Chapter 4.

Mapping genealogies - an observer epistemology – cosmology and sky situated knowledge.

> Western philosophy itself was cartographic, at least in the ways that philosophers were scouts in the unknown territories of the taken-for-granted mappers of the boundary between Oecumene and Anoecumene, spies in the no-mans-land between the sensibility of the body and intelligibility of understanding. [1]
>
> G.Olsson, 1998. *Towards a critique of cartographic reason.*

In this chapter I discuss the development of ideas about the structure of cosmic space in the field of the Western imagination. This enabled the eventual mapping of the night sky. In this tradition complex relationships between the intellect and the senses, between art, science and philosophy, have developed in conjunction with the notion of an observing subject. Scientific, artistic and religious imperatives have attempted to make sense of the natural world and humans' place within it. This has occurred through the competing practices of discourse, observation, technological devices, magic and superstition. My interest lies in the way that these relationships have been filtered through the prism of the observer and the study of the behaviour of light.

With this in mind I discuss the way in which philosophical thought in the ancient world imagined and eventually mapped cosmic space. What emerged was a speculative cosmology that through poetry and geometry, explored the hidden structure beneath the physical nature of things. These speculations developed into a capacity for surveying space in different ways. The Oecumene (the peopled space), and the Anoecumene (the space of gods and dragons), became defining elements in the configuration of both celestial and terrestrial space. The boundaries between them were

[1] G.Olsson, 'Towards a critique of cartographic reason,' Ethics, Place and Environment 146, in Pickles, *The History of Spaces,* p. 22.

continually being shifted and stretched to accommodate new knowledge. The 'out there' and the 'back here' remain so to this day, in a more contingent space where there is virtually no 'terra' that is not to some degree 'cognita.'

Traditionally mapping models have promoted certain points of view as well as revealing knowledge about physical space. I discuss some of these: models such as the sphere and the globe, the analemma, graticule and the all-encompassing map of space and time, otherwise known as the world map. These were implicated in the development of both celestial and terrestrial mapping. In the context of my own work my intention has been to revisit and re-contextualize some of these earlier concepts and spatial models. I work with fragments of these to reinvent new hybrid maps, or create spatial forms and patterns that underlie the process of understanding cosmic space through mapping. In the works on paper, I have attempted to reveal different spaces and times simultaneously by creating surfaces with various transparent layers of data. Now we understand the night sky through an enculturated vision of nature. It is mapped through technologies associated with the emanation and electronic transmission of light. A process that began long before with the analysis of sense experience and the act of observing using the naked eye, the camera obscura and the telescope. As our vision has extended, reality is increasingly re-negotiated or taken on trust.

Concepts, discourses and devices.

The process of looking at the unfolding of mapping practice reveals the ways in which space has been constructed. In the context of philosophical debate about Western conceptions of humanity, it also reveals the way in which it has been understood through a dialogue with Greek thought. This involved the principles of secular, rational thinking and the application of logic. Philosophical debate presents questions about belief systems, purposes and rules that generate mappings as Cosgrove explains:

> [c]ultivation of the mind and its capacity for abstraction, classification, categorization, logical induction and deduction, theoretical analysis and synthesis, indeed all those things that made up *scientia,* were defining qualities of humanity for Greek thinkers, introduced into Christianity through Hellenism's influence in Rome's empire… A hierarchical order that

> mapped space, society, the idealized body, and its faculties to a scale of humanity and opposed human "culture" to nature has been continuously re-worked in Western thought and practice. [2]

In Euclid's *Optics* (300BC), the Greek mathematician, investigating the nature of vision, presupposes the optics of the camera obscura as a demonstration that light travels in straight lines. Early observations of the sky were grounded in the optical principles of this basic image recording device. Light was recognized as a carrier of vision. However, in drawing on history to make visible the relationship between space and the 'observer,' Jonathan Crary suggests that vision is filtered through the experience of the observer and mediated by that experience. He makes the point that:

> [v]ision and its effects are always inseparable from the possibilities of an observing subject who is both the historical product *and* the site of certain practices, techniques, institutions and procedures of subjectification … There is no observing subject prior to this continually shifting field. [3]

It is said of the influential Greek philosopher and scientist Aristotle, that while watching sunlight shining through a very small hole between the leaves of a tree, he was able to see the crescent shape of the partially eclipsed sun projected onto the ground. It was a demonstration both of the behaviour of light and a mysterious phenomenon in the sky. He nominated sight as the most valuable of the senses.[4] Understanding that the optic nerve connected the eye to the brain, he suggested that the eye was 'the gate of the intellect' For the Greeks light occupied space as Schlain explains:

> [i]mplicit in both Plato's and Aristotle's ideas about light was that it was a "thing." They assumed it traveled from here to there through space, though they weren't sure if light performed this mysterious feat in a certain allotted time or whether its transfer was instantaneous. (This assumed), that space and time were absolute constructs of reality and that light was a go-between bouncing off the walls of this grid work. [5]

Greek philosopher-scientists investigated the cosmos by translating abstract thought into ideas which formed a coherent system. They constructed a science of linear, sequential time and space. Rather than being understood through experiential verification, theirs was an idealized, abstract universe

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[2] Cosgrove, *Apollo's Eye*, p. 25.
[3] Jonathan Crary, *Techniques of the Observer,* p. 5, 6.
[4] Schlain, *Art and Physics*, p. 34
[5] Ibid. p. 35.

embedded in the theory and order of geometry. Through concepts and discourses recorded in written treatises, we understand the influence they asserted on the process of constructing and understanding physical space.

Space was essentially a finite void filled with objects. The mathematical principles of Euclid's *Elements,* written in the third century B.C., based the universal principle of structure on the five regular geometric figures. We understand today that the legacy of Greek thought systems, (including Euclidean geometry and rational thinking), are constructs formed in a particular milieu. Nevertheless, they still influence our lives in fundamental ways. In themselves they are only part of what defines the technological and physical mapping of space. However, the influence of rational thinking and objective analysis on mapping practices, and their factual objectivity, continues to contribute to our engagement with space. Corner elaborates:

> [a]fter all it is the apparent rigor of objective analysis and logical argument that possess the greatest efficacy in a pluralistic, democratic society. Analytical research through mapping enables the designer to *construct* an argument, to embed it within the dominant forces of rational culture, and ultimately to turn those practices to more productive and collective ends…. (it is) a practice of relational reasoning that intelligently unfolds new realities out of existing constraints, quantities, facts and conditions. The artistry lies in the use of the technique, in the way in which things are framed and set up. Through reformulating things differently, novel and inventive possibilities emerge. [6]

Plato believed that reality was to be found in an ideal order which only the intellect could grasp. One of the enduring philosophical debates between Greek philosophers still continues to have currency today as new technologies are re-defining what is meant by reality. The debate has to do with the relative values of the intellect and the senses in the perception of reality. For Plato ideas were more 'real' than physical objects. There was a tension between realism and idealism in the examination and interpretation of nature. In an effort to fit the arts into ideas that he hoped to impress on society, he demanded rigid restrictions on their content. Today we would regard this as problematic. Artists too were searching for an ideal order behind appearances, but it was thought that this order was more likely to be revealed through the whole sentient self. What has endured to this day in

[6] James Corner, 'The Agency of Mapping' in Cosgrove, *Mappings,* p. 251.

juxtaposition with more esoteric transcendental beliefs is a materialist view. This view rejects the objectification of ideal forms, believing rather, that the world itself is reality, seen in the totality of the physical objects from which it is made.

