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Mudam Luxembourg
Musée d'Art Moderne
Grand-Duc Jean

EPPUR SI MUOVE

ART AND TECHNOLOGY, A SHARED SPHERE

A COLLABORATION BETWEEN MUDAM LUXEMBOURG AND MUSÉE DES ARTS ET MÉTIERS-CNAM, PARIS

EXHIBITION FROM 9 JULY 2015 UNTIL 17 JANUARY 2016

Aurora borealis, as observed March 1, 1872
Étienne-Léopold Trouvelot, 1881
Astronomical drawing

Photo: Aurélien Mole

musée des arts et métiers le cnam

MUDAM LUXEMBOURG

EPPUR SI MUOVE

ART AND TECHNOLOGY, A SHARED SPHERE

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PRESSKIT
JULY 2015

EPPUR SI MUOVE

ART AND TECHNOLOGY, A SHARED SPHERE

A COLLABORATION BETWEEN MUDAM LUXEMBOURG AND MUSÉE DES ARTS ET MÉTIERS-CNAM, PARIS

Exhibition From 9 July 2015 Until 17 January 2016

The product of an ambitious partnership with the Musée des Arts et Métiers, the exhibition *Eppur si muove . Art and Technology, a Shared Sphere* (And yet it turns) focuses on the many links that exist between the fields of the visual arts and technology, as well as the decisive influence that the history of the sciences and technology has exercised on contemporary artists.
Filling all the Mudam Luxembourg's exhibitions spaces, and in a spirit of dialogue, it brings together some 70 pieces dating from the 18th century and the present day from the collections of the prestigious museum in Paris and more than 130 works by artists who through the questions that they engage with, the experiences they offer, and the manner of production and collaboration they employ embrace the themes that have run through the domains of technology and science for several centuries.

Opening with a representation of the emblematic pendulum built by Léon Foucault – "the first to physically demonstrate the spinning movement of the Earth", in the words of artist Piotr Kowalski – the exhibition will be structured in three chapters: "Measuring the World", "Matter Revealed", and "Inventions Applied", each occupying a floor of the museum in several theme – based rooms. Questions tackled vary from celestial mechanics, descriptive geometry, the measurement of time and space, observation of the infinitely large and infinitely small, light, sound and electromagnetic waves, tools, energy, and cybernetics: each a facet of a world that man has always attempted to understand and mould.

By means of the dialogue that it stimulates, the exhibition *Eppur si muove . Art and Technology, a shared sphere* also reassesses the dynamics common to both domains, which are often artificially distanced from one another. Freed of the conception of art being autonomous, the works bear out the importance to the creative process of technical and scientific research, collaboration, experimentation, and instrumentation.
In parallel and aside from their undeniable physical beauty, the technical objects from the Musée des Arts et Métiers embody the dimension of intuition and creativity that goes hand – in – hand with all scientific research. This unique exhibition thus draws the contours of a "shared sphere" between artists and engineers, artists and scientists – a place where unique yet complementary gazes on the contemporary world intersect.

Sphere of Léon Foucault's pendulum, 1851
© Musée des Arts et Métiers – Cnam,
Photo: Studio Cnam

PARTNERS

The exhibition *Eppur si muove . Art and Technology, a Shared Sphere* is being organised in collaboration with the Musée des Arts et Métiers – CNAM to mark Luxembourg's presidency of the European Council for the latter half of 2015. It is under the patronage of Xavier Bettel, Prime Minister.

It involves partnerships with Fonds National de la Recherche Luxembourg,
The Loo & Lou Foundation, under the aegis de la Fondation Luxembourg et CFL-Société Nationale des Chemins de Fer Luxembourgeois.

