array

1. René Descartes 'La Dioptrique' ('Optics'), *Discourse on the Method* Leiden 1637. In *Selected Philosophical Writings* (trans. John Cottingham, Robert Stoothoff and Dugald Murdoch), Cambridge & New York: Cambridge University Press 1996, pp57-72, see pp63-64; a similar experiment is discussed in terms of the 'correctness' of perspective in Maurice Pirenne's *Perspective, Painting and Photography* Cambridge: Cambridge University Press 1970, pp63-71; Martin Jay discusses the relationship between Descartes' and Kepler's philosophical methods as an early example of the opposition between on the one hand, deductive reasoning based on the *a priori* existence of innate ideas in the mind and on the other, empirical observation. See Martin Jay *Downcast Eyes: The Denigration of Vision in Twentieth-Century French Thought* Berkeley & Los Angeles: University of California Press 1994, p72.

2. Ibid. p64.

Figure 7

René Descartes Plate from 1724 edition of *La Dioptrique*. The crossed sticks in the blind-folded man's hands refer to the inversion of the retinal images. Descartes maintains that despite the fact that the sticks are crossed, the man is still able to 'perceive' objects in their correct relation.

whilst *also* focusing an image on the retina.

This "perfect picture" in natural perspective which Descartes observes in the eye does not imply that the brain directly perceives the world in terms of *pictures* but does neatly point out the correspondence between such a natural picture and the artifice of a picture in linear perspective which seemingly acts on the perceptual system as if it were the real thing. Of course, outside the confines of both Descartes' experiment and the camera obscura, it is obvious that we do not see our retinal images and cannot therefore compare them with the reality they apparently represent. It is with our eyes, after all, that we see this reality. However, bearing in mind Descartes' observation, there *is* a sense in which our access to the real world is at one remove in that we can, at best, only imagine a comparison between reality and what we see of it. Vision is a conduit through which the world is manifested; we cannot simply step outside of the process and use vision to inspect itself, to look at itself 'looking' so to speak. In terms of pictures however, Descartes' engraving provides an image of the spectator's relation to the perspectival image and is, therefore, a useful model. In terms of digital imaging technology, specifically 3D modelling, the retinal screen can be likened to the monitor screen onto which is projected the perspectivally correct image of a virtual space. Indeed, this 'screen' provides the only means of access to such spaces, the window through which we both construct and perceive them.

Figure 8

Albrecht Dürer Plate from *Underweysung der Messung* 1st edition, Nuremberg 1525

Reference to two engravings by Albrecht Dürer from the early 1520's may take the point a stage further (see figures 8 & 9). The first depicts the interior of an artist's studio or workshop in which two male figures are engaged in representing a lute with the aid of a drawing machine. The lute is pictured on a table at one end of which is clamped a frame positioned at right angles to the table top. The frame serves as a window and it is through this that one of the figures peers at the instrument. Behind him, a length of string with a weight tied to its end is threaded through a ring or pulley attached to the wall such that it can move up or down depending on the movement of the other end of the string. This is attached to a stylus held by the second figure who, standing opposite the first, positions it at a certain point on the lute's surface. Passing through the frame, the string is held taut by the downward pull of the weight and the first figure is pictured in the process of marking the intersection of string and frame with two lengths of twine stretched within the borders of the frame. Attached to one side of the frame by a hinge is a screen on which can be seen a perspectival image of the lute. This has been constructed, it seems, by recording the intersections of string with frame and marking these points successively on the two dimensional screen. The three dimensional object has literally been painstakingly mapped onto

Figure 9

Albrecht Dürer Plate from *Underweysung der Messung* 2nd edition, Nuremberg 1538

a planar surface. Whether or not this apparatus was actually used by Dürer to create such images or whether he intended the image to demonstrate the principles of perspective interpreted as a window is not clear (the treatise to which they belong is concerned with *measurement*).[3] Concerning a discussion of digital space and modelling, however, it does provide us with a valuable visual model of the relationship between object and picture which has been noted by at least one observer.[4] The point at which the string is attached to the wall represents the

eye of an implicit observer and the string, their line of sight. The image, therefore, is directly related to the exact position of this observer.