Matter is understood through the senses. Things can be touched, whereas ideas or qualities are intangible. Therefore, it is argued, nature can be better understood through disciplined observation of objects which then establish the facts, reality, the truth. But questions remain about the changing perceptions of reality. How reliable is the observer? How reliable are the senses? Is it true, or only seemingly true, perhaps an illusion? What of the imagination? Maps claim to represent the world, giving a material reality to something that the human senses cannot grasp. This relies on a shared belief that the map is in fact a surrogate of space. Christian Jacob discusses this in the preamble to his essay about the ancient mapping of the 'inhabited world.' He suggests:

> [a]s an optical as well as an intellectual prosthesis, maps allow human senses and the human mind to achieve a new level of reality. Maps are impossible without such a shared belief about the materiality and the reality of the world they display, about the claim of the drawing to stand as a substitute for this world. [7]

Spherical geometry and cosmic space.

The central problem that dominated Greek astronomy, (a problem that has defined astronomy for most of its history), was the structure of the *cosmos, (*from the Greek*, kosmos* or ordered world*),* and it was spherical geometry to which they applied their observations. The emphasis was structural rather than locational. The theory of a cosmic structure based on circular motion, with the Earth at the centre, was first articulated by Eudoxus, a contemporary of Plato, and this idea was shared by both Aristotle and the Greek astronomer Ptolemy. It was perpetuated as the dominant model in Western thought for over a thousand years.

Where we situate ourselves in the cosmos has been an ongoing cause for speculation. A model that the Greeks imagined was the *Farnese Atlas*,

[7] Christian Jacob, 'Mapping in the Mind: the Earth from Ancient Alexandria,' in Cosgrove, *Mappings,* p. 25.

200A.D. (See fig. 55). It was a marble statue of Atlas carrying on his back a globe. Carved with the armillary circles, it represented most of the Greek Classical constellations seen from outside the celestial sphere. It was a device to elucidate the astronomy of Eudoxus. Cosgrove suggests that the *Farnese Atlas* was a forerunner to the development of ideas about global empire that emerged in the sixteenth century and beyond. He observes that:

> from Antiquity we can trace the connection between global space-time and ideas of human destiny. The sphere combines these discourses into a single image of order and, unsurprisingly from the earliest times offered divine legitimacy to human will. The Farnese Atlas … sculpts a human figure supporting the cosmos … the figure stands at the junction of heaven and earth, at once divine and human. [8]

Human will however has traditionally had little control over nature, (although there is evidence in the twenty-first century that this may be changing). In 1998, the Jodrell Bank Radio Observatory in the U.K. commissioned the British artist Colin Rose to create a sculpture for its arboretum. The idea of the observatory has grown out of human curiosity, a desire to map the night sky and, arguably, a desire to understand and master nature to its own ends. For this project Rose cast a sphere from white granite dust mixed with cement to create the twenty ton work*, Meteor*. It was an interesting juxtaposition, creating a tension between geometry and natural form. It also drew attention however, to the fragility inherent in the idea of mastering nature, as well as the fragility of nature itself. Thompson describes the sphere as 'sited beneath a gap in the tree canopy, suggesting that it had sliced its way through.' [9] Crashed into the earth and out of our control?

My own explorations of the sphere have looked at phenomenological aspects of this geometric spatial trope, referenced through both its form and content. Made of wood and painted with a pale, transparent wash, the individual arcs from which it is constructed are marked with an obvious surface grain. This forms repetitive and fragmented geometric patterns at varying scales that map, like Mandelbrot's fractals, the underlying patterns seen in the structure and materiality of the sphere. When placed in a darkened space its

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[8] Cosgrove, *Apollo's Eye,* p. 29,30.

[9] Ian Thompson and Marina Valzey*, Colin Rose – Edge to Edge* (London: Black Dog Publishing Ltd., 2002), p. 163, 165. Colin Rose, *Meteor*, 1998, polished white granite composite, 250 cm. diam., Jodrell Bank, Cheshire, United Kingdom.

