Gravity (and Wonder)

3 September – 27 November

Museum of Applied Arts & Sciences

Penrith Regional Gallery & The Lewers Bequest

Contents

Introduction

Gravity holds us to this beautiful earth, it governs the movement of the world, the shape of space and the flow of time. Through gravity we exist in relationship to everything. It is the most wondrous of forces to which we owe everything and know so little.

In this exhibition, Gravity (and Wonder), science and art come together in an exploration of gravity as phenomena, effect and wondrous experience. Borrowing from philosopher Rene Descartes' treatise Passions of the Soul (1649), wonder is the experience of awe, a sudden surprise of the soul, a wrestle with the unknown. For Descartes the experience of wonder was uncomfortable, and demanded resolve through active consideration, the acquisition of knowledge and finally understanding. And so too it is with Gravity.

Developed for curious minds, the Gravity (and Wonder) exhibition, public program and art and science residencies provide a bridge between the wondrous and the known. Both art and STEM (Science, Technology, Engineering and Math) stream audiences will be particularly attracted by the subject. The centrepiece exhibition brings together rare scientific instruments and inventions, specialist objects and archival material from MAAS' outstanding collection alongside the work of contemporary artists, including two new commissioned works by artists Sandra Selig, and David Haines and Joyce Hinterding. Through the exhibited explorations of science and art our knowledge of gravity is expanded.

Front Cover

Astrographic plate of the Moon, No 1, June 17
Australia, 1891
emulsion glass plate

photographer unknown

Museum of Applied Arts and Sciences Collection

Above

Badge with the Apollo Moon
United States, about 1968

Museum of Applied Arts and Sciences Collection

Gravity (and Wonder) is a collaboration between Penrith Regional Gallery & The Lewers Bequest and the Museum of Applied Arts and Sciences, and is supported by education partner, Western Sydney University. This project has been in development since late 2014 following discussions held between the leadership teams of both MAAS and PRG&TLB. The ambition was broad: to provide Western Sydney audiences with exciting, and innovative exhibitions through institutional collaboration. The result, Gravity (and Wonder) brings together a cross-institutional team of experts, including exhibition and collection curators, designers, project managers, educators, artists and scientists. In this, the first of three planned joint MAAS and PRG&TLB exhibitions, MAAS finds a welcome place in Western Sydney, in advance of its projected move to Parramatta.

Gravity (and Wonder) is the recipient of the inaugural Sir William Dobell Art Foundation Exhibition Grant, managed through Museums & Galleries of NSW. Our event partnerships include Penrith Lakes Development Corporation and Celestino Science Park. We thank our supporters for their generosity and leadership in making this project reach its audience.

Dr Lee-Anne Hall
Director, PRG&TLB

Katie Dyer
Curator Contemporary, MAAS

September 2016

Main Gallery

An exploration of the human fascination with gravity's invisible governing of the movement of the world, the shape of space and the flow of time. Brought together are rare scientific instruments and inventions, specialist objects and archival material from the Museum of Applied Arts & Sciences collection alongside the work of contemporary artists who examine gravity as phenomena and effect.

Moon 27th September
Edward Dobosz

Main Gallery (Themes)

Mass + Attraction

On Earth, gravity is understood and observed as a force of attraction between bodies of mass in proximity to each other. The greater the mass, the greater the attraction it exerts. It is gravity that shapes our world, keeps the oceans intact and the atmosphere in place, and holds us to the Earth's surface. As a force of attraction, gravity is both weak and strong; it will eventually and inevitably master everything. We need only look at the night sky to ponder its effects: crushing matter, exploding stars, gaseous nebula, the birth of black holes, and in time, the end of the known universe.

Motion + Acceleration

Gravity influences the motion and acceleration of all free-falling objects. To describe an object's motion you must describe not only how fast it is moving but also in what direction it is heading. In fact, any object on Earth is accelerating because gravitational forces are pulling it down.

From the earliest fantasies of flying or floating to the invention of space rockets, humans have aspired to be free of earthly bonds and reach new heights. It is gravity that must be conquered to achieve this elevation and thwart inertia.

Measurement + Understanding

Gravity helped form the universe. Civilisations and cultures have always tried to understand the unknown and developed their own notions of space (the 'heavens') and time (the 'beginning' and 'end'). These notions can be understood through philosophies of religious, spiritual or metaphysical transcendence or through scientific theories and explanation. Over the centuries, scientists have created exceptional technologies and instruments to help us understand nature, calculate the movements of the solar system, and measure specific and relative gravity and gravitational waves. While we can describe nature's methods, at a fundamental level why things behave the way they do is still unknown.

Spacetime

Time goes too slow for some and it runs away from others. We save it and spend it. We try to tame it with units of measure, yet it cannot grasped. Time is known only by its passing, and by the entropic effects upon matter - beginnings and endings in endless procession.

Albert Einstein first described Spacetime in 1915 as allowing us to understand our planet and universe within a space and time landscape puckered by the mass and gravitational pull of celestial bodies, across which the movement of all forms, including light, follow the curvature of space.

Artworks

Banumbirr (Morning Star Pole), 2011
acrylic on wood with feathers and bush string

Paul Buwang Buwang
b 1975, Australia
Language area: Yolngu
Lives and works in Galiwin'ku, Elcho Island

Courtesy of the artists and Elcho Island Arts

The story of Banumbirr, the Morning Star Pole, is passed inter-generationally from father to son. This grouping of Morning Star Poles is the work of senior Galpu artist Gali Yalkarriwuy Gurruwiwi and his son Paul Buwang Buwang. In teaching the ancestral stories and ceremonies of the Yolngu people, continuity of culture is assured.

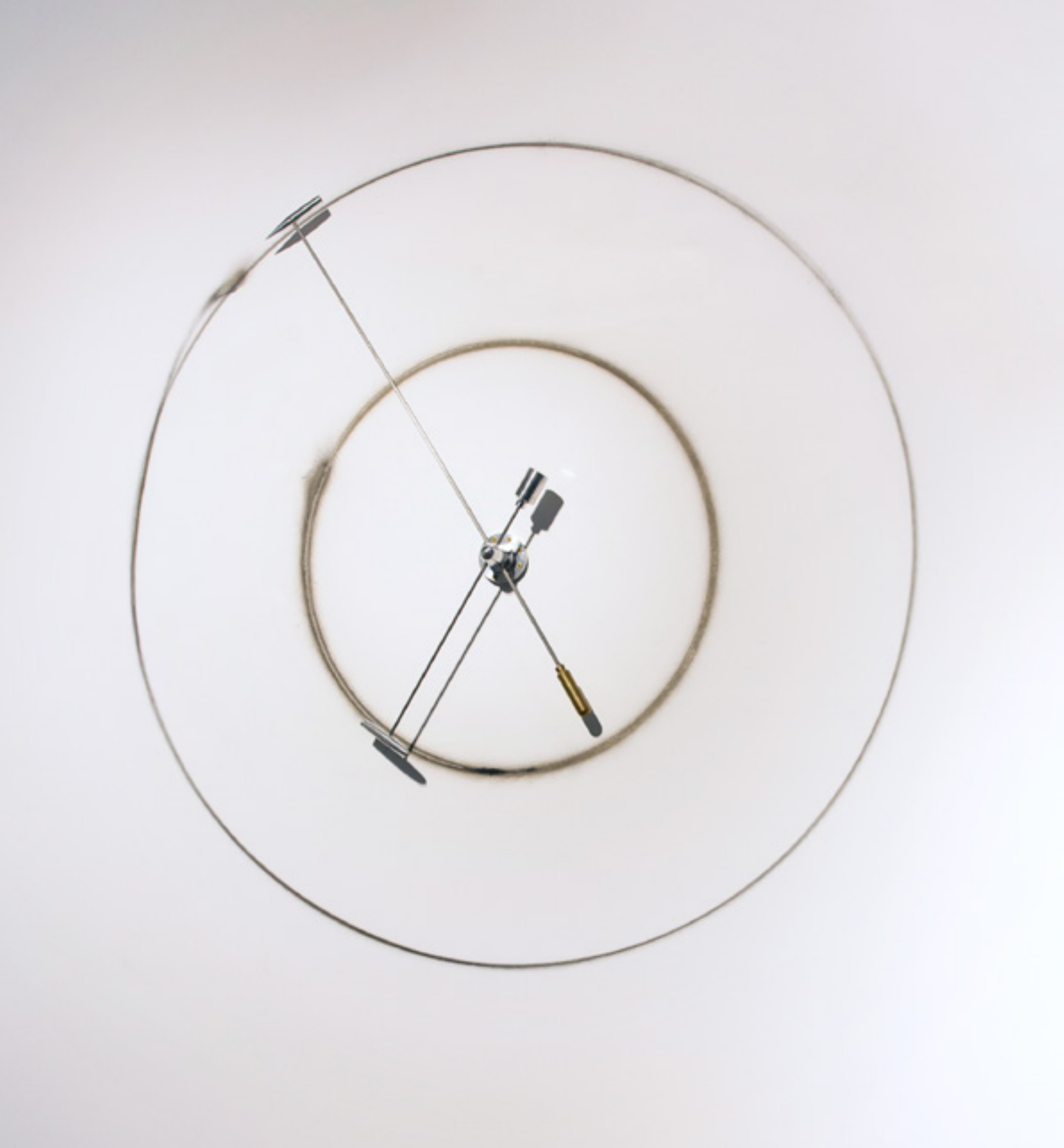
High speed counter-balance disc (study 2), 2011
polished 316 stainless steel, mild steel, bearings

Marley Dawson
b 1982, Australia
Lives and works in Philadelphia

Courtesy of the artist and Roslyn Oxley9 Gallery, Sydney

Marley Dawson's world is full of contraptions, instruments and machines. They speak to the modernist project: velocity, technology, industry and energy.

In this work the artist invites you to spin this sculptural wheel, the intervention between person and mechanism creating a work of motion. The action of the counterbalance is both new and expected: the motion is predicted by the shape and materiality of the object. Its prescribed route is a perpetual struggle between mass, force and human expectation.



High speed counter-balance disc (study 2), 2011
polished 316 stainless steel, mild steel, bearings

Marley Dawson
b 1982, Australia
Lives and works in Philadelphia

Courtesy of the artist and Roslyn Oxley9 Gallery, Sydney

In Circle Work (rocket assist) a rocket is set in motion. It behaves as it must — accelerating at great speed away from the force that propelled it. Fixed to a central pivot point, it cannot fly away but must spin until its fuel and force are spent. A charred trace of energy's harnessed movement is 'drawn' upon the wall.

Banumbirr (Morning Star Pole), 2010
Ochre, fixative, feathers and bush string on wood

Banumbirr (Morning Star Pole), 2009
Ochre, fixative, feathers and bush string on wood

Gali Yalkarriwuy Gurruwiwi
b 1942, Australia
Language area: Yolngu
Lives and works in Galiwin'ku, Elcho Island

Courtesy of the artists and Elcho Island Arts

Created by senior Galpu custodian Gali Yalkarriwuy Gurruwiwi, Banumbirr has a vital role to play in ritual performance. The stories, identity and country of each clan are transcribed into the patterns on the wood. It is used to mark the passage of the Morning Star in the heavens. In sacred Yolngu law the Morning Star is a bridge between the two halves of the universe — day and night — the star's light touching many Aboriginal sites in its arc.

Sound Ship (descender 1), 2016
audio, film documentation

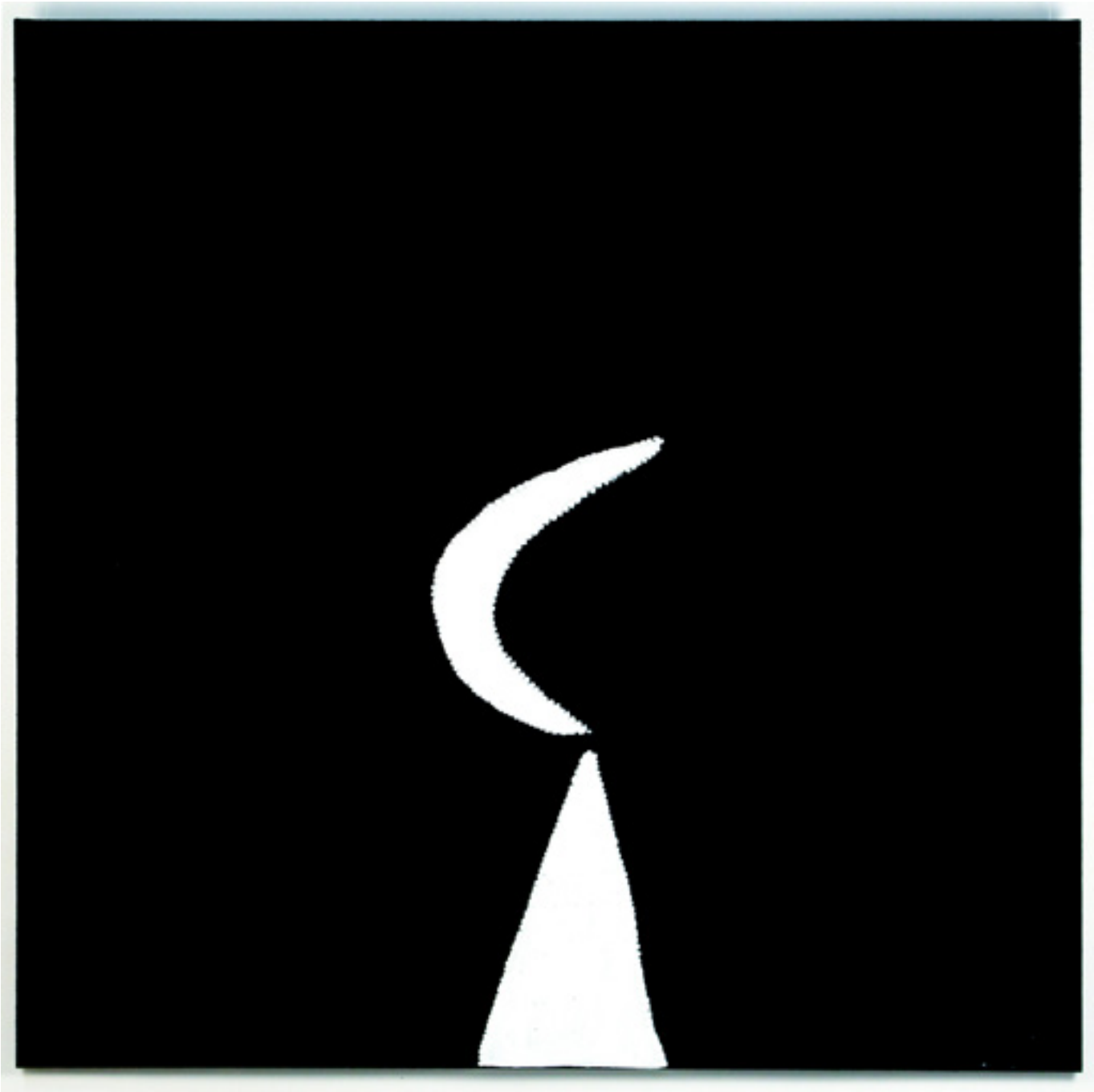
David Haines
b 1966, United Kingdom
Lives and works in the Blue Mountains

Joyce Hinterding
b 1958, Australia
Lives and works in the Blue Mountains

Courtesy of the artists and
Sarah Cottier Gallery, Sydney

For this commissioned artwork, instruments recording wind and vision were lifted by a weather balloon above 33,000 metres, into the icy reaches of the stratosphere. At low pressure, the balloon bursts and a parachute floats the payload back to Earth. Falling away and towards us, the instruments record movement and Aeolian sound. Before you is the path and pull of gravity — at once haunting, violent and beautiful.