SYMPOSIUM

The exhibition will be the subject of an international symposium to be held from 15 to17 October 2015 at the Mudam. Titled "Fabrique des sciences – Fabrique des arts", it will be chaired by Patricia Falguières, professor at the École des Hautes Études en Sciences Sociales, and is being organised in collaboration with the Conservatoire national des Arts et Métiers – Lorraine, the École supérieure d'Art de Lorraine, the Université de Luxembourg and the Luxembourg Institute of Science and Technology (LIST) and with the support of Fonds National de la Recherche, Luxembourg.

CATALOGUE

A Mudam Luxembourg publication is bring together hitherto unpublished essays by, among others, Marie-Sophie Corcy, Patricia Falguières, Arnaud Dejeammes, Vincent Crapon and Christophe Gallois, as well as a major section devoted to the exhibition with background descriptions and visuals of the works on view.

CURATORS

Marie-Noëlle Farcy, Christophe Gallois, Enrico Lunghi, Clément Minighetti (Mudam Luxembourg), Marie-Sophie Corcy (Musée des Arts et Métiers).

ASSOCIATE CURATORS

Vincent Crapon (Mudam Luxembourg), Lionel Dufaux, Cyrille Foasso (Musée des Arts et Métiers).

WITH THE CONTRIBUTION OF

Isabelle Astic, Anne-Laure Carré (Musée des Arts et Métiers).

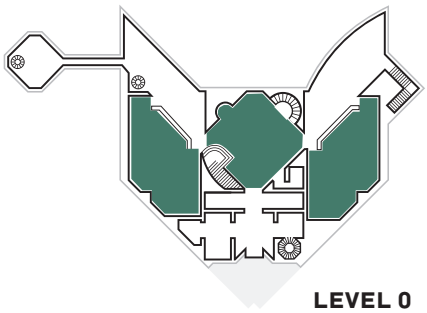
LIST OF ARTISTS

Dove Allouche
Darren Almond
Renaud Auguste-Dormeuil
Julien Berthier
Michael Beutler
Mel Bochner
Katinka Bock
Stanley Brouwn
Chris Burden
Nina Canell
Daniel Gustav Cramer
Attila Csörgő
Björn Dahlem
Edith Dekyndt
Wim Delvoye
Ólafur Elíasson
Christoph Fink
Gego
Jochen Gerner
Marco Godinho
Paul Granjon
Grönlund-Nisunen
João Maria Gusmão + Pedro Paiva
Wade Guyton
Rebecca Horn
Éric van Hove
Ann Veronica Janssens
Véronique Joumard
Anne Marie Jugnet + Alain Clairet
Rolf Julius
On Kawara
Paul Kirps
Piotr Kowalski
Sophie Krier
Alicja Kwade
Bertrand Lamarche
David Lamelas
Vincent Lamouroux
Katie Lewis
Jorge Macchi
Daria Martin
Kris Martin
Tatsuo Miyajima
Kazuko Miyamoto
Laurent Montaron
Gianni Motti
Carsten Nicolai
Navid Nuur
Lisa Oppenheim
Damián Ortega
Adrian Paci
Trevor Paglen
Nam June Paik
Miguel Palma
Panamarenko
Michel Paysant
Amalia Pica
Julien Prévieux
Evariste Richer
Georges Rousse
Thomas Ruff
Stéphane Sautour
Lasse Schmidt Hansen
Conrad Shawcross
Simon Starling
Stelarc
Thomas Struth
Takis
Jean Tinguely
Francisco Tropa
Guido van der Werve
George Widener
John Wood & Paul Harrison
Raphaël Zarka

AN EXHIBITION IN 3 CHAPTERS

CHAPTER 1
MEASURING THE WORLD

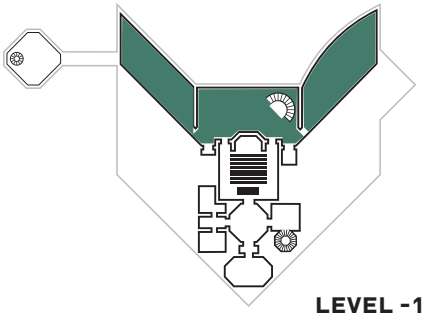
Invitation to Experiment
Unfurled Forms
Seizing Time
Surveying Space