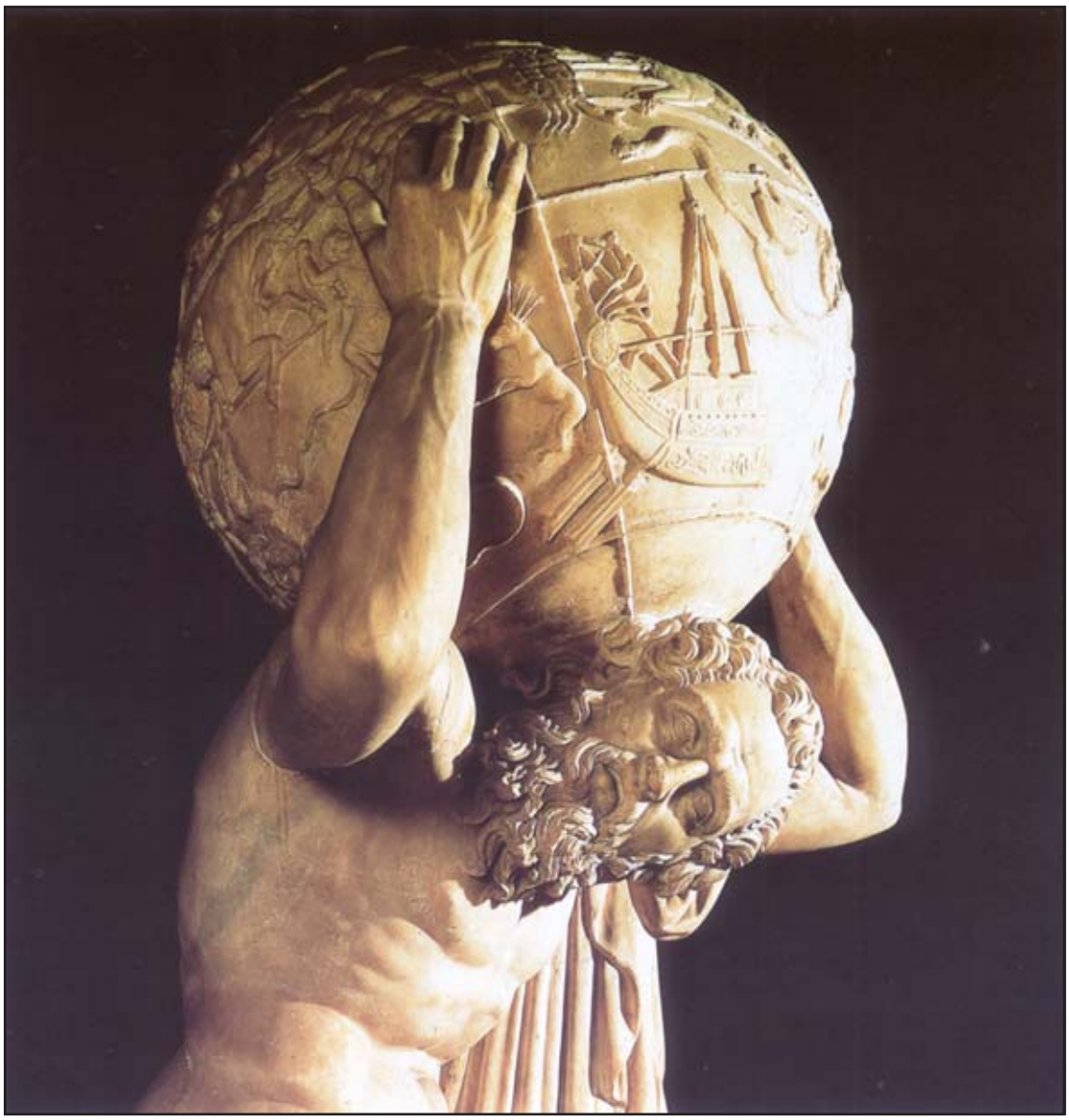

Fig. 55 *The Farnese Atlas*, 200 AD, marble, National Archaeological Museum, Naples.

geometry softens and it appears like a mysterious body in the night sky. Rather than having sliced its way through the atmosphere as Rose's sphere seems to have done, this sphere sits in the dark waiting to be found.

Throughout history astronomers and mapmakers have modelled current ideas about cosmic space that were expressed earlier in the idea of the *Farnese Atlas*. The idiosyncratic twentieth century American artist Joseph Cornell, also constructed three dimensional models of the universe. His work, *Untitled* (*Solar Set),* was a paradoxical juxtaposition of the ancient and the modern. He searched for concepts that might connect art and science through ancient Greek mythology, (which involved the study of appearances and mathematical patterns), as well as Enlightenment astronomy. Using found objects he developed a cosmology of his own in a boxed construction. The interior walls of the box were peppered with stars and the outline of constellations, over which is a tracing of mythological figures. Using balls and rods he referenced gravitational forces and the movement of planets, akin to the experiments of Galileo and Isaac Newton. C.A. Whitney (Professor Emeritus of Astronomy at Harvard University), suggests that:

> [t]hese balls carry our mind's eye beyond appearances to the invisible force of gravity that binds the satellites and the planets to each other and to the sun. An occasional ring suspended from a rod provides a crude analogy to the nearly circular orbit of planets around the sun.[10]

Through abstract explanations in General Relativity and Quantum Physics the work serves in part to emphasize the different concepts by which we understand cosmology today. Whitney suggests that:

> Cornell's constructions bring into focus the difference between the ancient worlds of appearance and the abstract and often strange world of modern scientific theory. Cornell playfully reminds us that there is more to the universe than meets the eye. [11]

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[10] Charles A. Whitney, "Cosmic Travels- The Cosmology of Joseph Cornell" in *Joseph Cornell- Art Minimal and Conceptual Only*: http://hometown.aol.com/mindwebart2/cornellpage2.htm p. 1,3, [accessed14/04/2006]. Joseph Cornell, *Untitled (Solar Set*), construction. Collection of Donald Karshan, New York.

[11] Ibid., p.3.

Light and shadows, patterns and predictions.

The earliest processes of astronomical mapping were developed by observing the change in length and position of the shadows. These were cast by a stick in the ground as the sun moved position in the sky. The pattern of the gnomon, and the relationship between light and shadow, articulate the connection between space and time. Although they are different, one cannot exist without the other. The observation of the sun and moon from Earth, and the effects of their projected light, have enabled all cultures at some time in their histories to develop systems of reckoning for the passage of time. The relationship between time and space, between 'out there 'and 'back here', determined the rituals of their lives.

For the past fifty years the contemporary American artist Joseph Turrell has been experimenting with light, and optical and acoustic perception. Employing visual phenomena as his material, Turrell works with astronomy and the sky and a number of historical references which Kemp notes:

> are presented through models, drawings, paintings, prints and photoworks …They range from the pre-historic observatories of stone circles and ancient temples, through the great astronomical castle and garden of Tychó Brahe on the Danish island of Hven around 1600, to the huge dishes of modern observatories. And at its heart, is a vision of 'infinitude' worthy of Turner. [12]

For some time he has been developing the *Roden Crater Project*, (see fig. 56), shaping space and using natural light to bring the sky almost within the viewer's reach. Kemp explains that:

> [t]he project involves the excavation of geometrical spaces that will serve as exploratories for our perceptions, as vessels for the enclosure of solar, lunar and stellar illumination, as devices for the inscription of time, (like a sundial or gnomon), and as a compound observatory in which precision, wonder and imagination are united.[13]

The interior spaces of the volcano are keyed into celestial events, and have been constructed with auditory as well as visual responses. The sky from the interior is viewed without a visible horizon, altering the perception of it, and anchoring it to the crater's rim so that it feels almost within reach. When the

[12] Kemp, *Visualizations,* p. 136-7.
[13] Ibid.