In the second of the two engravings from the 1538 edition of the treatise (figure 9), the lute has been replaced with a recumbent female figure who lies on the table top in what could be characterized as a position of voluptuous abandonment. The frame is still in evidence, but in place of the drawing screen there is a grid made up of what could be stretched twine. At the other end of the table, an artist, somewhat dwarfed by his model, peers at her through the window from behind a sectioned sheet of paper which corresponds to the frame's grid. In order to maintain the correct and consistent position in relation to his subject, a vertical column, not unlike a small obelisk stands on the table top, allowing him to position his eye, or rather, one of his eyes at an exact point in space in front of the frame/window. The principles for constructing the image are the same across the two plates although the second replaces the string with the draughtsman's implied gaze and the ring or pulley configuration with the tip of the obelisk. If perspective is predicated on the notion that light travels in straight lines or 'rays', there is an implicit link between the sight line from the obelisk, the intersection of that line with the frame/window and the point on the woman's body which is the subject of that gaze, whilst the grid within the frame serves to assist the draughtsman in transferring his perception of the woman's form from window onto drawing surface.

From a contemporary perspective, the difference between the two images is revealing. Whereas the first depicts the mechanics of representation, or as Martin Kemp has put it, "one of the classic set pieces of the perspectivist's art", the second imbues this process with a sense of *motivation*.[5] For Celeste Brusati, as well as illustrating the translation of something 'gigantic' onto a smaller scale - Dürer's own rationale for the image - the plate "reinforces the dominant hierarchy of gender and its attendant asymmetries in a blatantly over determined way".[6] The window/grid precisely bisects the plate, evenly separating artist from model, or more broadly, nature from culture, and enables the diminutive artist to scrutinize and impose a rational control over his subject. Indeed, if the sexual

3. See Martin Kemp *The Science of Art: Optical Themes in Western Art from Brunelleschi to Seurat* New Haven & London: Yale University Press 1990, p172-173.

4. William J. Mitchell *The Reconfigured Eye* Cambridge, Mass. & London: MIT 1992, p154. Mitchell draws the analogy between what is known as 'ray tracing', a method for rendering images of 3D virtual objects, and the perspectivists' use - starting with Alberti - of the notion of light travelling in straight lines as 'rays'.

5. Kemp, op.cit. p172.

6. Celeste Brusati *Artifice and Illusion, The Art and Writing of Samuel van Hoogstraten* Chicago & London: University of Chicago Press 1995, p200.

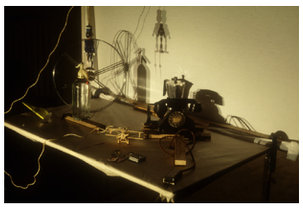

Figure 10

Recreation of 'The Miracle of the Shadows' from N.A.Valyus *Stereoscopy*

View of the objects and table configuration

theme is carried a stage further, the obelisk takes on a distinctly phallic resonance and the omission of the image on the artist's drawing paper from his literal point of view seems telling indeed. The point is not, however, to misrepresent Dürer's intentions but to highlight the role which implied or represented viewpoint can play in the interpretation of pictures as the processes of looking and picturing undoubtedly have resonances beyond the purely representational. It is this relationship between the *terms* of representation in a pictorial sense (perspective, for example, as simply a means of depicting space) and the other *senses* in which those terms can be understood (perspective as implying a knowledge or awareness in a figurative sense about the relationship between things) which has informed both the specific subjects of this project and the semantic relationship in the visual work between method or means and content.

Finally, a phenomenon described in N.A. Valyus' *Stereoscopy* as 'The Miracle of the Shadows' which was recreated early in the project suggested another way of looking at the subject of space, representation and the viewer.[7] The experiment or demonstration was as follows: a screen made of a semi-translucent fabric was clamped to a table onto which were placed a variety of everyday objects including a telephone, coffee pot etc. At some distance from this configuration, two empty slide projectors were positioned next to each other such that they lit the table and cast two sets of shadows of the objects onto the screen (figure 10). Red and green filters were placed in the slide bays resulting in two sets of shadows which were correspondingly coloured. That is, the shadows from the red projector were green and the shadows from the green projector were red. When the screen was viewed from the reverse, the silhouettes of the objects in corresponding colours were all that could be seen (figure 11). Moreover, if one looked at the screen through stereoscopic glasses fitted with red and green filters, the red shadow was only visible through the green lens and the green shadow through the red with the result that each eye received only one set of shadows corresponding to the position of the respective projectors. As the projectors were a certain distance apart, the resulting shadows overlapped to an extent but there was some discrepancy between the projected silhouettes, that is, there were points of correspondence and non-correspondence between them which related to the objects' placement at different points on the table. When viewed through the glasses, the effect was such that the shadows, though in reality two dimensional, conveyed information about both the objects' relative volumes and their placement on the table-top as they appeared at different depths on the screen. If an object was moved, the apparent position of its projected image in this virtual, stereoscopic space shifted accordingly. What was intriguing about the