The artists would like to acknowledge their support team: Michael Petchkovsky, Robert Brand, Jason Brand, Dan Stocks, Chris Caines, Alain Della-negra and Kaori Kinoshita



Garnkiny Ngarranggari, 2014
mowantu (ochre), Tharlngarri (Snappy Gum) charcoal on canvas

Mabel Juli
b early 1930s,
Australia Language area: Gija
Lives and works in Warmun

Courtesy of the artist and Warmun Art Centre

The moon is a continuous theme in Gija Ngarrangkarni (Dreaming) stories.In this painting senior Gija artist Mabel Juli — sister to Rusty Peters — depicts the story of Garnkiny, the Moon man, who is forbidden to marry a woman of his mother-in-law's skin. He retreats to a high hill, Yarin, and looks down at the people below. He promises them that unlike all others, he alone will live forever, rising over and over as the new Moon.

Flying Form, 1950
welded steel

Inge King
b 1915, Berlin; d 2016, Australia

Penrith Regional Gallery & The Lewers Bequest Collection, gift of Tanya Crothers and Darani Lewers, 1979

Like many of sculptor Inge King's artworks, Flying Form is an idea in opposition to its form and materiality. In this maquette, strips of black, rough- cut steel plate are welded in a stack. Its ragged edges suggest neither the lightness of a bird's flight nor the elegant lift of an airliner. It is instead an ominous assemblage: perhaps the plucked feathers of a crow or formation bombers in a crowded sky.

Play: On the beach with the Ballet Russes, 2008
digital film
excerpt duration 10:00 mins

Gillian Lacey
b 1942, United Kingdom
Lives and works in the United Kingdom

Courtesy of the artist

In this excerpt from Gillian Lacey's film Play, members of Ballet Russes are shown dancing upon the sands of Bungan Beach, Sydney, during a visit to Australia in the late 1930s. Play makes routine the human form in flight. Strength and physicality are wondrously revealed as dancers skip across the sand, leap, then turn mid-air, and with each soft footfall the illusion of gravity defied is achieved.

Three Mothers for the Moon, 2016
natural pigment on canvas

Rusty Peters
b 1935, Australia
Language area: Gija

Courtesy of the artist and Warmun Art Centre

Rusty Peters is a senior Gija Man from Warmun, Western Australia. Like his sister Mabel Juli, he paints the creation stories for which he has permission and responsibility.

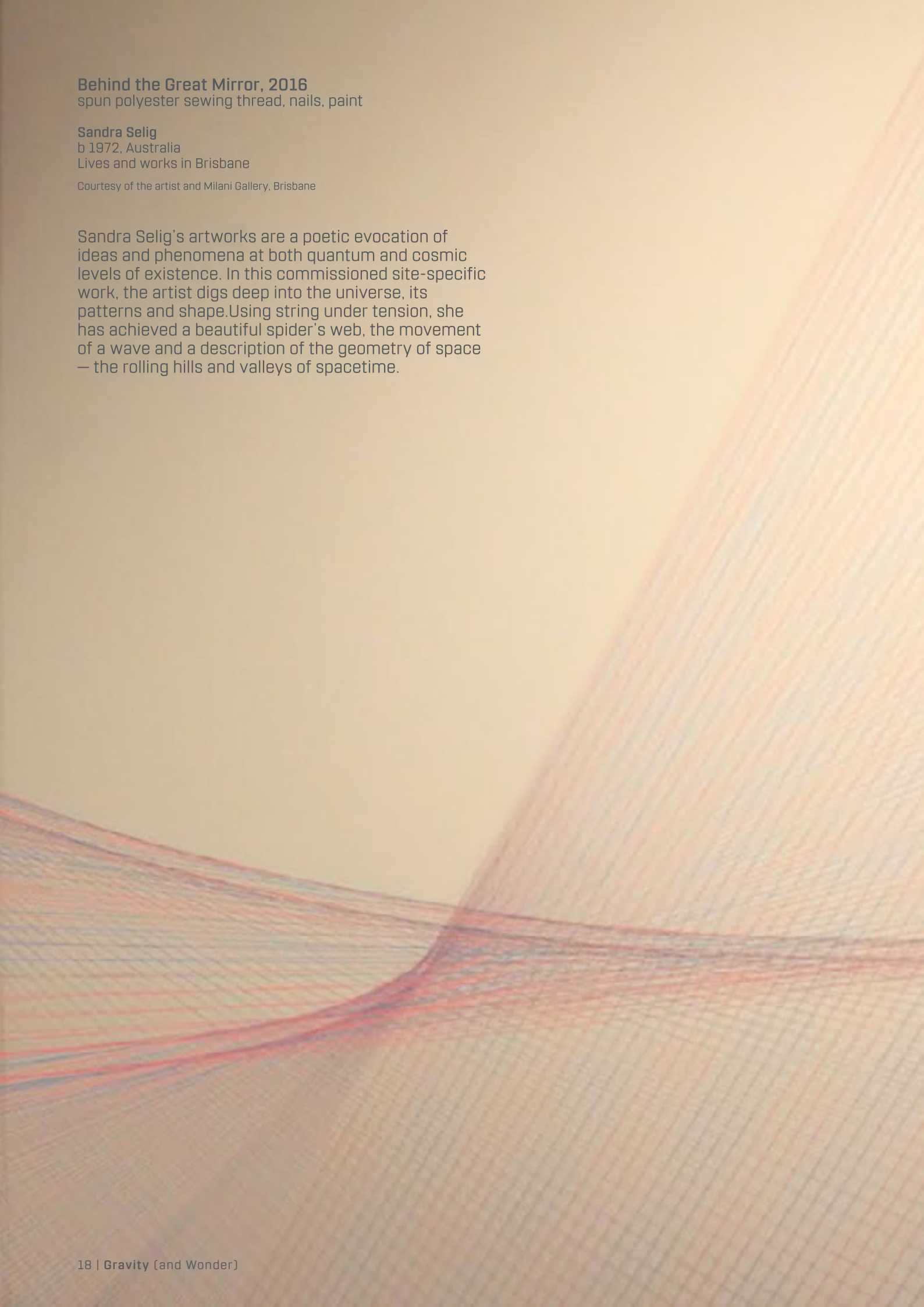
This artwork tells the story of Garnkiny who was exiled because of his love for a woman to whom he was related by skin. In his anger, he made the people into the features of the land — the hills and trees— and found his place in the velvet dome of a billion stars.

Dwelling, 2010
video, running time 9:22 mins

Hiraki Sawa
b 1977, Japan
Lives and works in London

Courtesy of the artist and
James Cohan Gallery, New York

The magic and adventure of flight come alive in this video by Hiraki Sawa. Dozens of small model aeroplanes take off and land in the artist's apartment. They navigate this interior space, deftly negotiating kitchen and hallway, and taxiing neatly to their ports on the bedroom floor. In this work, perceptions of reality and imagination combine and become a meditation on time and space.



Behind the Great Mirror, 2016
spun polyester sewing thread, nails, paint

Sandra Selig
b 1972, Australia
Lives and works in Brisbane

Courtesy of the artist and Milani Gallery, Brisbane

Sandra Selig's artworks are a poetic evocation of ideas and phenomena at both quantum and cosmic levels of existence. In this commissioned site-specific work, the artist digs deep into the universe, its patterns and shape.Using string under tension, she has achieved a beautiful spider's web, the movement of a wave and a description of the geometry of space — the rolling hills and valleys of spacetime.

Prop, 1968
lead

Richard Serra
b 1938, United States of America Lives and works in New York and Nova Scotia

National Gallery of Australia Collection, purchased 1973

American minimalist artist Richard Serra is known for his simple geometric arrangements that utilise scale, mass and volume to great effect. In Prop, the arrangement is in two parts: a pipe made of rolled lead is placed in a leaning posture, pinning a lead sheet to a wall. The entire structure appears precarious, an impossible tension between object fixedness and slip, stability and collapse. Only by understanding the competing force vectors of gravity and friction can Serra's trick be revealed.

Dome 31202 Czech Republic, 2000/2004

Dome 30705 Hungary, 2000/2004

Dome 21608 Spain, 1997/2007

colour photographic prints

David Stephenson
b 1955, United States of America
Lives and works in Hobart

Courtesy of the artist, Bett Gallery, Hobart and Saul Gallery, New York

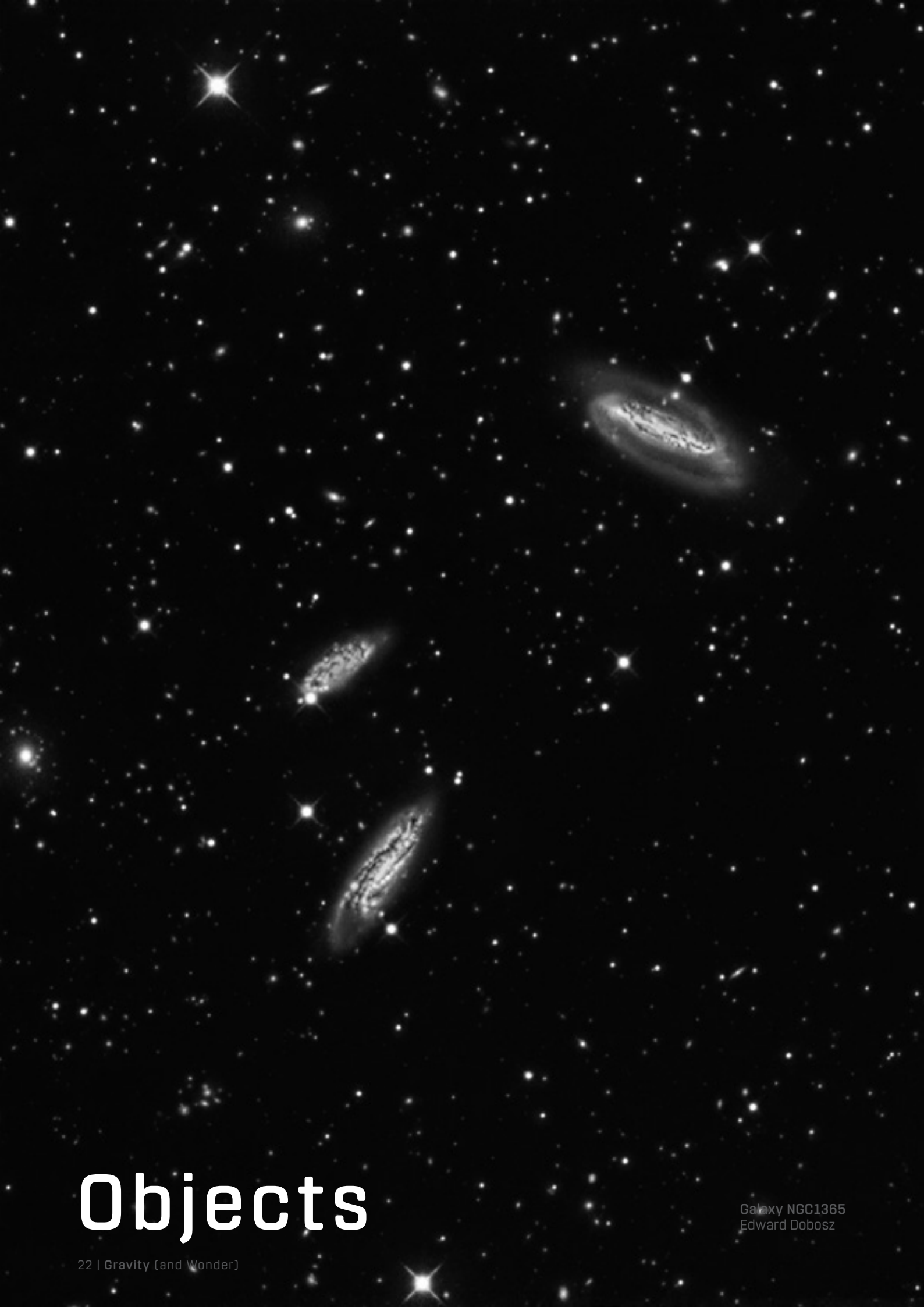
David Stephenson has spent years photographing the architecture of the faithful, including the ceiling domes of the world's great places of worship. Domed ceilings are the work of skilled artisans who, using the stories, patination and symbols of their faith, have sought to magnify the divine. Exhibited here: the Orthodox St Bernard's Chapel, Cistercian Monastery, Czech Republic; the Jewish New Synagogue, Hungary; and the Sala de la Justicia, Alcazar, Seville, built as part of what was a Moorish palace.