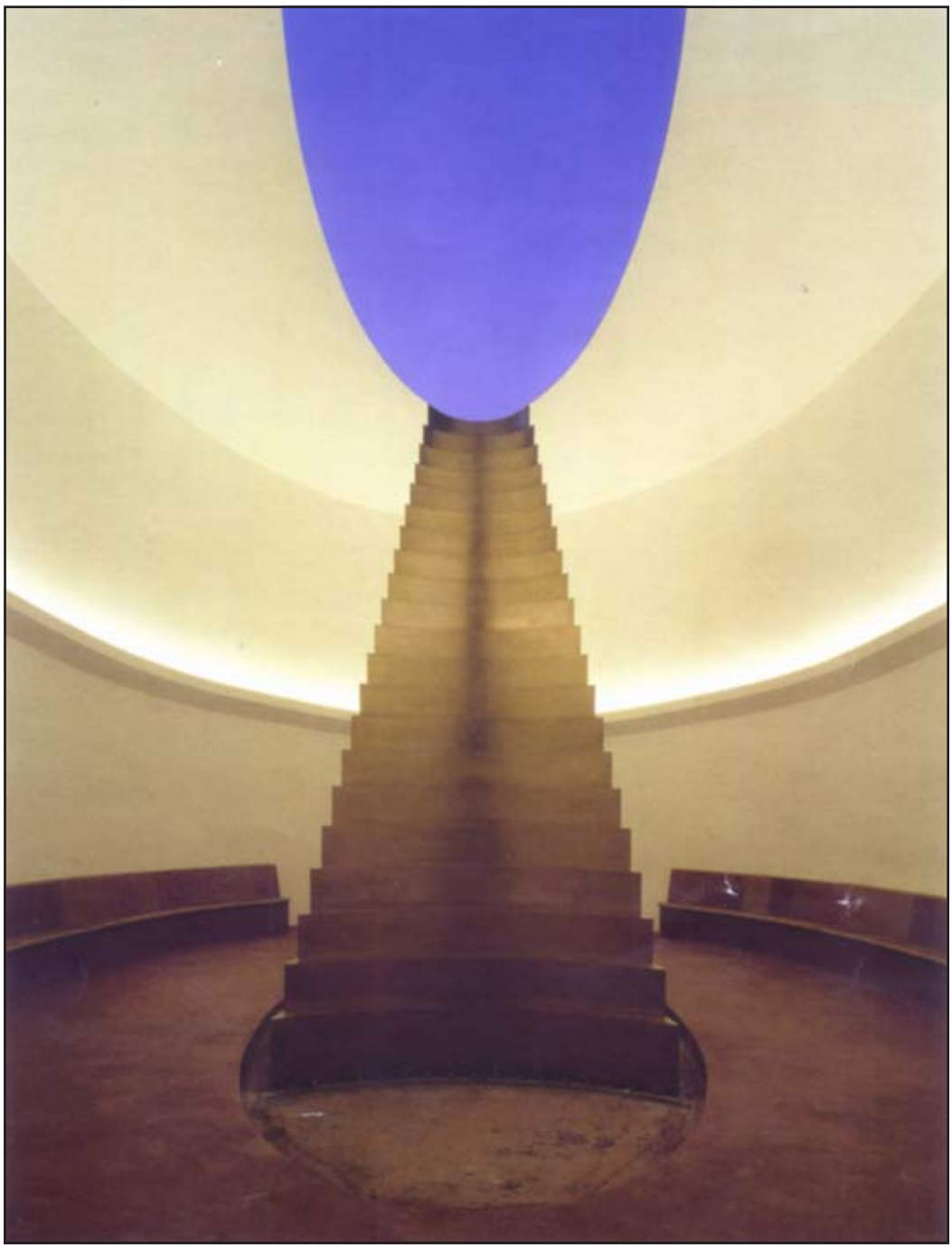

Fig. 56 James Turrell, *Roden Crater,* 2003, (interior view), Arizona U.S.A.

viewer emerges from the centre of the crater the dome of the sky re-attaches to the horizon. Turrell says of this work:

> I wanted to gather starlight that was outside the planetary system, from the galactic planes. You're taking light that is older than our solar system and blending it with light that's eight and a half minutes old. [14]

Memory mapping and the search for causes.

Mapping in non-Western indigenous cultures has been strongly reliant on the immediacy of sense experience and mnemonic and oral traditions. Pickles emphasizes that an understanding of indigenous, non-western cartographic histories is expanding our contemporary idea of map making. He suggests that in this broader context, it is 'mapping' instead of 'map-making' that now determines what is regarded as a map, greatly extending the variety of representations and symbolic forms in the genealogy of cartography. He observes:

> [i]ndigenous mappings do not necessarily have the same kinds of materiality and reproducibility as do western maps, and what constitutes a map and a mapping practice is not necessarily the same across cultures. In some societies, gestural and performative practices are central to the ways in which people structure and represent their worlds spatially, serving as tools of way-finding and spatial representation. [15]

Universally however, in all cultures, the observation and mapping of the night sky had another more subliminal function. Beneath the cyclic patterns witnessed by the naked eye observer there has always been the search for causes. Although there was a diversity of thought systems between ancient Egyptian, Hindu and Aboriginal cultures for example, Schlain makes the point that:

> they share the conviction that there is no sharp dividing line between the 'in here' space of imagination or 'subjective' reality and the 'out there' space of 'objective' reality. In fact, admixing the inner space of dream, trance and myth with the events of everyday existence characterized every belief system worldwide before the Greeks. [16]

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[14] Jane Neal, 'Seeing The Light' *Art Review*, May 2006, ed. Rebecca Wilson (London, 2006), p. 11. James Turrell, *Roden Crater Project*, 2003, interior view. U.S.A.
[15] Pickles, *The History of Spaces*, p. 15.
[16] Schlain*, Art and Physics*, p. 28, 29.

The Yolngu Aboriginal community in Yirrkala north east Arnhem Land see the earth reflected symbolically in the sky. It is mapped through the constellations which take on the identity of earth bound creatures. The complex patterning in the paintings of the universe by Aboriginal artist Gulumbu Yunupingu, from Yirrkala, remind me of the digital mappings in light and colour in my own work. They suggest, for Western eyes, subliminal mathematical relationships with space. They are subtly layered variations of patterns of star forms and dots, which are richly textured.

Yunupingu, with a humanist eye, focuses on the links between people on earth and the stars in the sky, between 'out there' and 'back here.' Her work seems like a metaphorical mapping of the cycle and interconnectedness of life through the patterns of stars in the night sky. In her work *Gan'yu- Stars,* (see fig. 57), the large stars represented are those visible to the naked eye, and the dots are those we cannot see but are there as well, (evident when viewed through a telescope). She understands that a being with an infinite view of the night sky would see nothing but stars. [17] Paintings of Aboriginal Australians are not always recognizable as maps but they are often regarded as maps by the Aborigines themselves. They reveal like an aerial or x-ray view invisible patterns and networks that map the land and the sky.