LEVEL 0

CHAPTER 2
MATTER REVEALED

World Scales
Optical Games
Acoustic Figures
Signs of the Invisible



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CHAPTER 3
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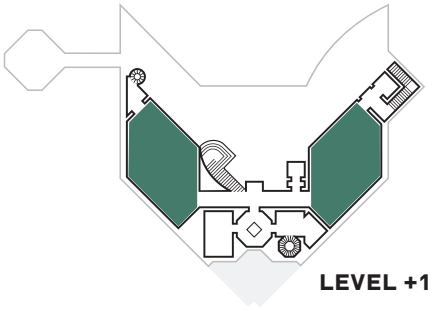
Production in Question
Machines on the March
The Electrical Spark
Locomotion, Real and Dreamed of
Dizzy Numbers
The Fascination of Living Things



LEVEL +1

CHAPTER 1

MEASURING THE WORLD

INVITATION TO EXPERIMENT

UNFURLED FORMS

SEIZING TIME

SURVEYING SPACE

CHAPTER 1: MEASURING THE WORLD

INVITATION TO EXPERIMENT

"As soon as this pendulum starts to move, it belongs in a way to celestial spaces[1]."
Léon Foucault

The experiment which Léon Foucault first presented in February 1851 at the Paris Observatory, and then in the following month at the Pantheon, marked a major moment in the history of sciences: if the idea that the Earth rotates on its own axis was by then accepted, this was the first tangible demonstration of a fact whose hypothesis had been stated since Antiquity, and whose discovery, associated with that of the heliocentric theory and figures as emblematic as Copernicus and Galileo, was punctuated by controversies. "You are invited to come and see the Earth turn[2]", read the announcement for the event. The enthusiasm stirred up by the experiment in Paris was such that, in the ensuing months, it was reproduced in dozens of cities all over the world.

Symbolically, the presentation of Léon Foucault's pendulum thus represented one of the high points of the experimental approach, based on the principles of experiment and demonstration, which found its origins in the Renaissance, and played the leading role in the famous physics cabinets of the 18th century, with which the history of the Musée des Arts et Métiers is closely bound up. It is this approach and the technical objects accompanying it which this first section of the exhibition is concerned with, organised around Léon Foucault's pendulum. It brings together objects and works which explain the laws and physical phenomena which drive the world, the Earth's diurnal rotation, but also gravity, the communication of motion, levitation, and whirlwinds.

Like the "tribute" paid by Piotr Kowalski to Léon Foucault in 1974 in a project for the La Défense site in Paris, this section also underscores the interest shown by certain artists in objects stemming from the history of science and technology: Raphaël Zarka produces a replica of a 19th century instrument directly inspired by an experiment conducted by Galileo; Carsten Nicolai photographs the Astrolabe (17th century) designed by Father Emmanuel Maignan in the cloister of the Trinità dei Monti in Rome; and the *Antigravity Model* of Grönlund-Nisunen, for its part, borrows the principle of the gyroscope, invented by Foucault himself the year after the first presentation of the pendulum.

[1] William Tobin, *Léon Foucault*, french adaptation of James Lequeux, Les Ulis, EDP Sciences, 2002, p. 149.
[2] *Ibid*., p. 145.