Floating Sequence, 2012
balsa wood, watercolour, gouache, polyester thread, lead weights, balloons, helium

Amy Joy Watson
b 1987, Australia
Lives and works in Adelaide

Courtesy of the artist and Hugo Michell Gallery, Adelaide

Floating Sequence creates the illusion of rocks being pulled apart, threatening to lift off the Earth's surface by the gentle pull of helium balloons. It is both a visual pun and a neat illustration of gravitational forces and effects upon matter. Just as we are bound to the Earth and each other by gravity's invisible pull, our human dreams and aspirations are also weighted — tethered to the life we lead, and from which we sometimes yearn to break free.



Objects

Galaxy NGC1365
Edward Dobosz

Photograph of 29 cm equatorial telescope at Sydney Observatory
Australia, about 1870 albumen print

photographer unknown

Museum of Applied Arts and Sciences Collection

Commemorative envelope of the Apollo 13 mission, the first rocket to orbit the Earth

United States, 1970

Museum of Applied Arts and Sciences Collection

Commemorative envelope featuring Soviet era space history stamps

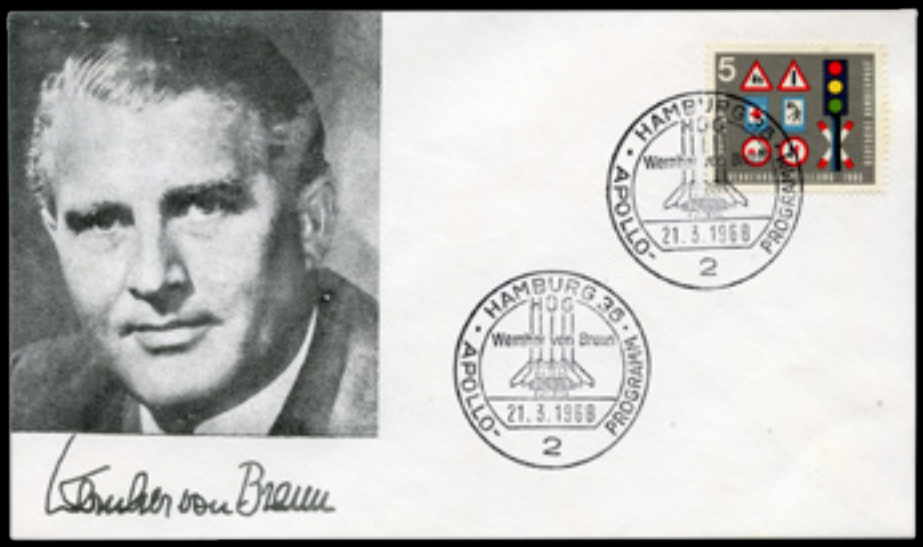
Russia/Mongolia (former USSR), 1962

Museum of Applied Arts and Sciences Collection

Commemorative envelope of Sputnik, the first satellite launched into space

Russia (former USSR), 1962

Museum of Applied Arts and Sciences Collection



Commemorative envelope featuring Wernher von Braun and rocket technology

West Germany (now Germany), 1968

Museum of Applied Arts and Sciences Collection

Model of a queen bee
France, 1825-80
papier-mâché and metal

Dr Louis Thomas Jérôme Auzoux
1797-1880, France

Museum of Applied Arts and
Sciences Collection, purchased 1883

Physics demonstration model
England, 1863-70
wood and brass

Elliott Brothers Ltd
London

Museum of Applied Arts and Sciences Collection

This apparatus was invented by G R Smalley who was the Government Astronomer at Sydney Observatory, 1863-70. It was made by Elliott Brothers Ltd, one of the leading instrument manufacturers in the 1800s and 1900s. The model is designed to illustrate some of the basic principles of force, motion and gravity. However, despite research by MAAS curators and conservators, the actual operations and measuring methods are no longer known. The animation depicts how its various parts move but how this illustrates principles of force, motion and gravity remains a mystery.

Centre of gravity toy
place unknown, about 1893
painted plaster, wood and metal

Museum of Applied Arts and Sciences
Collection, gift of the Technical College, 1893

Toy space rocket
Japan, about 1960
tinplate, steel and plastic

Museum of Applied Arts and Sciences
Collection

Orrery
France, 1851–77
wood, brass and ivory

maker unknown

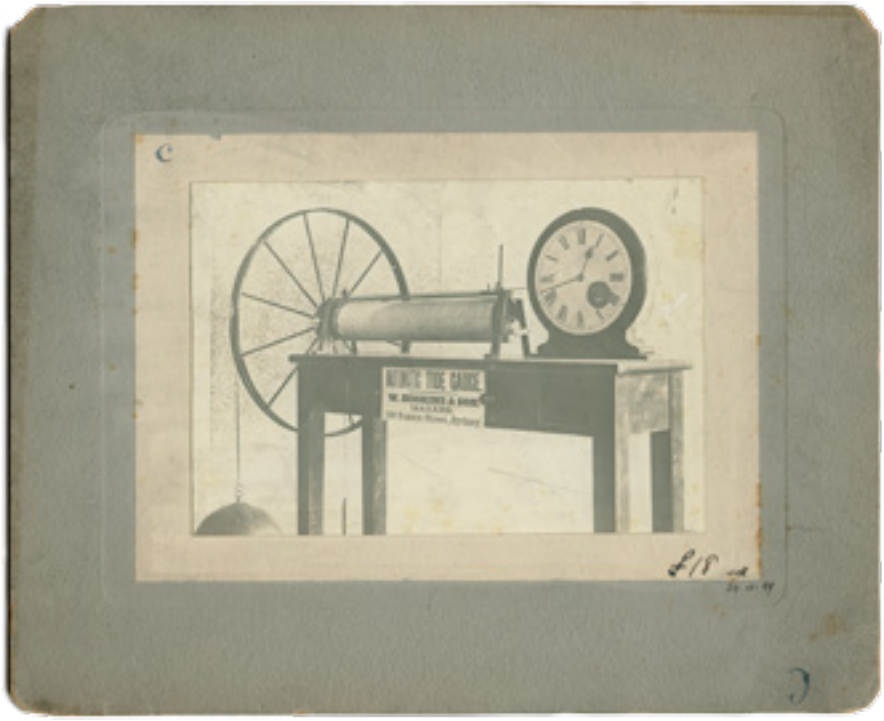
Museum of Applied Arts and Sciences
Collection, purchased 1986
Illustration and animation by Apattra Hongsuwong

Orreries were used in the 1700s and early 1800s to demonstrate the solar system and the rate at which the Earth and other planets orbited the Sun. This model includes eight planets and their corresponding moons. Ceres, the only dwarf planet in the inner solar system, is also included. Pluto was not discovered until 1930, so it is not represented.

Photograph of the Moon during total eclipse, taken at the Red Hill Station, Pennant Hills, NSW
Australia, 1904
Silver gelatin print

photographer unknown

Museum of Applied Arts and Sciences



Photograph of a Sydney Observatory automatic tide gauge
Australia, 1899
silver gelatin print

photographer unknown

Museum of Applied Arts and Sciences

Photographs from the Wallal expedition series
Australia, 1922
silver gelatin prints

photographer unknown

Museum of Applied Arts and Sciences
Collection, purchased 1986

In 1922, a major Australian and international scientific expedition visited the remote community of Wallal, Western Australia, to prove Einstein's theory of general relativity. They observed a total solar eclipse and measured how light from distant stars was bent as it passed the Sun. The measurements confirmed the existence of spacetime curvature, demonstrating the accuracy of Einstein's theory and revolutionising our understanding of the universe. These photographs document aspects of the expedition, including the assistance received from the local Nyangumarta people.

Badge with the Apollo Moon Landing Space Project emblem
United States, about 1968

Museum of Applied Arts and Sciences Collection

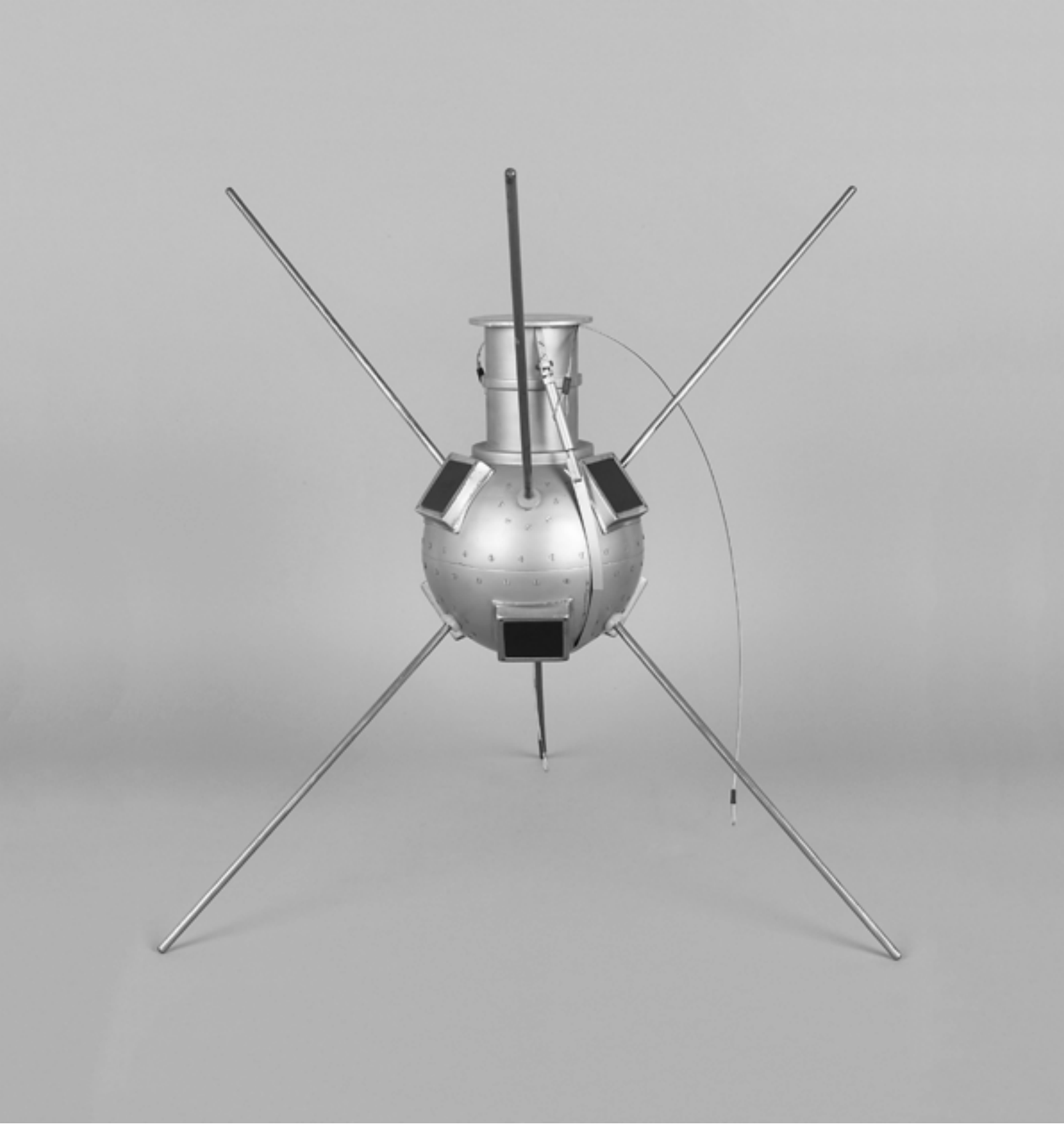
Commemorative medal of the first landing on the Moon, Apollo 11 mission
place of production unknown, 1969

Museum of Applied Arts and Sciences Collection

Model of 'Emperor Alexander' apple
Australia, 1900 painted wax

Painted for the Museum, probably by
Charles Toms

Museum of Applied Arts and Sciences Collection



Vanguard 1, satellite replica
Australia, 1958 metal and wood

Museum of Applied Arts and Sciences

This is a full-size replica of the tiny Vanguard 1 satellite that was launched in 1958. Vanguard 1 was the first satellite to be powered by solar cells and was equipped with instruments that enabled the shape of the Earth to be determined with precision for the first time. Although it stopped transmitting in 1964, it remains the oldest artificial object currently orbiting the Earth.

Gravity is crucial for keeping satellites in orbit — without it, satellites would fly off into space.

Radio headset, part of the Soyuz TM-10 spacesuit
Russia (former USSR), 1989 leather, cotton, metal and plastic

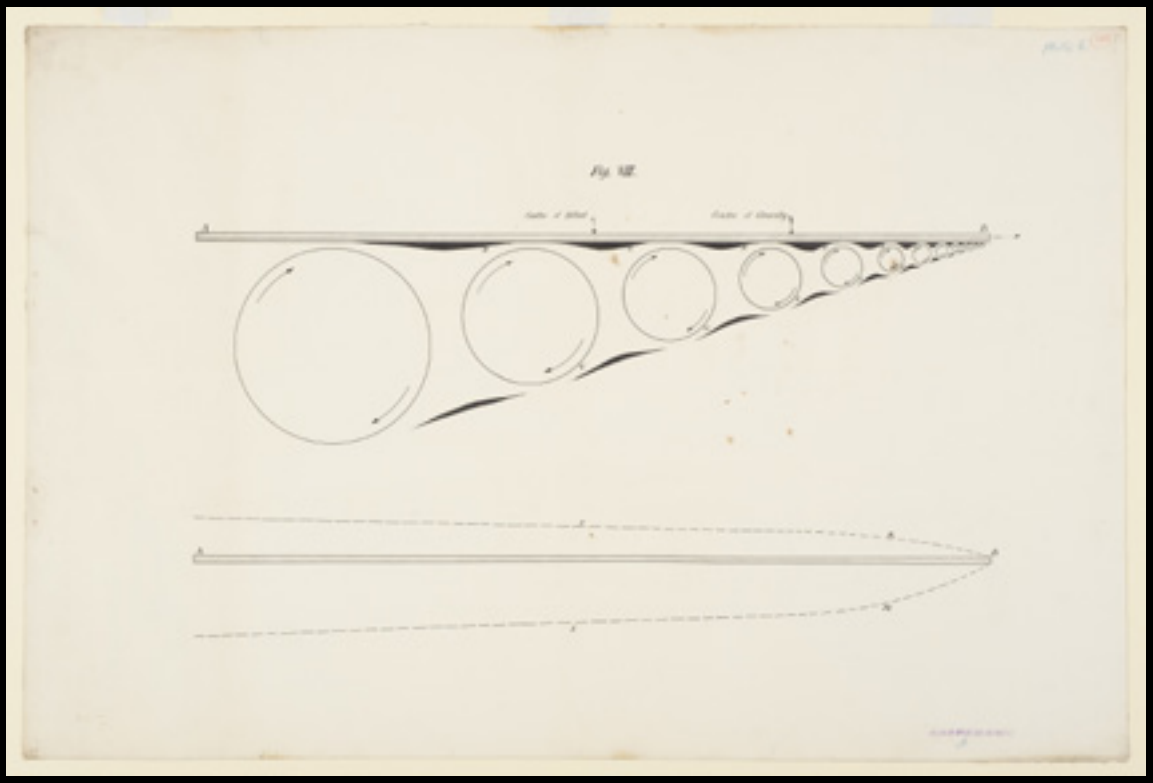
Museum of Applied Arts and Sciences Collection, purchased 1994

Hydrometer
also known as gravity beads
Scotland, 1750–1805
etched glass, wood, paper and fabric

James Corte
dates unknown, Scotland

Museum of Applied Arts and Sciences Collection,
gift of Robert C Dixon, 1954
Illustration and animation by Apattra Hongsuwong

These glass beads measure the specific gravity of spirits, proving their alcohol content. Each numbered bead corresponds to the guide on the lid. Beads are placed in the liquid and the number is read from the one that floats rather than sinks. The buoyancy of solid objects in a fluid is directly related to the specific gravity of the fluid. Specific gravity refers to the ratio of the density of a liquid to the density of water.