Locational frameworks in a moving world.

The observation of cyclic patterns of astronomical phenomena, and the development of systems for prediction and the reckoning of the passage of time, has been fundamental to our perceptions of and interactions with space and time. I am writing today on the Winter Solstice, the twenty first of June 2006. The air is sharply cold. The forecast for the day is thirteen degrees Celsius. The sun, positioned over the Tropic of Cancer, has reached the extreme of its northern migration and is standing at its greatest angle to the celestial equator. This equator is the ecliptic where most of the visible stars can be observed. Situated in a band of sky a few degrees either side of the ecliptic is the zodiac. The ecliptic, in Greek cartography, was the baseline for

[17] Information provided by Alcaston Gallery, Melbourne. Gulumbu Yunupingu's site specific work about the universe now covers the ceiling of a long hallway in the new Musee du Quai Branly in Paris, which exhibits indigenous art from around the world.

Fig. 57 Gulumbu Yunupingu, *Gan'yu – Stars*, 2005, pigment on bark, image courtesy Gulumbu Yunupingu and *Alcaston Gallery*, Melbourne.

a locational framework and referencing system in the sky. It was a mnemonic device for way-finding.

Those of us who have a rudimentary understanding of astronomy and geography will know that in reality it is not the sun migrating between the tropics, but the earth that is moving. With its moon, (which orbits the earth every twenty seven and a half days), it is tilted at an angle of about twenty three and a half degrees. Orbiting around the sun it rotates from west to east on its own axis, (which is pointed towards Polaris the Northern Star).The complex behaviours and movements of planetary and stellar objects in space make it difficult to perceive distances on astronomical scales, or our motion within the solar system. Hence it is difficult to have a sense of our being in the universe. With this in mind I have used David Malin's time lapse star trail photographs in my work. In part the intention was to map the motion of the night sky, exposing the viewer to the way in which we on our planet are bound by the laws of gravity, both in our solar system and in an expanding universe.

Adam Nieman's work assists viewers to have a sense of themselves in relation to this moving universe. A contemporary scientist and multi-media artist working at NESTA Futurelab. in the U.K., he is developing an ongoing project titled, *Welcome to our Neighbourhood: belonging to the universe (even if most of it is hard to get to).* Initially he will install a celestial *Signpost* in Bristol, in the U.K. and later others will be placed around the world. He is developing a series of complex kinetic sculptures made with perspex rods, small spheres and light sources. They locate the viewer in the universe. Based on earth but connected at the same time to outer space through models of star systems, they move in relation to the surface of the earth. This enables viewers to perceive objects in celestial as well as three dimensional space. [18]

[18] The works, including *Local Stars* is described in greater detail by Nieman in *Welcome to the Neighbourhood:* www.olats.org/space/13avril/2004/te_aNieman.html p. 2, [accessed 13/04/2006].

The Equation of Time.

If you could record the position of the sun in the sky at the same time every day, say at noon, for a year, you would notice that it takes a particular path. At certain times throughout the year the sun's position not only varies higher and lower, (north and south), as the seasons change, but also slightly east and west. This figure of eight path that the sun makes in the sky over a period of a year is called the analemma. It often appears on modern globes. According to its latitude it is a graduated plot of the declination of the sun over a meridian. [19]

I have referenced the analemma in the digital work *South*. This has been inserted within layers of images made from the deconstructed gore sections of a sphere, and a cruciform x-ray image of the interior of a globe. Together with these are hand drawn wave patterns and text from Corsali's sixteenth century *Crux* map, as well as time lapse star trails, lines of light curving across the image as if bent by gravity. (See appendix 2). Over these is a sequence of fine red vertical lines of light that move machine like across the data in this hybrid map. These mappings and spatial fragments, revealed simultaneously, were intended to give a sense of the way these elements interact to expose the complexities of mapping space and way finding.

As a graphic representation, the analemma reminds us of our own position as an object located on a moving Earth subject to gravitational forces, spinning through space and around the sun. The irregular figure of eight is caused by the eccentricity of the earth's orbit. The centre of the figure eight represents the equinoxes, and the extremes represent the solstices. The sun takes this path because, 'the Earth is tilted on its axis in relation to the plane of its orbit around the sun, and the earth does not orbit the sun in a circle but in an ellipse.' [20] The position of the sun does not always equate with the position you expect it to be according to your watch, (clock time versus sun

[19] Similarly, the contemporary astronomer Dennis Mammana has simulated an analemma over the *Presidential Panorama* photograph of the surface of Mars. Having in mind the behaviour and position of Mars in the solar system, he calculated the position of the sun in the Martian sky once every thirty Martian days. The path revealed by his calculations formed a simple stretched pear or tear drop shape. M. Nemiroff, J, Bonnell, *Astronomy Picture of the Day*, *Martian Analemma*, Dennis Mammana:
http://antwrp.gsfc.nasa.gov/apod/ap030626.html p.1, {accessed 29/04/04}

[20] www.analemma.com/Pages/frmaesPage.html [accessed 29/04/2004].

time). The difference in time between what your watch reads and the position of the sun is called the 'Equation of Time.'

The contemporary Japanese artist Hitoshi Nomura has used the analemma. in his work *Cowara (cosmic waves and radiation*), 1987-1992, (see fig 58). He has studied the complex spirals and patterns that are created by sun and moon over time, when observed from fixed positions on Earth. Recording them as photographic images on a chart, he projected them as spatial sculpture on glass in conjunction with sound. Tony Bond observes that:

> [t]hese works manifest part of this conception of space and time – making the sounds and images of cosmic processes available to us, transformed into a detectable range of sound and light…[In Nomura's} case observation is also committed to documentation (in keeping with scientific method) – yet the synthesis is a metaphysical one. [21]

The surveying capacity of the human mind – three mappings.