7. N.A. Valyus *Stereoscopy*, New York: Focal Press 1966, pp355-356. I am indebted to Jeffery Edwards at Chelsea School of Art who brought my attention to Valyus' book and with whom I re-staged the demonstration. R.L. Gregory describes a similar experiment in *The Intelligent Eye* (London: Weidenfeld and Nicholson 1970, p41) and a working example can be seen at The Exploratory in Bristol, an interactive educational facility concerned with the psychology of perception which Gregory helped to found.

Figure 11

'The Miracle of the Shadows'

The reverse of the screen

exercise was the causal relationship between the actual space inhabited by the objects, the disparity of the two projectors and the shadowy images on the screen. If either of the two former elements were altered, the illusion was necessarily altered too.

Relating 'real' space to what could be called the 'virtual' space produced by the illusion provided a useful and tangible analogy for picturing the relationship between the digitally modelled object and its perspectival representation on the screen of a monitor. As I mentioned previously, this two dimensional image is after all (currently) our only means of access to such objects: through the screen we construct and perceive them simultaneously. The monitor screen is precisely a window, in the sense that Alberti implies, onto an extensive space which can be interpreted as stretching beyond the frame through which we look.[8] Having witnessed the causal relationship between object and representation implicit (and frequently illustrated) in numerous perspective treatises since Alberti (see figure 4), an avenue of exploration suggested itself regarding how this particular technology might be located and used in terms of art, how it could be related to the practices familiar to us via painting, photography and cinema, and perhaps more importantly, how the technology could be used to question the role such images assume or invite regarding what we habitually call 'the viewer' or 'the spectator'. If these processes of picturing the world imply the position and presence of a viewer, it seemed appropriate to raise a number of questions about this viewer: what do they bring to the picture; what could their viewpoint imply in a narrative sense; to what extent, as Marcel Duchamp put it, do they complete the picture?[9] In addition to this and bearing in mind the question raised earlier concerning where the work *resides,* the extreme case of the stereoscopic illusion could be used to explore in a broad sense the relationship between the picture or artwork and the spectator's perception of it. What is the relationship between physical reality, the 'real' image and the viewer's mental or perceptual image? Does the work truly exist only when I look at it? To what extent is it independent of me?

If an image as well as a sensation can be 'internal', that is, 'in my mind', it is usually referred to as a *mental* image. A problem with the notion of such an image is that it is not at all easy to point to one as we might to a real, material image - a picture of a chair, for example - or to the chair itself. A mental image which we call to mind in the absence of the object to which it refers, combines knowledge about that object (its perceived structure, colour, size etc.) with visual aspects of it (a familiar view of it, for example) into more of a mental conception of the object. If we look at an object or a picture, there is a sense in which our actual perception of it is interrelated with our mental image or conception of it;

8. L.-B. Alberti *On Painting* (trans. Cecil Grayson), Harmondsworth: Penguin 1991. See Book I, section 12 (p48) and more specifically, section 19 (p54): "First of all, on the surface on which I am going to paint, I draw a rectangle of whatever size I want, which I regard as an open window through which the object to be painted is seen."

9. see Marcel Duchamp *Duchamp du Signe* Paris: Flammarion 1975, p105; and *The Creative Act*, the text of a talk given to the American Federation of the Arts, Houston 1957, reprinted in *The Writings of Marcel Duchamp* (eds. Michael Sanouillet & Elmer Peterson), New York: Da Capo 1989, pp138-40.