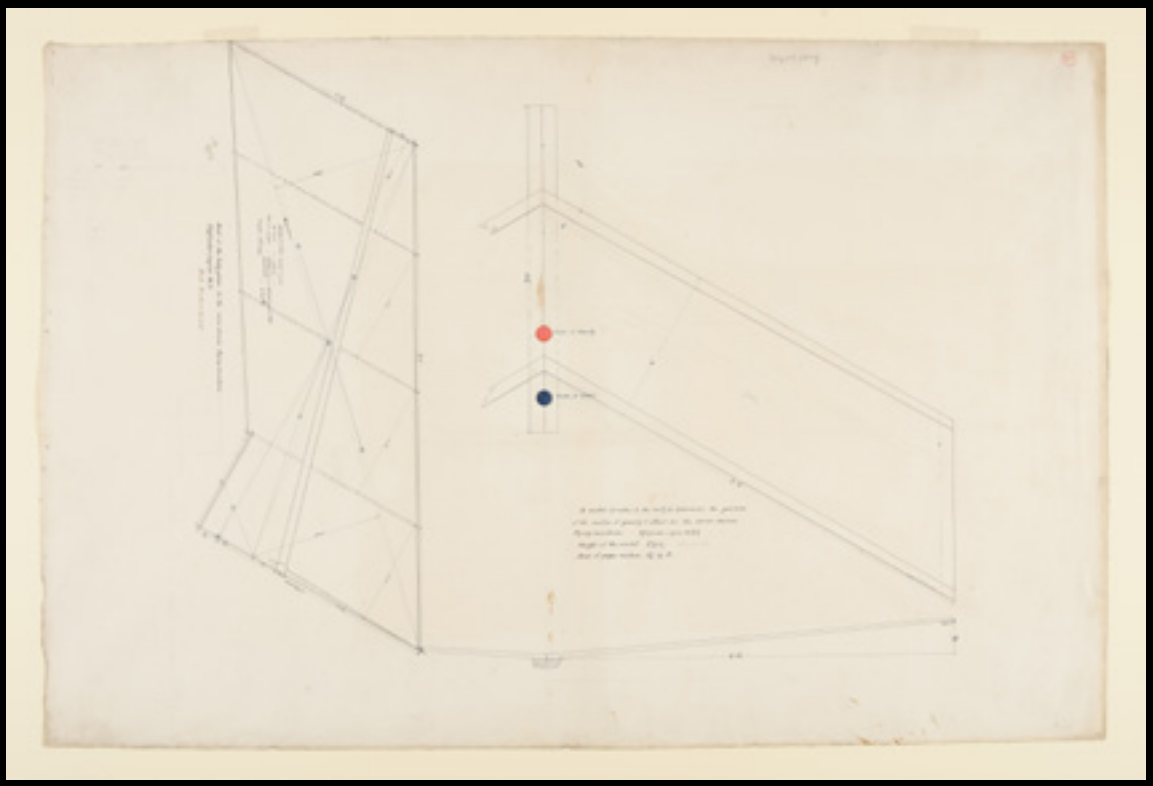


Diagram for flying machine
Australia, 1889
pencil and ink on paper

Lawrence Hargrave
1850–1915, Australia

Museum of Applied Arts and Sciences
Collection, acquired 1963

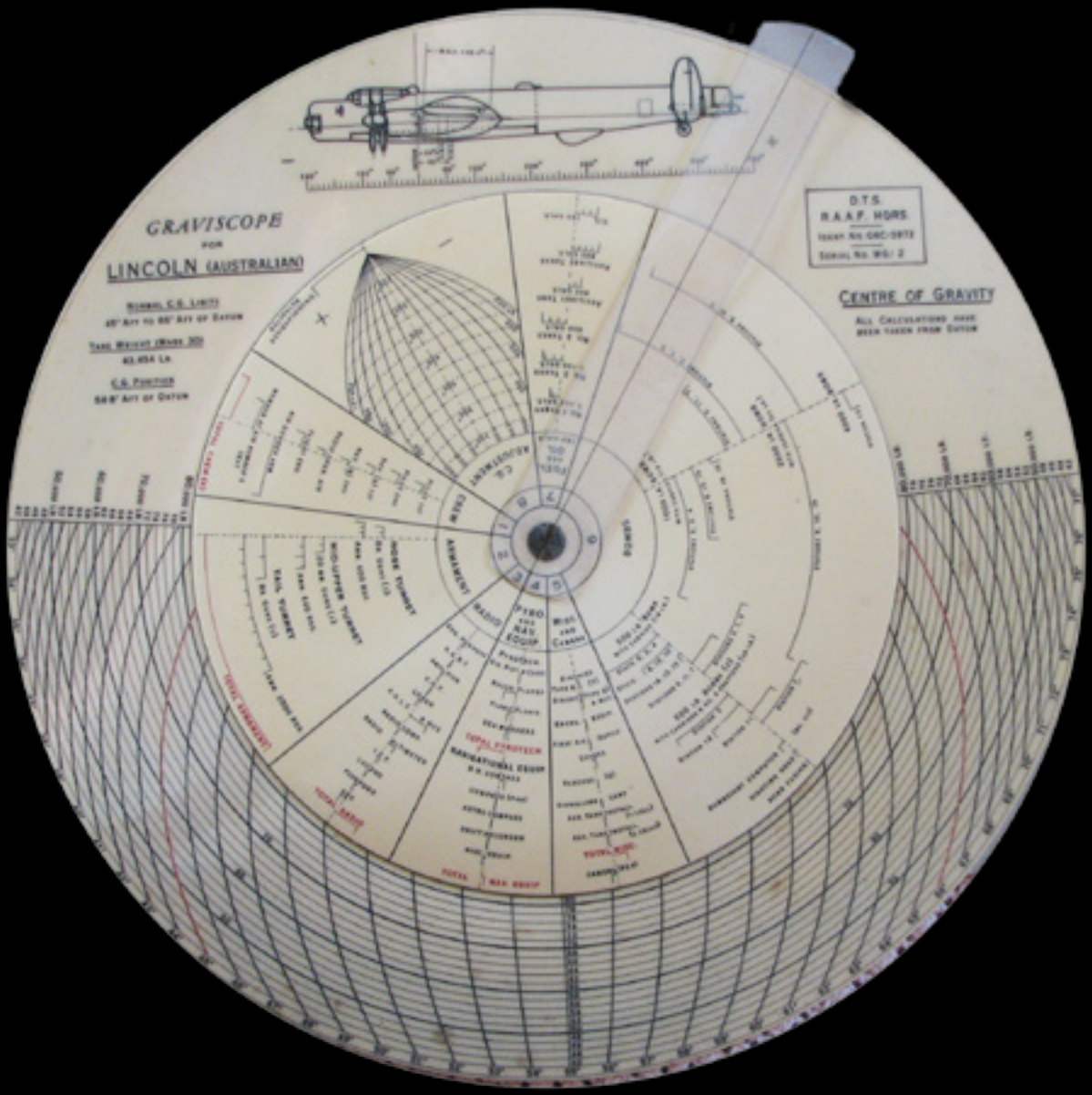
Lawrence Hargrave was a remarkable Australian inventor and early pioneer of flight. Like others before him, he attempted to solve the problem of flight by studying the motion of birds' wings. Flying encompasses two major problems: overcoming the weight of an object by some opposing force and controlling the object in flight. Both relate to the object's weight and centre of gravity.
This diagram illustrates what he called a 'vibratory flying machine'—a model propeller aeroplane powered by compressed air.

Tide indicator
England, 1910–20
etched glass, wood, paper and fabric

Designed by Charles Lenthall and George Baugh; made by Heath & Co Ltd

Museum of Applied Arts and Sciences Collection, donated through the Australian Government Cultural Gifts Program in memory of Associate Professor Allan Bromley, 2010

The gravitational forces of the Sun and Moon cause the ebb and flow of Earth's tides. The ancient Greek astronomer Seleucus (about 190–unknown BCE) studied tidal changes and concluded that the Earth orbits the Sun and that the Moon causes our tides. Complex machines that calculated the sum of these effects, in order to predict the time and height of tides up to a year ahead, were made from the 1870s. This portable tide indicator simplified the calculation.



Graviscope from a Lincoln bomber
Australia, about 1940
paper, plastic and leather

White & Gillespie
Australia

Museum of Applied Arts and Sciences Collection, donated through the Australian Government Cultural Gifts Program in memory of Associate Professor Allan Bromley, 2010

Electro-mechanical pendulum clock
France, about 1918
brass, wood and glass

maker unknown

Museum of Applied Arts and Sciences Collection

This clock was used at Sydney Observatory from 1918 to 1940. The swinging pendulum governs the rate at which the clock measures time; a rate determined by the pendulum's length and local acceleration due to Earth's gravity.

Pendulums, therefore, demonstrate that the gravitational pull on objects varies depending on location, being weaker for objects higher above the Earth's centre. So, the same pendulum clock will keep different time in Sydney than in the Blue Mountains if the pendulum's length is not adjusted.

Planimeter
England, 1880-1900
brass and steel

Stanley Mathematical Instruments London

Museum of Applied Arts and Sciences Collection, donated through the Australian Government Cultural Gifts Program in memory of Associate Professor Allan Bromley, 2010

Illustration and animation by Apattra Hongsuwong

A planimeter is a drafting instrument used by engineers and cartographers in order to measure irregular two-dimensional space — often spaces bound by a closed curve. Naval architects favoured this instrument for measuring area, moment of inertia, volume and the centre of gravity. These are measured by moving a tracing point around the outline of a diagram. One point is fixed while the other rod traces the shape. Measuring wheels automatically compute the coordinates as the tracer is moved.

Photograph of the Orion nebula
Australia, 1890
silver gelatin print

H.C. Russell 1836-1907
Australia

Museum of Applied Arts and Sciences Collection

Photograph of the Moon, taken at the Red Hill Station
Pennant Hills, NSW, Australia, 1899-1930

James Short 1865-1943
Australia

Museum of Applied Arts and Sciences Collection

Main Gallery (Artists)

Paul Buwang Buwang

Paul Buwang Buwang is a Yolngu man from Elcho Island (Galiwinku). He is the son of senior artist Gali Yalkarriwuy Gurruwiwi, who has taught him to paint the stories and ceremonies of his people, such as the story of Banumbirr, the Morning Star. In inter-generational exchange, the continuity of Yolngu culture is assured. Buwang Buwang's works have been exhibited widely in Australia and internationally.

Marley Dawson

Marley Dawson was born in Wellington, NSW in 1982. He received a Master of Visual Arts from Sydney College of the Arts, Sydney, Australia and currently lives in Philadelphia, America. Marley investigates the physicality of materials and the processes of development. His practice transforms established commercialised manufacturing processes into experimental objects.

Gali Yalkarriwuy Gurruwiwi

Gali is a traditional Aboriginal (Yolngu) Mala Leader and Galpu clan representative who was taught traditional art forms, stories and laws by his father Gapuka. Following the death of his father, Gali became the custodian of the sacred feathered ceremonial Banumbirr (morning-star pole). The Banumbirr are typically held by men during mortuary ceremonies and specifically communicate an understanding of identity related to a particular Aboriginal clan and their specific span of country.

David Haines and Joyce Hinterding

David Haines and Joyce Hinterding often collaborate on projects that explore the typically unseen and unheard natural forces of the world and have exhibited widely, both nationally and internationally. Their commissioned work, Sound Ship (descender 1) is a visual and aural enquiry into gravitational forces which is both beautiful and terrifying to behold.

Main Gallery (Artists)

David Haines

David Haines was born in London, UK in 1966 and currently lives in the Blue Mountains, NSW. He is both a practicing artist and academic at Sydney College of the Arts who works across a range of media including video, sound, photography, painting and aroma chemistry. He has exhibited widely in Australia and internationally. He has an ongoing practice with his partner, Joyce Hinterding exploring, measuring and documenting phenomena. Recent work including the commission, Sound Ship to the Edge of Space involves enquiries into the cosmos.

Joyce Hinterding

Joyce Hinterding was born in Melbourne, Australia in 1958 and currently lives in The Blue Mountains, NSW. Artist and academic at Sydney College of the Arts, Hinterding has developed an interdisciplinary practice involving sculpture, installation and performance. Her recent work includes large scale immersive environments which are underpinned by investigations into energy, including modes of monitoring and recording acoustic and electromagnetic occurrences. With her partner David Haines she has established an international reputation through research and exhibition.

Mabel Juli

Mabel Juli was born in the early 1930s at Five Mile, near Moola Boola Station, south of Warmun, Western Australia. She is a Gija woman whose paintings articulate the complex Ngarranggarni creation story, Garnkiny, which explores Giga law and lore including the origins of mortality. Her work also documents early colonial encounters experienced in her country Darrajayin, which is covered largely by Springvale Station.