By observing the relationship between shadow and time the Greek polymath Eratosthenes, in the third century B.C, gave what Cosgrove describes as, 'imaginative significance to that implicitly imperial border zone, the "ends of the earth. "' [22] He worked with the accumulated knowledge of mathematics and spherical geometry to calculate the circumference of the Earth, and as Peter Whitfield observes:

> [b]y this measurement, the principle of which is still used today, Eratosthenes established two traditions of long standing in cartography…. That cartography has been only one avenue in (the cartographer's) pursuit of knowledge. …. (and the demonstration), to future mapmakers that they must first look to the heavens if they are to get their bearings on earth…. It was Eratosthenes who first proved "the surveying capacity of the human mind " on an Earth-wide scale, condensing the size of Earth from an unknown immensity to a measured dimension. [23]

Later, in AD 140, the Alexandrian astronomer Claudius Ptolemy, published the *Almagest*, a critical compilation of all the astronomy known at the time in what he believed to be a geocentric universe. Ptolemy mapped the positions and brightness, (magnitude), of about 1000 stars in forty eight Classical

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[21] Anthony Bond, *The Boundary Rider-9thBiennale of Sydney*, exh.cat., (Sydney: Art Gallery of New South Wales, 1992), p. 180.
[22] Cosgrove, *Apollo's Eye*, p. 43.
[23] Peter Whitfield, *The Mapping of the Heavens,* (The British Library,1995), p. 27, 28.

Fig. 58 Hitoshi Nomura, *Cowara (cosmic waves and radiation*), 1987–1992.

Greek constellations, named for mythological figures. The constellations became a referencing system, refining patterns and landmarks in the sky. Believing that the perfect form of motion was circular he made the planets revolve in circles. The *planetes,* (the Greek word for wanderers), had been discovered when it was noticed that certain stars were not fixed, but moved in irregular ways independently across the sky. (We know now that this irregularity is caused as the planets overtake or are overtaken by earth in their various orbits at a distance from the sun). Jacob describes what would have been involved in the process of Ptolemy's research:

> [w]ithin the Alexandrian Library, in order to build up a whole picture of the world, one had to move slowly along a course of mediations and analogical operations, from empirical data to the final intellectual scheme. [24]

Ptolemy's fascination with the night sky was not just about science, but about what motivates and moves the human spirit. It was a place that connected him to a world beyond his own, 'back here', and took him outside of himself, 'out there.' In his own words, in an epigraph opening the *Almagest*, Dava Sobel recounts; 'I know I am mortal by nature, and ephemeral, but when I trace at my pleasure the windings to and fro of the heavenly bodies I no longer touch earth with my feet. ' [25]

The basics of scientific map-making were explored by Ptolemy long before they became common practice. His *Geographia,* a collection of regional terrestrial 'maps' made from information drawn from texts, travel reports and previous maps, is based on points placed on a graticule over a designated space. He developed the idea of drawing maps to scale, 'to survey the whole in its just proportions,' and devised a projected framework of co-ordinates linked by minutes and degrees north of the equator, (the south being little known). [26]

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[24] Jacob, 'Mapping in the Mind,' in Cosgrove, *Mappings*, p. 35.
[25] Dava Sobel, *The Planets*, (London: Fourth Estate, 2005), p. 38.
[26] Wilford, *The Mapmakers*, p. 33. Wilford describes the system of co-ordinates. 'The lines used in mapping are known as parallels (lines running east-west) of latitude and meridians, (lines running north-south) of longitude. Such a network of lines is called a graticule or a grid, or, more commonly, a co-ordinate system. To locate or 'fix' a place on Earth in relation to any other place it is necessary to know its latitude, (distance from equator) and longitude, (distance from the Prime Meridian at Greenwich, U.K.): the place should be drawn on the map at the point where the two lines of known latitude and longitude intersect.'

Eratosthenes had also made a somewhat more abstract world map in Alexandria. It is said that his treatise placed mapping in an historical and geographical context. The map itself separated the geography from any connection to literature and poetry. It revealed new methodological rules in which the data conveyed by travelers was converted into mathematical relationships. Jacob describes the differing ways that Ptolemy and Eratosthenes approached the process of mapping as a system unfolds:

> [i]f Ptolemy's regional maps were a catalogue of positions, Eratosthenes' world map was perhaps more like a relational database: a device wherein a given place was meaningful and relevant only as an element within a system of relations. Ptolemy was interested in an inventory of the world and no limits restricted the continuous addition of new locations. Erastothenes was interested in the structure rather than the inventory. … (His) purpose was to build a structure of abstract geometrical lines and shapes which did not represent anything real in the geographical space but made visible mathematical relationships within the orthogonal frame of the map. … Eratosthenes' map was thus a computing device. It allowed the mathematical cohesiveness of the step-by-step construction of the picture of the world to be checked by the progressive discovery of new topographical data. [27]

In my work *Deep Field* I reference these differing ways of thinking about the mapping of space, as well as later Early Christian attempts to map all possible relationships simultaneously. The intention was to use abstract map fragments and data involved with the process of mapping to make visible the relationships that structure my map of the night sky. Here different spaces play off each other in a network of relationships that also reference mapping co-ordinates. These networks and locational devices have been woven into a more chaotic structure of patterns of light at various scales and focus. In his catalogue essay for the exhibition *Which Way Is Up*? Selenitsch describes the work:

> [t]he source material has been shuffled into different scales, and juxtaposed through vertical strips. This allows for all the images to be seen simultaneously as the eye sweeps left to right, guided by the spectrum line across the lower part of the composition. Different scales and different images co-exist in a composition that weaves a horizontal reading convention through vertical segments. This crossing of the eye and data

[27] Jacob, 'Mapping in the Mind ' in Cosgrove*, Mappings*, p. 40,41,42.

> helps to structure an image not only of the sky and beyond, but also of the way we make images. [28]

There was however another form of mapping that Jacob refers to. It had its roots in the power of the art of verbal description, the Greek word being *ekphrasis*. It was a form of mental mapping, adapting and describing the Alexandrian map. Written by Dionysius Periegetes in the second century A.D. it was a *Description of the Earth.* He was able to build visual impressions of the world, to create a mental map through the recited poem and the written text. Unlike Eratosthenes map which no longer survives, this text endured for centuries after its creation. The poet constructed a textual map, an assemblage of diverse information that allowed the reader, following the instructions of the poet, to be the map maker. Jacob observes:

> [l]iterary pleasure was linked to cognitive efficiency. Vision was the foundation of knowledge, and a text, thanks to specific rhetoric, allowed the encoding and transmission of this vision from the writer to his readers. Thus Dionysius' readers through a fanciful didactic experience could share the abstract and surreal vision of the Alexandrian cartographer. [29]

The fragmentation of space.