 

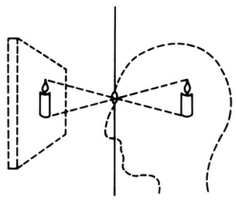

Figure 12

W.J.T. Mitchell 'Real and mental images'

See note 12.

that is, perception is a primary activity dealing with the relationship of external stimuli to pre-existing notions of what is perceived. In a stereoscopic image in which we perceive spatial relationships in a manner which is analogous to our perception of actual three dimensional space, the material picture provides the basis for the experience but the depth perception occurs somewhere within our visual array. It would be unreasonable, indeed, to say that this additional space is truly 'external' to us even though it appears to be situated in and around the perceived picture plane.

In his paper 'Proof of an External World', G.E. Moore attempts to counter the Idealist notion that the existence of things outside us rests on a matter of faith and to question the validity of Kant's own proof of the "objective reality of outer intuition". The latter implies that spatial awareness is an *a priori* intuition and does not result from an empirical investigation of actual space in the physical world. As Kemp maintains, Kant's "idea of space can lay the foundation for sensory intuition but cannot be conceptually touched by perception of the exterior world."[10] Moore uses a common-sense analytical method to separate what we understand to be the 'external' world from any experience or any perception we may have of it and so argues against the solipsistic notion that the self is all that exists or is all that can be known.[11] If something I might perceive is independent of my having any experience at that time, then it could be said to be external to my mind. Moore begins by defining more precisely what the term 'external' might mean and differentiates between things which are *presented in space* and things which are *to be met with in space* suggesting that the latter expression is more precise in describing what we normally understand as external things. The after-image caused by staring at a white circle on a black ground for a prolonged period and subsequently looking at a white background, is in Moore's argument, presented *somewhere* in space. It is not, however, really justifiable to say that it is *to be met with in space* as it is impossible that someone else would experience or perceive that *very same* after-image whereas they will perceive the very same piece of black or white paper. Similarly, a pain which I may experience may appear to be located in my leg which is in itself spatially located but it cannot be felt by another person although they may experience an identically similar sensation. By stating that there are some things which we experience in a private sense and others in a more public space, Moore establishes the notion of 'external' things by positing those aspects of experience which could be called 'internal'.[12]

If there are experiences which occur within our perception which cannot be shared in a literal sense, then these can be differentiated from things which can be shared. If, then, these things are 'to be met with in space', although imply-

10. Kemp, op.cit. p238.

11. G.E. Moore 'Proof of an External World', *Selected Writings* (ed. Thomas Baldwin), London & New York: Routledge 1993, pp147-170. See also Bertrand Russell 'The Existence of Matter', *The Problems of Philosophy* Oxford & New York 1980 (1912), pp7-12. Russell questions the notion that an object, for example, a cat, consists only of sense-data: "If the cat exists whether I see it or not, we can understand from our own experience how it gets hungry between one meal and the next; but if it does not exist when I am not seeing it, it seems odd that appetite should grow during non-existence as fast as during existence. And if the cat consists only of sense-data, it cannot be *hungry*, since no hunger but my own can be a sense-datum to me." (p10)

12. In a discussion of the mental image, W.J.T. Mitchell includes the diagram illustrated in figure 12 which superimposes, as he puts it, three separate instances of the relation

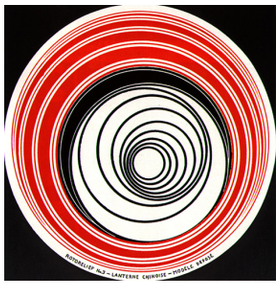

Figure 13

Marcel Duchamp *Rotorelief - Lanterne Chinoise* 1935

ing that they might be perceived, it does not follow that they are, that they ever have been or that they ever will be, by me or anyone else. Moore goes on to question the notion that such things that are to be met with in space are necessarily external to our minds by considering those things which could be said to be *in our minds*. After-images or pains are typical examples of such things - whereas a pain or an after-image could be said to be 'in my mind', my body most definitely is not, even though I may be thinking about it. Moore maintains that if