Inge King

Inge King was born in Berlin, Germany in 1915 and died in Melbourne, Australia in 2016. She is widely recognised as a major contributor to Australian modern abstraction. King travelled widely in her youth spending time in Berlin, Glasgow, New York, Paris and London, settling in Melbourne in 1951. She was inspired by the welded sculptural works she saw in New York, and began working with industrial steel and arc welding. King typically explored the formal spatial elements of sculpture, often describing her sculpture as ‘vision in motion’.

Main Gallery (Artists)

Gillian Lacey

Gillian Lacey lives and works in the UK. She has worked in animation and film making as a practitioner and teacher since the 1960s. Lacey has developed a strong commitment to creating and facilitating issue based film making and has become increasingly interested in dance. Her creative approach to documentation has seen an interest in exploring the past through chance discoveries in the present culminate in a combination of film, interviews and musical compositions.

Rusty Peters

Rusty Peters is a senior Gija man born on Springvale Station south west of Warmun, Western Australia. He is of Joowoorroo skin, his bush name is Dirrji and he learnt traditional law while working as a stockman at Mabel Downs. Beginning in the 1990s, Peters has painted for various Aboriginal arts organisations, including Waringarri Arts, Jirrawun Aboriginal Arts and Warmun Art Centre. He uses traditional ochre and charcoal to depict the stories of country from Springvale and Moola Boola stations.

Hiraki Sawa

Hiraki Sawa was born in Ishikawa, Japan in 1977 and currently lives in London. He studied at the University of East London and the Slade School of Art at University College in London. Sawa explores notions of memory through the creation of imaginary landscapes located within a domestic setting. These staged scenes are populated by unexpected encounters between disparate inanimate objects that disrupt perceptions of reality.

Sandra Selig

Sandra Selig was born in Sydney in 1972. She currently lives in Brisbane, where she completed a Masters in Visual Arts at Queensland University of Technology. Selig is a multi-media artist who uses everyday objects in her practice, such as thread, string and paper. Her work is often site-specific and explores concepts of intangibility through the complexities of geometry, light and perceptions of space. As both artist and musician, Selig is a member of the electronic duo Primitive Motion.

Main Gallery (Artists)

Richard Serra

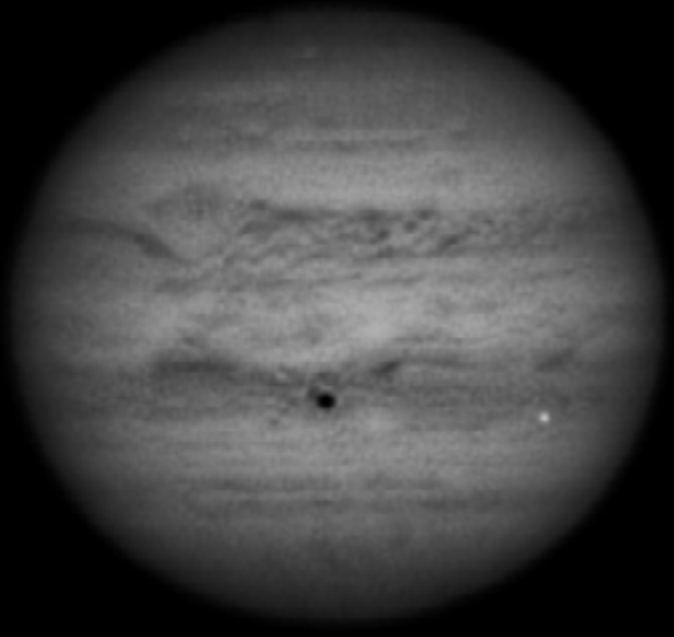
Richard Serra was born in 1938 in San Francisco, USA. He currently lives between New York and Nova Scotia, Canada. During the 1960s Serra became interested in the materiality of industrial materials and began to work with fibreglass, rubber and metal. Engaging with the physical properties of such materials, he created works that relied on the forces of gravity and the material's given weight to eliminate the necessity of welding. Serra's practice includes many large-scale, site specific works that deliberately interrupt traditional notions of space.

David Stephenson

David Stephenson is an American-born photo-media artist who lives in Hobart, Tasmania. He studied at the University of Colorado and the University of New Mexico, completing a Master of Fine Art degree in 1982. Notions of the sublime, the 'transcendental power of light' and a fascination with space and time has fuelled Stephenson's enquiry into the awe and beauty of both nature and culture, including his typographic documentation of the ceilings of European sacred architecture.

Amy Joy Watson

Amy Joy Watson was born in Adelaide, South Australia in 1987. She graduated with a Bachelor of Visual Art, Honours in 2008 from Adelaide Central School of Art and been the recipient of many awards and residencies. Watson's practice centres on exploring notions of weightlessness within the conventions of geometry and sculpture. Her works are typically handmade, referencing the traditions of a skilled artisan in an ever increasing computer generated world.

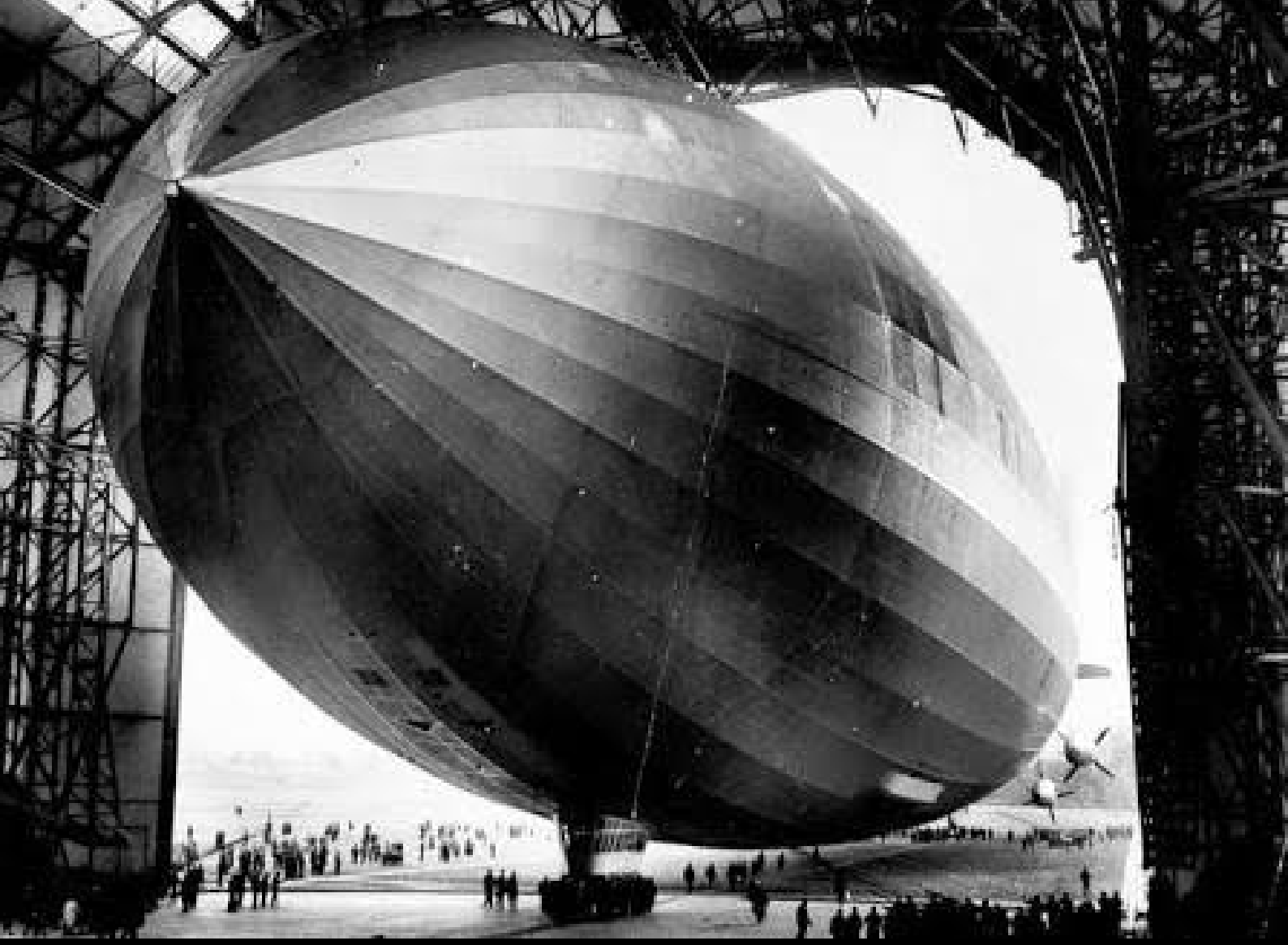


Lounge Room Gallery

In the Lounge Room Gallery we pay homage to great and curious minds: Galileo (1564-1642), Sir Isaac Newton, Albert Einstein. As with all great minds their thinking was not fettered by convention, but loosened by imagination.

On exhibition is *Hindenburg Mix III* 2016, by composer and sound designer, Barton Staggs and filmmaker, Alex Ryan. The film uses archival footage which documents the Hindenburg airship disaster in 1937. The music accompanies the gentle movement of the airship as it floats above the ground in defiance of gravity's pull, before it catches alight and plummets to the ground.

Io Plus Europa Transit Jupiter
Edward Dobosz



Hindenburg Mix
Barton Staggs and Alex Ryan

Hindenburg Mix III for piano, strings and tape is the third 'mix' or movement of an orchestral work exploring weightlessness was written by Barton Staggs in 2001 for the BBC Philharmonic orchestra.

The starting point for the work was the recollection of a passenger on the Hindenburg airship who later recalled that on take off "... the ground actually seemed to be leaving us, rather than we leaving it; there was no motion ..."

An invitation to participate in the Gravity and Wonder symposium presented an opportunity to work with filmmaker Alex Ryan to realise a new version of the work. Herein, composition and archival footage of the Hindenburg – its construction in Friedrichchafen, Germany, and it's tragic spectacular demise at the Lakehurst Naval base in New Jersey in 1937 - provide a poetic evocation of the event.

Lounge Room Gallery (Artists)

Alex Ryan (filmmaker)

Alex Ryan is a film director and writer based in Sydney, Australia. A graduate of the University of Technology Sydney (UTS) and the Australian Film Television and Radio School (AFTRS), Alex has directed award winning short films and music clips, usually dealing with characters on the edge of society - explorers, rebels and scapegoats.

His latest short, Ngurrumbang, screened at festivals around Australia and internationally, was a Dendy Awards Finalist at the 2013 Sydney Film Festival and was nominated for best direction in a short film at the 2014 Australian Director's Guild Awards. In 2015 he launched his own production company, Wedgetail Productions, specialising in aerial cinematography.

Alex was recently awarded the Lexus Australia short film fellowship and funding to make his next short, 'Red Ink', which will have its premiere screening at the 2017 Sydney Film Festival.

Barton Staggs (composer / sound designer)

Barton studied composition at the University of Sydney with Peter Sculthorpe and was awarded a Tait Memorial Trust Scholarship for postgraduate study in composition at the Royal Northern College of Music in Manchester. Barton's music has been performed by Ensemble Offspring, the Tankstream Quartet, Claire Edwardes, the Elektra String Quartet and the BBC Philharmonic under James MacMillan.

His music has been broadcast by ABC Radio in Australia, BBC Radio 3 in the UK, the National Radio Network of Argentina and Polskie Radio in Poland.

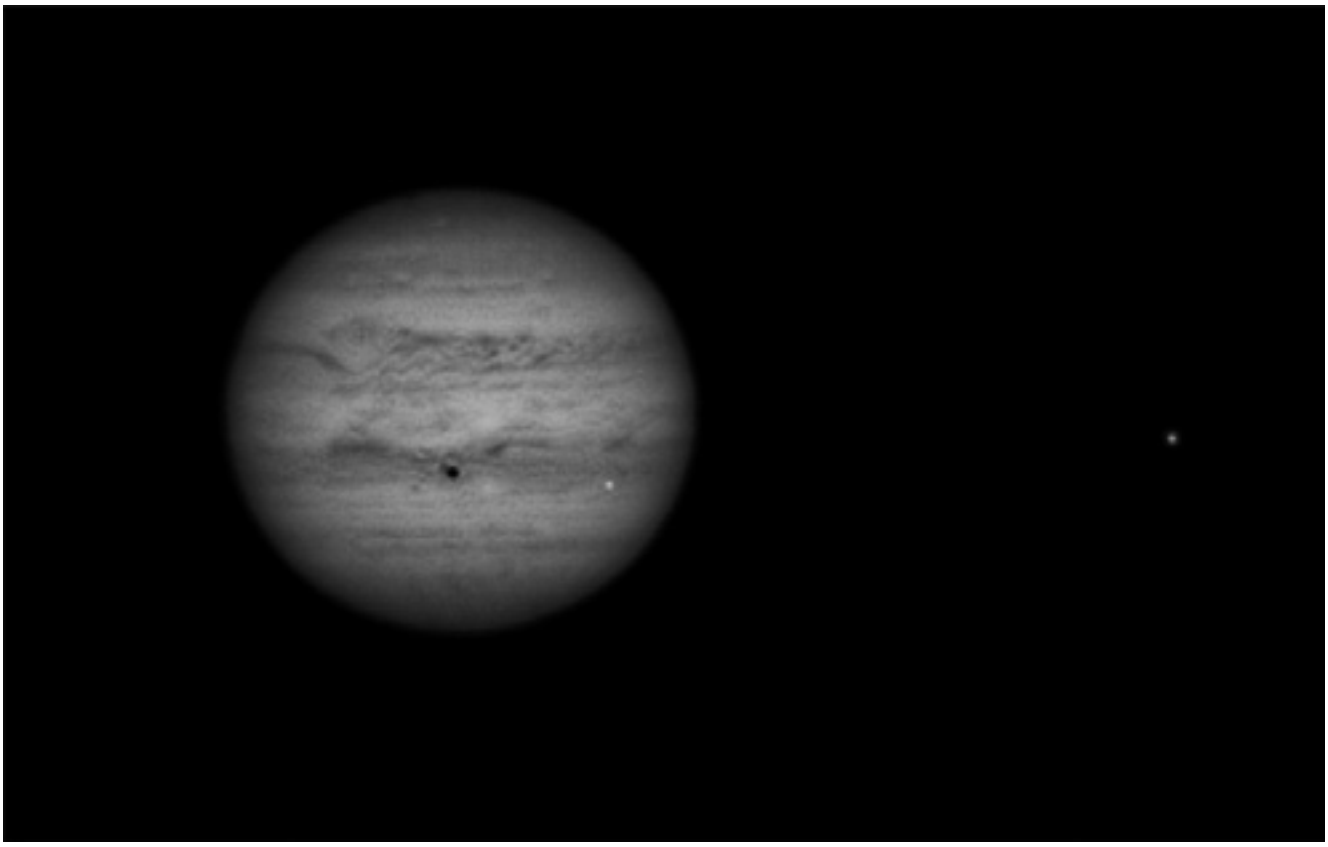
Barton is active as a composer and sound designer for site-specific and screen based digital media artworks. Major projects include Tammy Brennan's Confined (nominated for an APRA Art music award), Justine Cooper's Moist and Excitation for the MAAP festival in Beijing, Nicole Ellis' Tidal Vectors for the Museum of Sydney and Ghost Nets with James McGrath and George Evatt for Sculpture by the Sea.