In Medieval Europe space and time were filtered through a theological discourse. Homogenous, ordered Euclidean space underwent a conceptual fragmentation in which different regions of space became disconnected. Mapping was essentially a social process, an act of the symbolic, imagined and psychologically projected worlds. The problem for Christian thinkers was how to reconcile late pagan neo-Platonic thinking and its openness to astrology, with the inherent tensions between free will and fatalism, between possibility and certainty, embedded in their idea of God. Whitfield observes:

> Neoplatonism especially had at its heart the conviction that there were many levels of being, and that this world was a mere image of a higher archetype. There were many possible pathways to the higher realms of being, and the Platonic doctrine that the stars were divinities or intelligences among whom the human soul had its true home, meant that astronomy and astrology were seen as a science through which the chain of being, the harmony of human life with the cosmic order, could be studied and understood. [30]

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[28] Alex Selenitsch, 'Crux: Felicity Spear', Geoff Quilley, 'Projections: Sarah Winfrey', in exh. cat. *Which Way Is Up?* (England: Fermynwoods Contemporary Art Gallery, 2005), p. 1.
[29] Jacob, 'Mapping in the Mind', in Cosgrove, *Mappings,* p. 49.
[30] Whitfield, *The Mapping of the Heavens*, p. 33.

Early Christian artists attempted to represent all possible relationships simultaneously. Schlain quotes Poulet's *Studies in Human Time* to elaborate suggesting:

> [t]here was not one duration only. There were *durations,* ranked one above the other, and not only in the universality of the exterior world but within himself, in his own nature, in his own human existence. [31]

Maps became more works of art than information, typically being maps of the world as it was understood. They were either the schematic T-O maps that divided the sphere into three continents, or the *mappaemundi* being constructed from vestiges of classical knowledge, information gleaned from travellers, mythology and religious doctrine. Whitfield observes:

> Christian thinkers (like their Islamic counterparts) sought to construct a framework of information about the creation as a whole with which their central religious beliefs would be in harmony. Cosmology became central, since an understanding of the mechanics of the universe would lead to a knowledge of God… cosmology… was determined by *a priori* beliefs, so that intellectual energy was poured into elaborate speculations in which philosophy, mechanics and theology were held in balance. [32]

Things shifted when, in the late Middle Ages, Arabic texts referencing classical Greek astronomy and philosophy entered Europe and were translated into Latin. Ptolemy's *Almagest* was among them. The dissemination of these texts created a crisis of authority between belief in the will of God and the rational laws of physics. (*Physis* being the Greek word for nature). What emerged was a rational theology fused and reconciled with Christian doctrine. Among the new rationalists was the thirteenth century Florentine Italian poet Dante Alighieri. In his epic poem *The Divine Comedy,* (especially in *Paradi*so), he used classical spherical models and verbal descriptions of cosmology to express the ordered harmony of the Universe. Whitfield suggests:

> [p]erhaps the central mystery which Dante is exploring is how the mechanical Universe can be moved by a spiritual force. Dante seems to have thought that Aristotle's philosophy did provide an answer to this metaphysical question through his definitions of matter and form. While

[31] Schlain, *Art and Physics*, 44. There is a resonance here, in this multiplicity of durations, with developments in art and science at the beginning of the twentieth century.
[32] Whitfield, *Mapping The Heavens*, p. 47.

> matter was the material substance from which things are made, form was that which gave each thing its true quality. Form causes stars to shine and to move, while in man form is soul. Man is in fact a conjunction, a horizon between soul and body, while the cosmos is imbued by God with eternal harmonious motion which expresses form… [33]

In his essay, *Mapping Eden* Alessandro Scafi, discusses the representation of Earthly Paradise in Medieval world maps, in which he pictures the presence of a 'microspace' and 'macrospace.' [34] Microspace, he suggests, represents the familiar world of our personal experience. The macrospace is that of the cosmos, a remote space like the heavens: out of our reach. It is a space that must be imagined. However it is possible that we may project on to macrospace our microspace experience. The model of an Earthly Paradise (belonging to the realm of macrospace), was superimposed over the microspace of the 'mappaemundi.' However in the context of Earthly maps, as Scafi observes:

> [t]he mappaemundi mirrored macrospatial thinking, whereas the portolan charts and the local and regional maps had a practical purpose outside the realm of religion and mythology and reflected microspatial thinking. [35]

It is in the context of my own work, and in terms of the possibilities for more creative contemporary mappings, that I am interested in this cartographic paradox, this attempt at the folding and layering of various forms of spatial mapping within and over another. Mention has been made in earlier chapters of the way in which I use this process to build mapping images of the sky that simultaneously layer and reveal information from different times and spaces. What is also of interest is the relationship that the *mappaemundi* had to space and time. Scafi continues:

> [b]y representing a many-layered gathering of historical events as well as points in the geographical space of the world, the Medieval mappaemundi demonstrates a strong intuition for the 'spacetime' character of reality. [36]

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[33] Ibid., p. 49

[34] Alessandro Scafi, 'Mapping Eden: Cartographies of the Earthly Paradise' in Cosgrove *Mappings*, p. 55.

[35] Ibid., p. 63. The portolan charts were graphic extensions of written descriptions found in maritime pilot books, mostly oriented north, indicating the introduction of the magnetic compass. The wind rose became the compass rose and a network of rhumb, (constant - course), lines based on compass bearings was introduced to the chart. Amir Aczel describes the magnetic compass in 'The Riddle of the Compass' (San Diego, New York, London: Harcourt Inc., 2002), as the first mechanical measuring device, allowing measurement to be visualized as direction.

[36] Ibid., p. 64.

Spatial relationships were grounded in a connection between geographical space and time, echoing our contemporary understanding of modern physics where space and time are understood as interdependent in a four-dimensional space-time continuum. The *Medieval Wheel Calendar*, pictured from the fourteenth century *Catalan Atlas*, (see fig 59), schematizing the four elements, the seven planets, the twelve zodiac signs and the twenty eight phases of the moon and its nineteen year cycle and the four seasons, was a cosmic diagram which visually combines the elements of time and space that dominated medieval science. With the invention of the mechanical clock in the fourteenth century a new metaphorical image of nature emerged. It was a controlled mechanism representing the classical, cosmic structure and motion of the Universe, the clock face being reminiscent of the earlier Arabic astrolabe. [37]

In Venice, in 1459, Fra Mauro made a *mappaemundi,* (see fig. 60), in which different conceptual frameworks and ideas were explored. Within the circular framework of the Medieval map he drew on a wide variety of sources, including Ptolemy's *Geographia*, portolan charts, accurately mapped coastlines, Arabic documents and various travel narratives. Religious, mythological and pagan references virtually disappeared, and the Garden of Eden was now relegated to a corner outside the space of the sphere. In their place was evidence of the ground-swell of empirical science and the process of secularization that eventually rethought the space of the observer.

For the Greeks the basis of an emerging world map had been theoretical geometry, but by the Middle Ages it had become the religious imagination. Fra Mauro's map is particularly notable for its transitional quality, indicating a shift towards a different frame of reference for mapping space. In his map the focus is on representing measurable space, rather than multi-dimensional space.