I add a date to an expression about a pain I have had - 'last week I had a headache' - it follows that I was having an experience at that time, whereas if I locate an expression about my body in time - 'last week I had long hair', for example - it merely provides historical or biographical data and neither establishes that there was necessarily anything in my mind nor that I was having an experience.[13] If something external to our minds (i.e. our bodies) existed at a specific time, it does not follow that we were having an experience at that time. Similarly, if something external to us experiences pain, although constituting an experience internal to it, by no means implies that we experience something. Therefore if a thing were dependent on my having an experience, it would not exist outside me, *it would not be itself*. Moore uses the example of a soap-bubble to make his point which is worth quoting at length:

"But if it is true that it would not be a soap-bubble, unless it *could* have existed at any given time without being perceived by me at that time, it is also certainly true that it would not be a soap-bubble, unless it *could* have existed at any given time, without its being true that I was having any experience of any kind at the time in question: it would not be a soap-bubble, unless, whatever time you take, from the proposition that it existed at that time it does *not* follow that I was having any experience at that time. That is to say, from the proposition with regard to anything which I am perceiving that it is a soap-bubble, there follows the proposition that it is external to my mind."[14]

Bearing in mind the 'Miracle of the Shadows' demonstration, a stereoscopic illusion or any image/work which *privatizes* the viewer's access to it could perhaps be said to necessarily and fully exist only when perceived. The material object or image no doubt exists as it provides the basis for the experience but there is a sense in which the work is not really *complete* until looked at or, if one reverses the polarity, the work completes the viewer's perception of it. In the cases where such optical illusions are appropriated for the purposes of art as seen, for example, in Duchamp's *Rotoreliefs* (figure 13), this completion is an automatic or involuntary function of the viewer's perceptual system which nevertheless

12. (cont.) ... between image and referent as follows: a real object (the candle on the left) and a projected image (the candle on the right); a real object and a mental image of it - a relation which proposes the mind as a camera obscura; a real image or picture and a mental image of it (all optical inversions have been rectified for simplicity's sake). Like Descartes' image of the enucleated eye, the diagram as a whole is misleading as model of the mind in that it represents consciousness, as Mitchell puts it, "as an activity of pictorial production, reproduction and representation governed by mechanisms such as lenses, receptive surfaces and agencies for printing, impressing or leaving traces on surfaces." As before, the mind is implied as a drawing surface and presupposes another mind to view it (and so on). If the right-hand side of the diagram were removed, that is, the side which refers to the 'mind', the left-hand side representing the world would "continue to exist quite nicely" whereas if the reverse occurred and "the world were annihilated, consciousness would not go on". Mitchell points out that what is pertinent about the diagram is that it reflects the way in which we represent the world and the mind to ourselves. If the

leads to some form of mental or conceptual projection about the artist's intentions. Duchamp's spinning discs are best viewed with one eye closed and induce a perception of rhythmically pulsating forms which appear three dimensional even though they are printed on thin card. The impression is, of course, optically-based although the discs are not concerned with effect alone but with using that effect to suggest certain mental or physical states - particularly with regard to eroticism and desire - through a kind of hypnosis.[15] The viewer is drawn into the picture almost by subterfuge whilst at the same time being provoked or invited to speculate on its significance. In a sense, such a work induces a *primary experience*,

one that cannot be reproduced. One's perception of it may result, in theory, in an identically similar experience to that of someone else but this does not mean that the perceived image is the *very same* image perceived by that other person. Although the material image/object/ artwork exists before, during and after the perception of it, the image in one's mind is transitory and necessarily *private*.[16]

12. (cont.) ... diagram is seen as a model of the way we talk about images, it places both mental and material images in the same logical space. When the notion of the 'mind' is removed from the equation, we must necessarily remove the idea of an image as without the mind "there would be no more images, mental or material" except, perhaps, the retinal images in the open eyes of a dead man. Illustration and quotations from W.J.T. Mitchell *Iconology: Image, Text, Ideology* Chicago & London: University of Chicago Press 1986, p16-17.

13. Moore, op. cit. p102.

14. Ibid. p164-165.

15. I will be discussing Duchamp's involvement with optical and perceptual phenomena more extensively in chapter 6.

16. Bertrand Russell discusses the essential privacy of each individual's experience in relation to their subjective perception of time and space in *Human Knowledge: Its Scope and Limits* London: Routledge 1992 (1948), p105.