Moon 27th September

Edward Dobosz

Edward Dobosz

Ted Dobosz is an active member of Western Sydney Amateur Astronomy Group. Now retired he is a highly regarded amateur astronomical photographer. This collection of images were captured by powerful telescopes. Visible here are celestial bodies such as the Moon, Jupiter, Saturn, Sun, distant solar systems, galaxies, gaseous nebula and the swirling structure of pockets of our universe.



Io Plus Europa Transit Jupiter

Edward Dobosz

List of works by Edward Dobosz

Centre of Our Milky Way Galaxy 2

Comet Lovejoy C2014 Q2

Flame and Horsehead Nebula

Galaxy NGC1365

H-Alpha Sun 21st September 2013

Io Plus Europa Transit Jupiter

Lunar Apennine Mountains

Mars 28th April

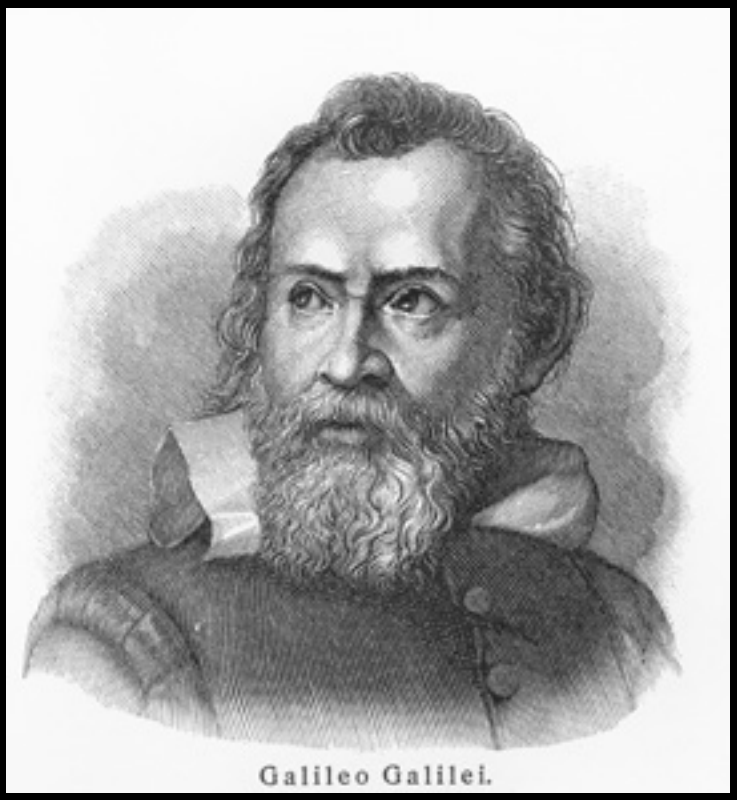
Moon 27th September

Moretus Crater 14 Sept 2013

NGC6334 Cat's Paw Nebula

Saturn Occulted by the Moon 14 May 2014

Lounge Room Gallery (Genius)



Galileo Galilei (Pisa, Italy 1564-1642)

Galileo was a scientist and scholar who became known as the father of modern science. Best known as a physicist and astronomer he revolutionised scientific process by emphasising the need to test scientific theories by conducting empirical experiments. In 1604 Galileo tested his theory on motion by dropping two steel balls of different masses from the leaning tower of Pisa. Observing two different objects falling to earth at the same time proved that constant force does not lead to constant speed, as previously believed, but to constant acceleration; this Galileo termed, the universal law of acceleration.

Galileo also transformed the study of astronomy and our understanding of the cosmos. By adapting a spyglass into a telescope, Galileo became the first person to determine that the moon was not flat and smooth but covered with craters. He also discovered that Venus had phases like the moon and observed four moons circling Jupiter. This empirical evidence led Galileo to openly support the Copernican theory that the earth and planets revolved around the sun. In doing so he challenged the established order set by the Catholic Church and was tried as a heretic at the 1615 Roman inquisition and was held under house arrest for the rest of his life.

Lounge Room Gallery (Genius)

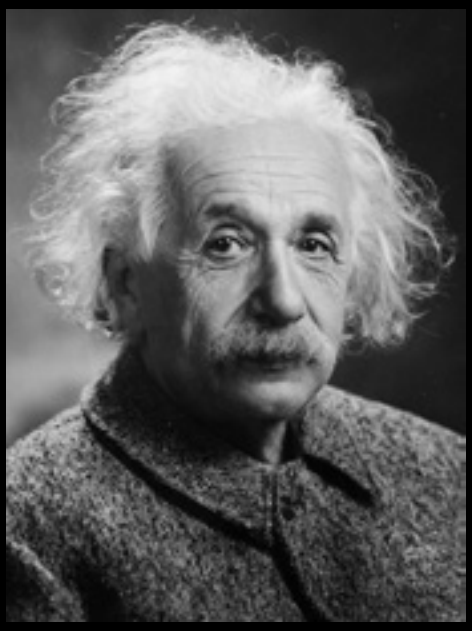
Sir Isaac Newton (UK, 1643-1727)

Isaac Newton was a formidable intellect, whose interests and engagements covered the fields of mathematics, the physical sciences, mechanics, optics, philosophy and theology. Born in Lincolnshire he studied mathematics at Cambridge University. He was considered by many to be one of the most influential scientific thinkers of all time.

Isaac Newton's book The Principia is considered by many to be the single most important book written on Physics. Sir Edmund Halley of Halley's Comet fame, so revered his work that he funded the publication of this work.

Perhaps apocryphal, the story goes that when Isaac Newton was old, he asked how he happened upon the notion of universal gravitation, he replied, "by thinking on it continually".

Lounge Room Gallery (Genius)



Albert Einstein (1879-1955)

Albert Einstein is the most famous scientist, mathematician and physicist of the twentieth century. Born in Ulm, Germany in 1879, Einstein was fascinated as a child by the workings of a small compass he was given. The movement of the needle, which always pointed north, led to a life-long fascination with 'invisible forces'. His life's work has its foundation in these wondrous moments of childhood.

Albert Einstein had a greatly prolific period of thinking and writing in the early years of the 20th century. In 1905 he published The Special Theory Relativity. In it, Einstein considered 'inertial frames', and showed that all motion moves at constant speed, relative to other inertial frames. He argued that nothing travels faster than the constant speed of light at 3,000,000 kilometres a second. Therefore, should it be possible, anything travelling near this speed would appear to distort space and time.

In 1915 Einstein published his General Theory of Relativity. This work was the first major theory of gravity since Isaac Newton's work 250 years previous. Einstein's theory incorporated time to propose space as four dimensional. Conceptualising space-time was a revolutionary moment in science.

Einstein was recognised by the world community in 1921 when he won the Nobel Peace Prize, for his explanation of the phenomena known as the photoelectric effect.

In 1933 Einstein took up a research position at the Institute for Advanced Study in the United States. Following the rise of Nazism in Germany, Einstein took out US citizenship in 1940. He lived and worked in Princeton, New Jersey until his death in 1955.

Einstein's equation $E=mc^2$ articulated the equivalence of mass and energy. This finding led to the development of nuclear science and inevitably the atom bomb. Einstein deplored this use of his work and in later life became a pacifist.

Lounge Room Gallery (Genius)

Leonardo da Vinci (Italy, 1452 -1519)

Leonardo da Vinci was an artist, engineer, scientist and inventor. He created a long lasting legacy across a range of disciplines, including painting, architecture, mechanics and human anatomy. His illustrated notebooks reveal a vast array of mechanical inventions, some of which would not be realised for approximately 500 years including, the bicycle, submarine, flying machine and parachute.

Da Vinci believed that 'knowing how to see' was critical to understanding life and how the world worked, and his archives reveal the depth of his exploration into a wealth of topics such as anatomy and optics, as well as fight and gravity. His fascination with aviation was derived from his observation of how bats and birds navigated the dynamics of air flow and balance. This sense of wonder, combined with an imagination that could envisage humans defying gravity, led to the invention of a series of flying machines, including gliders and a helicopter.

Leonardo da Vinci was the quintessential Renaissance man. For da Vinci, there was no divide between art and science. Rather, these disciplines complimented each other and informed his way of seeing, questioning and knowing the world.

House of Wonder

The Gallery plays host to resident artists and scientists in House of Wonder, situated in Lewers House. Paired in creative collaboration are: Emma Fielden, Kate Turnbull and Leahlani Johnson, with early career scientists from Western Sydney University, Graeme Wong (Star Formation and the structure of molecular clouds), Jordan Collier (The history of supermassive Black Holes), Andrew O'Brien (Galaxy Clusters).

Following a six week studio residency, the results of the House of Wonder art and science collaborations will be exhibited in Lewers House from 16 October - 27 November 2016. Come and find out what it is all about at the 'Open Studio' On Sunday 9 October between 12-3pm.

Driven by creativity and the imagination, art and science will be shown to be disciplines in company, not in opposition.

House of Wonder (Artists)

Emma Fielden

Artist Statement

My art practice is focused upon cosmology, the infinite and the infinitesimal, human awe and systems of belief that surround these concepts. I am often guided by my interest in physics, mathematics and astronomy. I am interested in how human awe and wonder, and our longing to understand our place in the cosmos, have arguably led to complex structures of belief like religion. These lines of enquiry have moved me to probe further into scientific research through books, online resources and university lecture podcasts. I am interested in research regarding the origin, evolution and composition of the universe. I am particularly fascinated by dark matter, the mysterious stuff that makes up such a large portion of our universe, not visible through traditional methods of observation and whose existence is only inferred by the gravitational effect it seems to have on visible matter.

Bio

Emma Fielden works across sculpture, installation and drawing. Since graduating from studies in 2006, her work has been regularly shown in solo and group exhibitions. She was a finalist in the 2016 Blake Prize and has received awards including the 2014 National Contemporary Jewellery Award and the 2009 Buda Australian Decorative and Fine Arts Society Award. In 2013 she received a New Work Grant from the Australia Council and was commissioned to make commemorative brooches for the recipients of the 2013 Australia Council Visual Arts Awards. During 2016 Fielden is based at Parramatta Artist's Studios.

House of Wonder (Artists)

Leahlani Johnson

Artist Statement

My practice explores the paradoxical nature of time. Working across the disciplines of ceramics, painting, installation, floristry and the moving image, I employ disparate materials to reveal opposing durational qualities of stillness, temporality and flux. Divergent concepts of time are further examined through the process of making the work and in the final form an exhibition may take.

In my art practice, I have been investigating the manifold nature of time within visual form. This investigation aims to reveal multiple forms of time to create areas of exploration to experiment and re-imagine its appearance within. The ambiguity surrounding time's nature and form connects it to the wider concept of invisibility and the unknown. I explore between the counterpoints of invisibility and visibility, as time becomes redefined and reshaped within different pools of philosophical and scientific thought, highlighting both the expanse and challenge of visualising time. The investigation of time in my art practice reveals a connection to mystery and the universe through an exploration of the circular rhythms and patterns inherent in the natural world.

Bio

Since 2009 Leahlani Johnson has exhibited in group and solo exhibitions exhibitions. Recent solo exhibitions include The certainty of this, 2015, Hazelhurst Regional Gallery & Arts Centre, and Forgetting what lies behind, 2014, Bathurst Regional Art Gallery, Bathurst. From 2012 - 2014 she was a resident artist at Parramatta Artist Studios. In 2015 she completed a Masters of Fine Arts at UNSW Art & Design, and a residency at the Moya Dyring Studio, Cite Internationale Des Arts in Paris with the Art Gallery of New South Wales.

House of Wonder (Artists)

Katie Turnbull

Artist Statement

My background in animation has seen my practice extend from digital screen based work to films, apps and kinetic sculpture. I see my work as 'time based sculpture'. Taking as my subject matter the history of the moving image, the natural environment, mapping of place and experience, psychology and patterns in crowd behaviour. My work explores these themes through combining pre-cinema objects, mapping, animation and new media technology.

My most recent works take data from maps, gps tracking technology and personal data in line with the phenomenon of 'the quantified self' and transposes this data between mediums to create, what I see as a new form of mapping. Maps contain records of experience, a worldview, cognitive schema and culture. These maps are a way to describe and show a place in a way that elicits an emotive response. Experimentation is an important aspect of my practice, with an emphasis on process, intuition, and innovation.

I am interested in galaxy clusters and dark matter. I am curious to explore the almost inverted sense of time when exploring the clusters and translating that to a video based word accompanied by kinetic sculptures. I like exploring gaps in process, communication and cognitive function. I can see a link between the concept of dark matter and ideas about inaction in human psychology. I like the idea of a work that speaks to the complex structures so distant from us, and also the complex structures within us that seen equally as distant.

House of Wonder (Project Outlines)

Andrew O'Brien

Galaxy Clusters

My recent PhD research concerns galaxy clusters. Galaxy clusters are the largest gravitationally bound objects in the Universe. They consist of hundreds of galaxies and contain a large well of swirling gases between the galaxies within them. As clusters span such large distances, studying them can give insight on how the Universe as a whole is evolving and also reveal the distribution of the invisible and mysterious 'dark matter'.