[37] The astrolabe was a set of overlapping hand held disks containing astronomical information used to take measurements for celestial navigation.

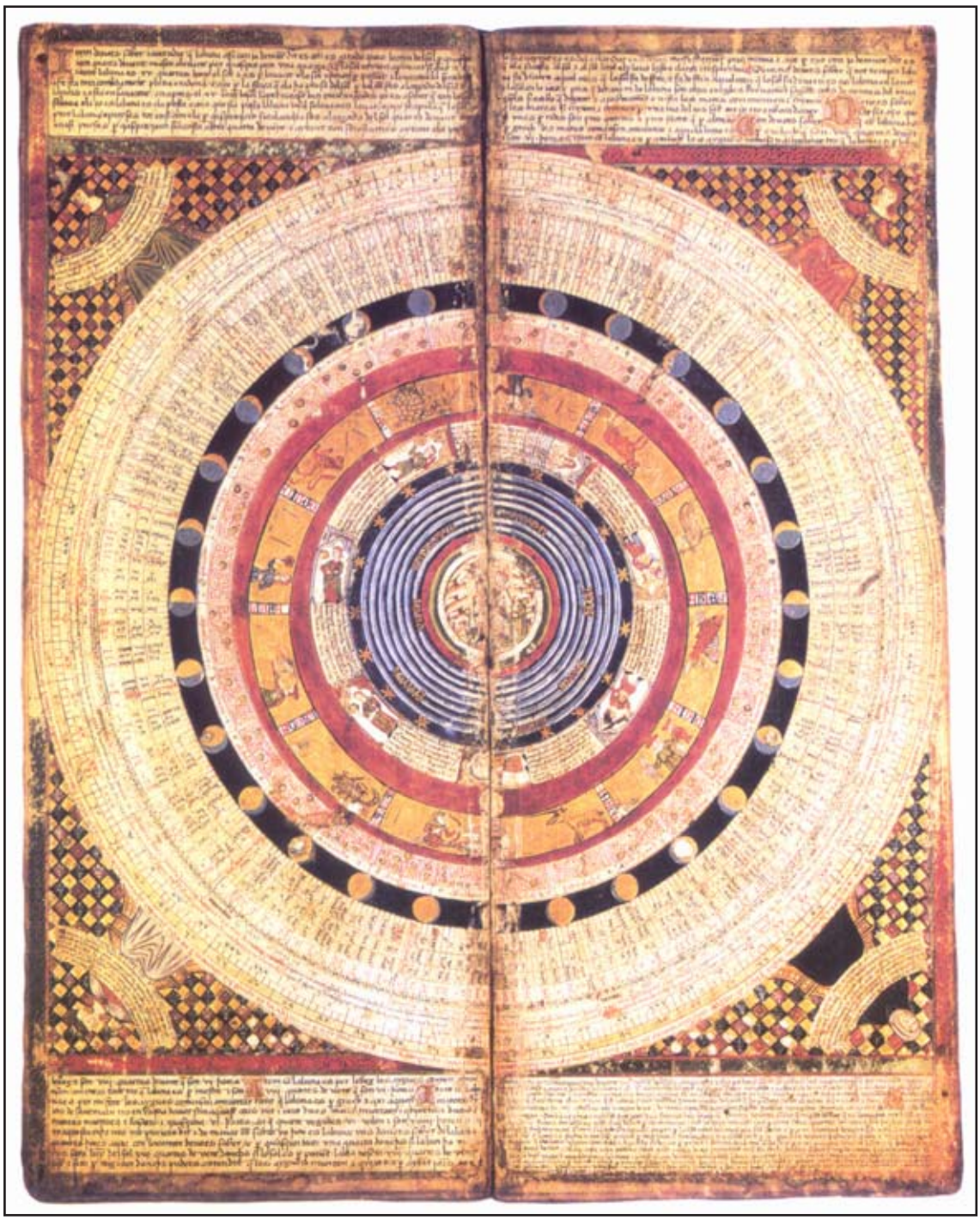

Fig. 59 *Wheel Calendar*, 14th. C., Bibliotheque Nationale, Paris.

Fig. 60 Fra Mauro's *mappae mundi,* 1459, Biblioteca Nazionale Marciana, Venice.

Whitfield describes the visual impact of this map, a new vision that paralleled the technical developments in contemporary painting and engendered new experiments with space, form and illusionism:

> [t]here is one way in which the Fra Mauro map differs from all others: its surface style, its visual texture, is a repetitive pattern of text and image, composed in blue and gold. No features dominate but no part of the surface is empty, so the entire map shimmers with its almost hypnotic pattern. In almost any section of the map, the surface resolves itself into miniature landscapes, composed of a towered city, a nearby river and some trees. These scenes are directly comparable to the distant perspectives glimpsed in the background of fifteenth century paintings. [38]

In this chapter I have discussed the way in which ideas about space and mapping practices have gradually evolved as our spatial boundaries have expanded. I have referred to the way in which mapping practices have emerged in different forms together with a capacity and a desire to survey space. This occurred in various ways: through the study of mathematics and light, through structural or locational turns of mind, and through imaginative texts. It became an attempt to identify or 'map' an all-encompassing cosmic or world view employing a combination of techniques and strategies, some of which I have revisited in my work. These were based on increasingly complex observations of the natural world that were a blend of science, art and theology. They were also underscored by the belief in light as a carrier of vision, and vision as the foundation of knowledge.

Ptolemaic mapping with its projections and co-ordinates went 'underground' during the religious turmoil of the Middle-Ages. However it re-emerged in the fifteenth century at the same time as Fra Mauro was constructing his world map. Beneath the concept of Ptolemy's *Geographia* was a system to map the world in which a finite, spatially referenced spherical earth could be increasingly inscribed with new explorations.

Jerry Brotton remarks on the impact of the re-emergence of this spatial grid, suggesting that:

> [t]he result of this shift in perceptions of terrestrial space from one of religious symbolism, to the construction of an empty, homogenous

[38] Peter Whitfield, *The Image of the World-20 Centuries of World Maps*. (London: The British Library, 1994), p. 32.

graticule of latitude and longitude, enabled the cumulative mapping of new found lands within this predetermined spatial grid. It also created the conditions for the development of a geographically comprehensive and all-inclusive apprehension of the early modern world. [39]

[39] Jerry Brotton, 'Terrestrial Globalism: Mapping the Globe in Early Modern Europe', in Cosgrove,*Mappings,* p. 75.