

APPENDICES

1. The *Aitoff Projection*. A 'true' projection of the sky as seen from the earth is akin to the inside of a globe. It is called the celestial sphere. The difficulty of displaying a three dimensional spherical model on a two dimensional surface means that the whole sky cannot be displayed. Multiple angles are required. The *Aitoff Projection*, an ellipse, is used to display maps of the whole sky and world maps, See *WMAP* homepage <http://map.gsfc.nasa.gov/> [accessed 11/10/2003]. The polar azimuth projection focuses on the north or south pole from above. Circular in shape it is structured by a grid of radial lines representing the meridians and grid of concentric circles representing the parallels. These projections are referenced in the works on paper *Bipolar 1,2, and 3*.

2. An analemma is an equation of time. The figure of eight path of the sun measured over a year and often seen on globe models. This is referenced in the digital print *South*. www.analemma.com/Pages/frmaesPage.html

3. Part of the *Diagram of Red Shifts in the Spectra of Quasars* formed the transparent column and line co-ordinates in my work *Deep Field*. Patrick Moore, *The Atlas of the Universe*, (Mitchell Beazley,1981), 213.

4. The electromagnetic spectrum is seen as a thin coloured line in a number of my digital prints. In the *Deep Field* digital prints there is a purplish tinge permeating the overall image. Recently, scientists have detected the cosmic spectrum indicating a change from hotter blue light to a cooler red light, creating a purplish tint in the light of the universe. Through a complex analysis of the most distant light in the universe that can be detected at near infra-red bands, scientists have been able to construct this spectrum to represent the sum of all energy in the local volume of the universe emitted at different optical wavelengths of light. (Keep in mind that from earth we are only able to see a small amount of visible light in the electromagnetic spectrum). The cosmic spectrum represents the approximate colour the eye

would see at each wavelength of light, as if all the light in the universe was put through a prism to form a rainbow. The intensity of its colour is in proportion to its intensity in the universe. Hence scientists have been able to determine the changing colour of the universe. *The Cosmic Spectrum and the Color of the Universe*, by Karl Glazebrook and Ivan Baldry. www.pha.jhu.edu/~kgh/cosspec/ [accessed 25/02/2007].

5. A photograph of a copper engraved etching plate of celestial gores, and a series of ultra-violet and infrared x-rays of historical globes obtained from Paper Conservation at the National Maritime Museum at Greenwich. Fragments of these images were used in the digital prints, *Out There, Bi-polar 1,2, and 3*, and *South*. I spent time conducting research at the National Maritime Museum at Greenwich, U.K. in 2004 and obtained a number of images and texts for use in my work.

6. Historic maps obtained from *The Crux Collection of Rare Maps*, at the State Library of New South Wales, including Corsali's *Ovalle Historia – Reyno de Chile* 1646 (including the Southern Cross star formation *El Cruzero*), and Verhaer's *Novus typus orbis ipsus globus ex Analemme Ptolomaei diductus*, 1614, (created as a southern polar projection and indicating the *Antarctic* and *Terra Australis Incognita*). Fragments of these images were used in the digital prints, *South*, and *Bi-polar 1,2 and 3*. <http://image.sl.nsw.gov.au> [accessed 15/06/2004].

7. Image of a section of the planet Saturn photographed from the Cassini space craft during the *Cassini-Huygens Space Research Mission to Saturn* in September 2004. It is a false colour image depicting varying temperatures in Saturn's rings, and is constructed from data processed by Cassini's composite infrared spectrometer instrument. A part of his image was used in *Bi-polar 2*. <http://photojournal.jpl.nasa.gov/catalog/PIA06425> [accessed 28/12/2004]. Red is a temperature of about 110 Kelvin (-261 degrees Fahrenheit), blue is 70 K (-333 deg.F.) green is 90 K.(-298 deg. F.), and water freezes at 275 K. (32 deg. F.). The spatial resolution of the ring portion

of the image is 200 kilometers (124 miles). The *Cassini-Huygens Mission* is a co-operative project of *NASA*, the *European Space Agency* and the *Italian Space Agency*. Organizations such as *NASA* have large scale programs to make space science accessible to the public. In an interview with Roger Malina of *Arts Electric* on *Space Art*, March 23, 2005, he noted that since it is the public that pays for this work, this is only right. *The Sciences Lab. at the University of California* at Berkeley has recently announced two research residency fellowships for artists funded by the Arts Council of England and co-sponsored by *Leonardo* (one of the major international organizations for science, technology and art). www.arts-electric.org [accessed 24/03/2007].