Traditional methods of finding galaxy clusters detect the faint emission from either the galaxies themselves or the gas that exists between them. These methods are limited to finding only nearby clusters as these emissions quickly fade with distance. Looking at distant objects in astronomy is very important as it enables us to look back in time. The more distant an object is, the more time any emission from that object has taken to reach us and so we view it as it appeared in the past. If weare to understand how galaxy clusters form, we need to see them at different stages in their life, ideally from their formation to the present day. To find very young galaxy clusters, radio wave detection is used to find the powerful jets emitted by black holes in galaxy centres. These jets usually emit in straight lines from the poles of the black hole, but the moving gases that exist throughout galaxy clusters can disturb these jets and distort them much like a flag waving in the wind. Since these jets are typically extremely powerful, they are easily detected over a wide range of distances.This allows galaxy clusters to be found in the very distant Universe and hopefully all the way back to when galaxy clusters began to form. deliberately interrupt traditional notions of space.

House of Wonder (Project Outlines)

Graeme Wong

Star Formation and the Structure of Molecular Clouds

The focus of my PhD has been to gain understanding the structure of the molecular clouds, the possible birth place of stars. Star formation can begin when the dense cloud cores within molecular clouds, made up of interstellar gas and dust, collapse under their own weight or gravity. The whole formation process, from molecular cloud to star can take about 10 million years. To understand the star formation process requires an understanding of conditions which could possibly trigger these series of events. Understanding the structure and what it is comprised of, can help us identify the areas where new stars can possibly form.

Jordan Collier

The History of Supermassive Black Holes in the Universe

I have recently completed my PhD research entitled, 'The History of Supermassive Black Holes in the Universe'. In it, I considered how the intense gravity of supermassive black holes has influenced the way that galaxies evolve throughout cosmic history. It is contended that supermassive black holes lie at the heart of almost every galaxy. But only a small percentage of them are massive enough (and therefore have strong enough gravity) to cause the core of the galaxy to become active. One of the ways they become active is by launching jets away from the core, which we can observe with a radio telescope. These are called radio-loud, and they make up about 10% of the active galaxies.

I studied two types of radio-loud active galaxies to gain a better understanding of how galaxies evolve, and how the supermassive black holes influence them: 1) Infrared-Faint Radio Sources; 2) Gigahertz-Peaked Spectrum / Compact Steep Spectrum sources. Infrared-Faint Radio Sources are a new and rare type of object, which we found originate from the early universe. In my research a population of over 1300 of the brightest galaxies were found and their distance measured for the first time, which revealed them to be at a distance of between 10-12 billion light years away.

Gravity (and Wonder) Exhibition Opening

3 September 2016

Professor Barney Glover

Gathered here today at the opening of Gravity (and Wonder) exhibition, we are excited about this project, and what it represents. It draws on the strengths of both the Museum and Gallery in partnership, to break new ground in the ways exhibitions are developed and presented.

Our strength is our unique collection – spanning over 130 years, and now consisting of over 500,000 objects, its distinction is its hybrid nature – the applied arts and sciences.

We are committed to enhancing access to the collection, and this project provides a platform to showcase some treasures that capture Australian scientific discovery and innovation.

Some examples - drawings by a remarkable Australian inventor and early pioneer of flight Lawrence Hargrave, a 19th century Orrery, rare photographs of the Australian Wallal Expedition in 1922 which helped prove Einstein's theory of general relativity, a satellite fragment from Soviet Satellite which landed in rural NSW, beautiful constellations and planes taken at Sydney Observatory and archival material of controversial rocket scientist Werner von Braun.

The gallery's strength is its engagement with artists, and to select a body of work that capture the theme of gravity as a physical force, concept and inspiration. It is impressive that new works have been commissioned for inclusion in Gravity and Wonder.

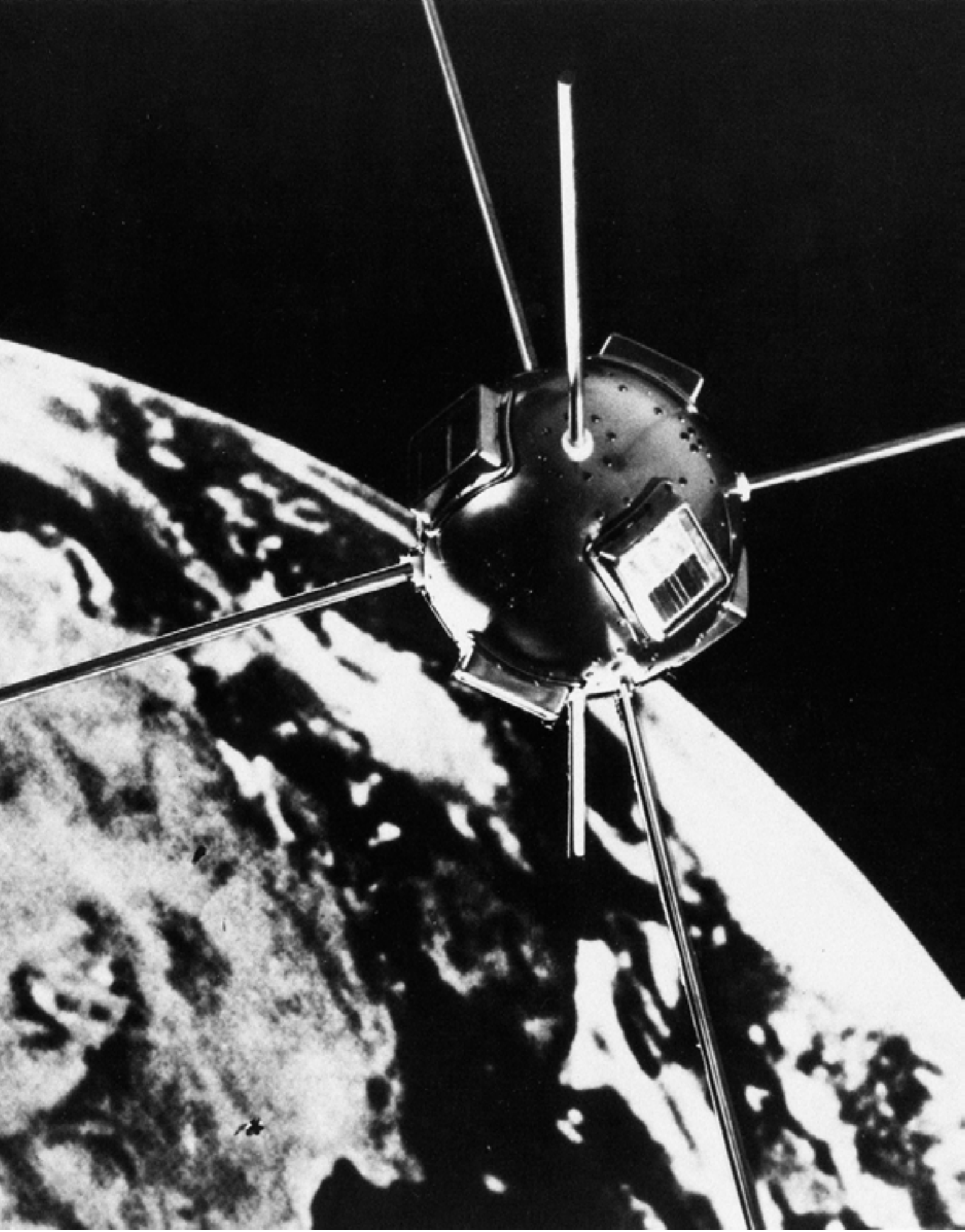
This blurring of the boundaries between traditional perceptions of a museum experience and traditional expectations of an art gallery experience is one of the strengths of this partnership.

And speaking now as the Vice Chancellor and President of Western Sydney University, I am delighted that in this role, we bring another dimension to the partnership, through our participation in the public program that complements the exhibition.

Gravity and Wonder marks the beginnings of what we see as a long term partnership with the Penrith Regional Gallery. This innovative cross-organisational agreement aims to deliver three projects at the Gallery in the coming years. The projects provide an opportunity for the teams to deepen understanding of each other's creative interdisciplinary practice, enabling new ways of working with partner organisations, as well as new interpretations of objects in the Museum's collection.

This is a really exciting project, and we commend the generous spirit of collaboration that has enabled the opening of the exhibition we celebrate today.

It is now my great pleasure to declare Gravity and Wonder open.



Museum of Applied Arts & Sciences

PENRITH REGIONAL GALLERY & THE LEWERS BEQUEST

Gravity (and Wonder)

3 September - 27 November 2016

The cause of gravity is what I do not pretend to know.

Sir Isaac Newton, 1692

MASS AND ATTRACTION

On Earth, gravity is understood and observed as a force of attraction between bodies of mass in proximity to each other. The greater the mass, the greater the attraction it exerts. It is gravity that shapes our world, keeps the oceans intact and the atmosphere in place, and holds us to the Earth's surface.

As a force of attraction, gravity is both weak and strong; it will eventually and inevitably master everything. We need only look at the night sky to ponder its effects: crushing matter, exploding stars, gaseous nebula, the birth of black holes and, in time, the end of the known universe.

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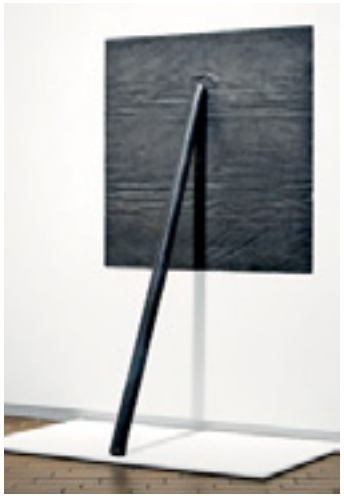


1. Amy Joy Watson, *Floating Sequence*, 2012, balsa wood, watercolour, gouache, polyester thread, lead weights, balloons, helium, dimensions variable. Courtesy of the artist and Hugo Michell Gallery, Adelaide. Photography by Andy Nowell

2. Photograph of a Sydney Observatory automatic tide gauge, Australia, 1899, silver gelatin print. Photographer unknown, Museum of Applied Arts and Sciences Collection

3. Richard Serra, *Prop*, 1968, lead, 259 x 152 x 112cm. Collection: National Gallery of Australia, Canberra, purchased 1973. © Richard Serra/ARS. Licensed by Viscopy, 2016

Front: Vanguard 1 satellite, launched 1958. Photo/Image courtesy of the Naval Research Laboratory

THINK

In 1687, Sir Isaac Newton proposed, 'Every object in the universe attracts every other object along a line of the centres of the objects, proportional to each object's mass, and inversely proportional to the square of the distance between the objects'.

This is expressed in the equation:

$$F = G\frac{m_1 m_2}{r^2}$$

Physicists refer to this law as belonging to Newtonian physics.

MAKE

An understanding of Newtonian physics underpins Richard Serra's artwork *Prop*.

In this work he uses a long lead pole to prop a large sheet of lead against a wall. How precarious is this heavy object? Why doesn't it fall over? Discover forces of gravity and friction in balance in this simple experiment.

You will need:
- a pen
- a business card.

1. Prop the business card against a wall with the pen.

2. Find the angle for your pen that holds the business card in place.

That it does so is because the forces involved are balanced. The downward force of gravity is balanced by the resistant forces from the wall, the floor and friction.

DO

Gravity has been observed to limit the height of mountains. Gravity is also weaker at a mountain's summit than at ground level.

See if you can find out why this is so.
Hint: consider the equation above.

Prop activity illustration by Apattra Hongsuwong

ABOUT THE PROJECT

Gravity invisibly governs the movement of the world, the shape of space and the flow of time. The *Gravity (and Wonder)* project explores human fascination with these fundamental aspects of the universe through scientific investigations and artistic explorations. This exhibition brings together rare scientific instruments and inventions, specialist objects and archival material from the Museum of Applied Arts and Sciences collection alongside the work of contemporary artists who examine gravity as phenomena and effect.

Gravity (and Wonder) is a collaboration between the Museum of Applied Arts and Sciences and Penrith Regional Gallery & The Lewers Bequest. The project collaborators are joined by education partner Western Sydney University, bringing its Penrith Observatory and academic expertise into the project. The exhibition is supported by the Dobell Exhibition Grant, funded by the Sir William Dobell Art Foundation and managed by Museums & Galleries of NSW.

Museum of Applied Arts & Sciences

PENRITH REGIONAL GALLERY & THE LEWERS BEQUEST

Gravity (and Wonder)

3 September - 27 November 2016

Everything is determined, the beginning as well as the end, by forces over which we have no control.

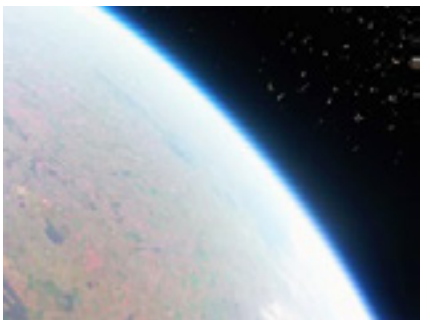
Albert Einstein, 1929

SPACE AND TIME

Time goes too slowly for some and it runs away from others. We save it and spend it. We try to tame it with units of measure, yet it cannot be grasped. Time is known only by its passing, and by the entropic effects upon matter — beginnings and endings in endless procession.

Albert Einstein first described spacetime in 1915 as allowing us to understand our planet and universe within a space and time landscape puckered by the mass and gravitational pull of celestial bodies, across which the movement of all forms, including light, follow the curvature of space.