8. Photographs by David Malin, astronomer from the *Anglo-Australian Observatory* at Siding Spring, New South Wales which include *Moonset into cloud the Warrumbungle Range Misc 6*, and *StarTrails Around the South Celestial Pole AAT6*. These images have been referenced in all my work. www.davidmalin.com and www.ast.cm.ac.uk/AAO/images.html [accessed 23/04/2004]. In an email letter to me on 2/06/2006, Malin describes the complex information embedded in the star trail images. 'By interpreting the star trails one can determine, with more or less accuracy, what time of year the photograph was taken, the geographic latitude of the location of the camera and the direction in which it was pointing. The duration of the exposure can be estimated to a few minutes by measuring the angular extent of the star trails, and the location of the Earth's axis of rotation projected on to the sky is at the centre of the concentric circles. The star colours are subtle, but they indicate the temperatures of the stars... [The image] explains the traditional link between astronomy, navigation and time keeping.'

9. Both the space based satellite *C.O.B.E. (Cosmic Background Explorer)*, and the *Two Micron All Sky Survey (2MASS) 2003-30-27*, (a survey conducted by ground based telescopes in Arizona and Chile,) use infrared detection technology to look at the large scale structure of the Milky Way and the local universe. They have captured an *Edge On View of The Milky Way* galaxy in infra-red or near infra-red light. It shows the Milky Way as a thin

disc of stars (white), surrounded by interstellar dust (yellow), as well as the central bulge or nucleus. This image is referenced in the digital image *Deep Field*. <http://photojournal.jpl.nasa.gov/gallery/universe> [accessed 30/08/04]. The Milky Way is a gravitationally bound collection of roughly a hundred billion stars. Our sun is one of these stars and is located roughly 24,000 light years from the centre of the Milky Way. We sit inside its flat spiral disc and most of the galaxy appears as a thick blurry band of light that stretches across the sky. Many of the stars in this galactic plane cannot be detected with visible light or ultraviolet telescopes because the cool clouds of dust and gas that hover around the galaxy's centre and make up the galactic spiral arms block their starlight from our view. A complete picture of the Milky Way would consist of several 'photographs' taken at various wavelengths in the electromagnetic spectrum, each of which gives a different facet of the nature of this vast star system

10. An image of the *3D Universe* made possible by the *Sloan Digital Sky Survey* team, which had previously painstakingly collected the spectra of individual galaxies and calculated their distances by measuring their red shifts. It is a map of the growth of cosmic architecture over time, a history of the universe and a reference or field guide to understand how matter is distributed in the universe. It has been conducted with ground based wide field telescopes at New Mexico's *Apache Point Observatory*, the data of which was later analyzed by astronomers at Berkeley, *University of California Sciences Lab*. The map is a wedge shaped slice of the cosmos that looks something like the foam formed by waves as they wash up on the beach. The image indicates the variations in galactic distribution which originated in the variations in temperature in the cosmic microwave background. It has been likened to a search in a sea of dark matter. The image is referenced in the digital image *DeepField*. <http://antwrp.gsfc.nasa.gov/apod/ap031028.html> [accessed 15/02/2005]. This survey spans a tenth of the northern sky, encompasses 600,000 uniquely luminous red galaxies, (which indicate like lighthouses where the matter is located), and extends 5.6 billion light-years deep into space, equivalent of 40 percent of the way back in time to the Big

Bang. It shows that large scale-structures are distributed in a way that fits with current ideas suggested by the accelerating expansion of the universe, as well as the map's assumed distribution of dark matter, which although invisible is affected by gravity, just like ordinary matter. This survey systematically and sensitively maps one quarter of the entire sky to look at the large-scale structure of the sky, the origin and evolution of galaxies, the relation between dark and luminous matter, the structure of the Milky Way and the properties and distribution of the dust from which stars like our sun were created.