1



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1. David Haines and Joyce Hinterding, *Sound Ship (descender 1)*, 2016, audio, film documentation. Courtesy of the artists and Sarah Cottier Gallery, Sydney

2. Rusty Peters, *Three Mothers for the Moon*, 2016, natural pigment on canvas, 150 x 150cm. Courtesy of the artist and Warmun Art Centre

3. Badge with the Apollo Moon Landing Space Project emblem, United States, about 1968. Museum of Applied Arts and Sciences Collection. MAAS Photography

4. Photograph from the Wallal expedition series, Australia, 1922, silver gelatin print. Photographer unknown, Museum of Applied Arts and Sciences Collection, purchased 1986

Front: Photograph of the solar eclipse, Wallal expedition, Australia, 1922, silver gelatin print. Dr C Adams, Museum of Applied Arts and Sciences Collection, purchased 1986

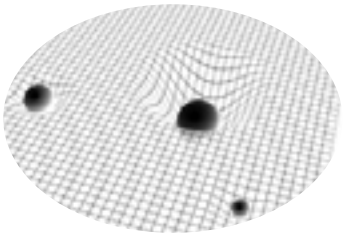
THINK

In 1915 Einstein predicted the existence of gravitational waves, or ripples in the fabric of spacetime.

One hundred years later, gravitational waves were finally detected by the Laser Interferometer Gravitational Wave Observatory in the USA. These waves were caused by the enormous energy of two massive black holes merging 1.3 billion years ago. By observing gravitational waves, scientists have gained groundbreaking new insight into the evolution of the universe.

MAKE

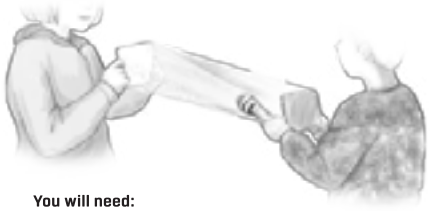
All matter distorts spacetime.



To conceptualise the fabric of spacetime, stretch and secure a piece of jersey over a large hoop. By placing different sized balls onto the jersey, you can observe the distortion of different masses upon the fabric plane. In spacetime these differing distortions or 'puckers' create the effect of gravity and hold masses in their spinning orbits.

DO

Nothing travels faster than light. To get a sense of its speed, try this simple activity.



You will need:
- a partner
- a torch
- two mirrors.

1. Give your partner a mirror and the torch and go outside after dark.

2. Stand at a distance from your partner, each of you holding a mirror to the front of your bodies.

3. Ask your partner to point their torch at your mirror and turn it on.

4. Watch as the torch's light is immediately reflected in your partner's mirror.

It has travelled this distance at nearly 300,000 kilometres per second.

Spacetime curvature diagram © ESA–C Carreau
Torch activity illustration by Apattra Hongsuwong

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Museum of Applied Arts & Sciences

PENRITH REGIONAL GALLERY & THE LEWERS BEQUEST

Gravity (and Wonder)

3 September - 27 November 2016

Listen to the sound of the Earth turning.

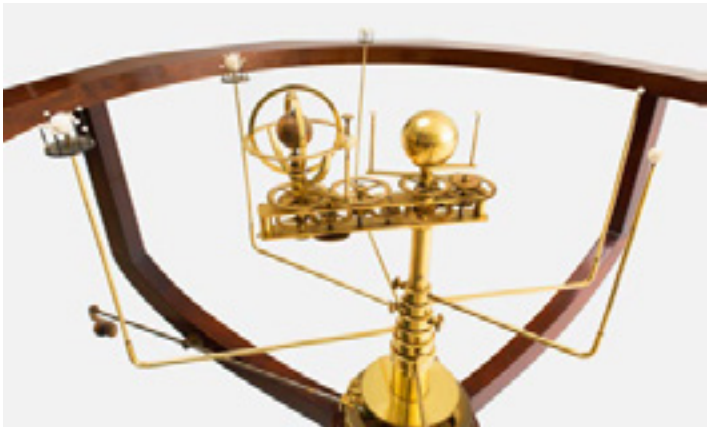
Yoko Ono, 2015

MEASUREMENT AND UNDERSTANDING

Gravity helped form the universe. Civilisations and cultures have always tried to understand the unknown and developed their own notions of space (the 'heavens') and time (the 'beginning' and 'end'). These notions can be understood through philosophies of religious, spiritual or metaphysical transcendence or through scientific theories and explanations.

Over the centuries, scientists have created exceptional technologies and instruments to help us understand nature, calculate the movements of the solar system, and measure specific and relative gravity and gravitational waves. While we can describe nature's methods, at a fundamental level why things behave the way they do is still unknown.

1



2

3

1. Orrery (detail), France, 1851–77, wood, brass and ivory. Maker unknown, Museum of Applied Arts and Sciences Collection, purchased 1986. Photograph by Ryan Hernandez, MAAS

2. Illustration of a planimeter by Apattra Hongsuwong, 2016

3. Mabel Juli, *Garnkiny Ngarranggari*, 2014, *mowantu* (ochre), *Tharlngarri* (Snappy Gum) charcoal on canvas, 150 x 150cm. Courtesy of the artist and Warmun Art Centre

Front: David Stephenson, *Dome No. 30705, New Synagogue, Szeged, Hungary*, 2000/2004, colour photographic print, ed. 5/35, 56 x 56cm. Courtesy of the artist, Bett Gallery, Hobart and Saul Gallery, New York

THINK

Keen observation, prediction and measurement of phenomena is the basis for all scientific knowledge. Such practices allow theories to be posited and tested.

In 1589 Galileo, atop the Leaning Tower of Pisa, sought to test the rate at which objects fall and found them to fall at the same rate despite their differing mass. He did not, however, understand why. Since then, important thinkers such as Newton and Einstein have improved our understanding and posed new questions.

From the international Wallal expedition of 1922 to the use of our major observatories to view gravitationally lensed galaxies, Australian scientists continue to play a part in observing, measuring and discovering the wonders of the universe.

MAKE

Create a paper plate sundial to tell the time.

Over thousands of years the cyclical movements of the Sun, Moon and stars have provided us with the means to measure time.

You will need:
- a paper plate
- a pencil.

1. Upturn a paper plate and mark a 10 on the rim at the bottom of the plate.

2. Push a pencil into the centre of the plate.

3. Go outside at 10.00 am, place the shadow of the pencil in line with the number 10.

4. At 11.00 am, mark 11 where the shadow falls on the plate. Continue with the following hours.

The following day the moving shadow of the pencil will fall across the numbers and you will be able to tell the time.

DO

Next time you are at a beach, observe the gravitational pull of the Moon as the tideline slowly shifts in and out over a 24 hour period.

The Moon's mass is about one hundredth that of Earth and it is 384,000 kms away. It has a strong and noticeable stretching effect on our planet's oceans, causing surface water to bulge both toward and away from the Moon.

Gallileo drawing: from F J Rowbotham, *Story Lives of the Great Scientists*. New York, 1918

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MAAS Museum of Applied Arts & Sciences

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We can lick gravity, but sometimes the paperwork is overwhelming.

Wernher von Braun, 1958

MOTION AND ACCELERATION

Gravity influences the motion and acceleration of all free-falling objects. To describe an object's motion you must describe not only how fast it is moving but also in what direction it is heading. In fact, any object on Earth is accelerating because gravitational forces are pulling it *down*.

From the earliest fantasies of flying or floating to the invention of flying machines and space rockets, humans have aspired to be free of earthly bonds and reach new heights. It is gravity that must be conquered to achieve this elevation and thwart inertia.

1

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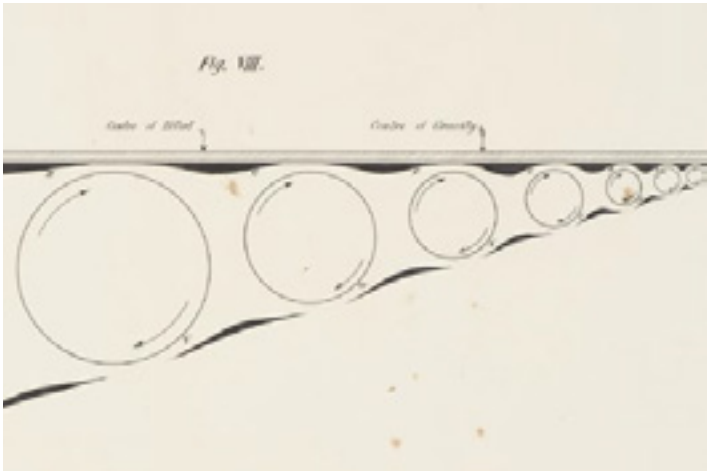


4

1. Gillian Lacey, *Play: On the beach with the Ballet Russes*, 2008, digital film. Courtesy of the artist

2. Marley Dawson, *Circle Work (rocket assist) 32", 39"*, 2013, stainless steel, aluminium, bearings, C6 rocket, 175cm diameter. Courtesy of the artist and Roslyn Oxley9 Gallery, Sydney

3. Diagram for a flying machine, Australia, 1889, ink and pencil on paper. Lawrence Hargrave, Museum of Applied Arts and Sciences Collection, acquired 1963

4. Model of a queen bee, France, 1825-80, papier-mâché and metal. Museum of Applied Arts and Sciences Collection, purchased 1883. Photograph by Ryan Hernandez, MAAS

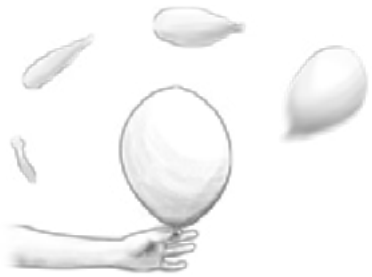
Front: Hiraki Sawa, *Dwelling* (detail), 2010, video. Courtesy of the artist and James Cohan Gallery, New York

THINK

To leave the Earth's gravitational pull, a speed of over 40,000 kms per hour must be achieved.

An object needs escape velocity to break free from the gravitational pull of a planet. Such velocities are only possible with the enormous force of rockets. When the rocket fuel runs out, it is gravity — the curvature of spacetime — that will determine the spacecraft's path.

MAKE



Use an inflated balloon to observe Isaac Newton's third law of motion: 'For every action there is an equal and opposite reaction.'

You will need:

• a balloon.

1. Blow the balloon up as large as possible.

2. Pinch the opening with your fingers and hold aloft before letting go.

3. Watch as the compressed air is forced through the narrow opening as the balloon's rubber material seeks to contract.

The balloon will appear to defy gravity as it flies at speed in the opposite direction to the expiring air. As the air is spent, gravity will make the balloon fall to the ground.

DO

Consider Marley Dawson's *Circle Work*.

A metal pipe is attached to a central pivot point. When the pipe is loaded with fuel and lit, providing great force, it behaves like a rocket accelerating. Because it is attached to the pivot, it cannot fly off in a straight line away from the force that has set it in motion. Instead, the attached pipe spins at great speed until its fuel and force are spent. Through this action a charred circle is 'drawn' upon the wall.

How has the artist applied Newton's third law of motion to the creation of this work?

Balloon activity illustration by Apattra Hongsuwong

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Public Programs and Education

Public Programs and Education

Gravity (and Wonder) public programs are produced and offered in association with Penrith Regional Gallery, Western Sydney University (WSU) and Museum of Applied Arts and Sciences (MAAS).

Gravity (and Wonder) in the Garden
Sunday 11 September 11-3pm

Sydney Observatory gravity model demonstrations

Sydney Observatory Solar Telescope viewing

Tours of the Gallery Garden

Demonstration by Sydney Observatory staff using a model of space and planets to show force of gravity
Free

In conversation with Costa Georgiadis
Join ABC Gardening Australia's Costa Georgiadis, in conversation with garden designer David Duncan and plant scientist, Peter Western.
Book online through MAAS website.
Cost: $25.

Public Programs and Education

Stargazing

Saturday evening Star Gazing Nights are jointly presented by Penrith Regional Gallery and Western Sydney University, Penrith Observatory. Citizen Science activities for the whole family.

View the night sky - telescopes provided.

Star Gazing at Western Sydney University, Penrith Observatory, 8 October, 7pm - 9pm

Star Gazing in the Gallery Garden, 22 October, 6.30 - 9pm

Bookings: 4735 1100

House of Wonder Open Studio Sunday, 9 October (12 - 3pm)

House of Wonder open to the public. Artists and scientists will discuss the work they have produced responsive to the thematic Gravity (and Wonder) and the specific research undertaken by participating scientists.

Free

Public Programs and Education

Gravity Geeks Art + Science Symposium
Joan Sutherland Performing Arts Centre
Saturday 5 November, 9 - 5pm

Gravity Geeks Art + Science symposium brings together artists, scientists, STEM researchers, educators, students and members of the general public.

Scientists and artists present and discuss recent work, research and discoveries. Featuring special performances by contemporary dance company, *Shaun Parker & Company'*, Parkour group, *Dauntless Movement Crew*, and special screening of Hindenburg Mix 111.

Bookings: 4723 7600

Education Program

Schools will be offered two different opportunities to engage with Gravity (and Wonder) exhibition and Science, Technology, Engineering, Arts, Maths (STEAM) program.

Booked School visits to the Exhibition Gravity (and Wonder)

Schools Intensive Weeks:

Primary School: (12 - 16 Sept) A Gallery educator led, cross curricular art and science experience.

Secondary School Week (24 - 28 Oct) Syllabus linked curator led gallery tours and workshops. Scientist / Artist-in-residence Open Lab Program.

Leisure Workshops: Gravity (and Wonder) themed art making and digital animation.

Holiday Program (Term 3): Tackling the Laws of Gravity, science-themed art making workshops

Acknowledgements:

Sir William Dobell Art Foundation
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Joan Sutherland Performing Arts Centre
Western Sydney University, Penrith Observatory
Professor Miroslav Filipovic
Dr Ain de Horta
Raelene Summer
Michael Do
Volunteer Invigilators

Exhibition team:

Curators:

Katie Dyer
Dr Lee-Anne Hall

PRG & TLB

Dr Lee-Anne Hall - Director
Marian Simpson - Exhibition Manager
Naomi McCarthy - Education Manager
Lead Installer and Technician - Graeme Robinson
Krissie Scudds - Communication Manager
Fiona Knoke - Volunteer Co-ordinator
Members of the extended PRG&TLB Project Team

MAAS

Katie Dyer - Curator Contemporary
Kate Ford - Exhibition Project Coordinator
Kat Bond - Senior Exhibition Designer
Fil Bartkowiak -Exhibitions Graphic Designer
Judith Matheson - Editorial and Publishing Manager
Vanessa Pellatt - Editor
Deborah Vaughan - Program Producer (Regional)
Members of the extended MAAS Project Team

Catalogue Designer - James Marquet

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Sponsors

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