Pendulum, 1851, Léon Foucault (1819 - 1868)
Paul Gustave Froment (1815 - 1865)
Fac-similé

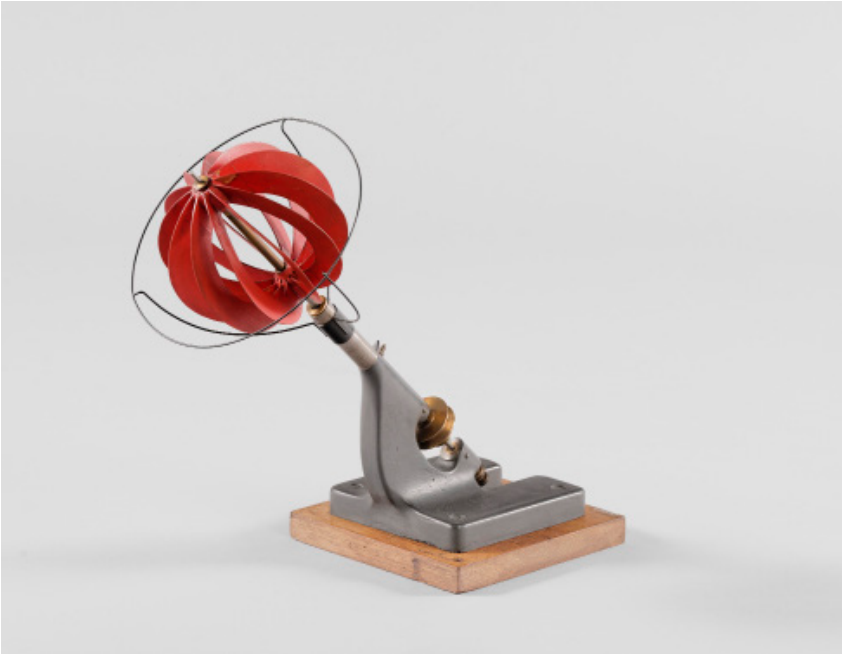
Sophie Krier
In collaboration with Franck Debouté
Table for the Léon Foucault's Pendulum, 2015

Stand for seven identical ivory balls suspended and mounted on a mahogany occasional table, late 18th century
Cabinet of Jacques Alexandre César Charles (1746–1823)
Paris, Musée des Arts et Métiers – Cnam

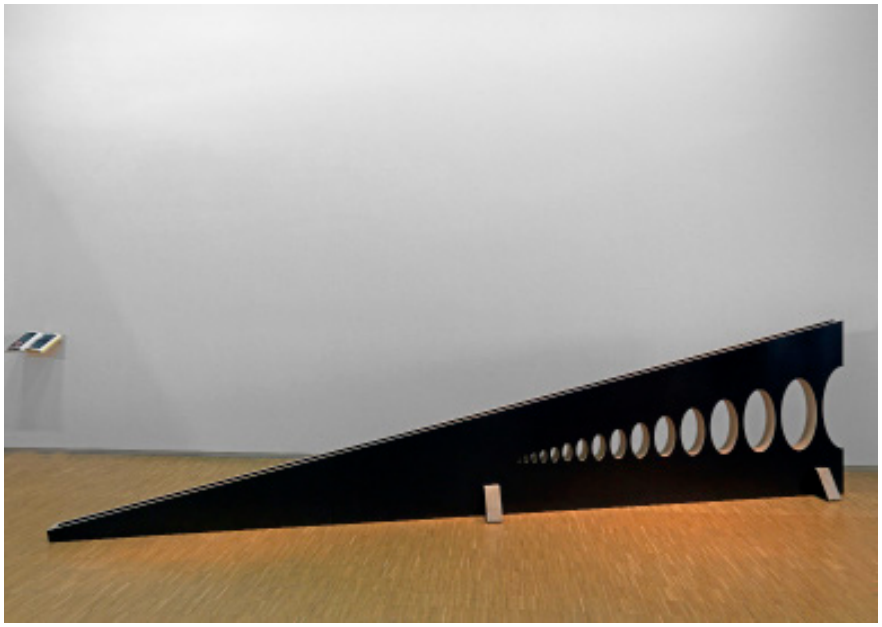
Collection of apparatus for demonstrations and experiments on whirlpools making it possible to reproduce a large number of natural phenomena such as: waterspouts, storms and spinning spheres, the properties of magnets, etc., 1887
Charles Louis Weyher (1836-1916)
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

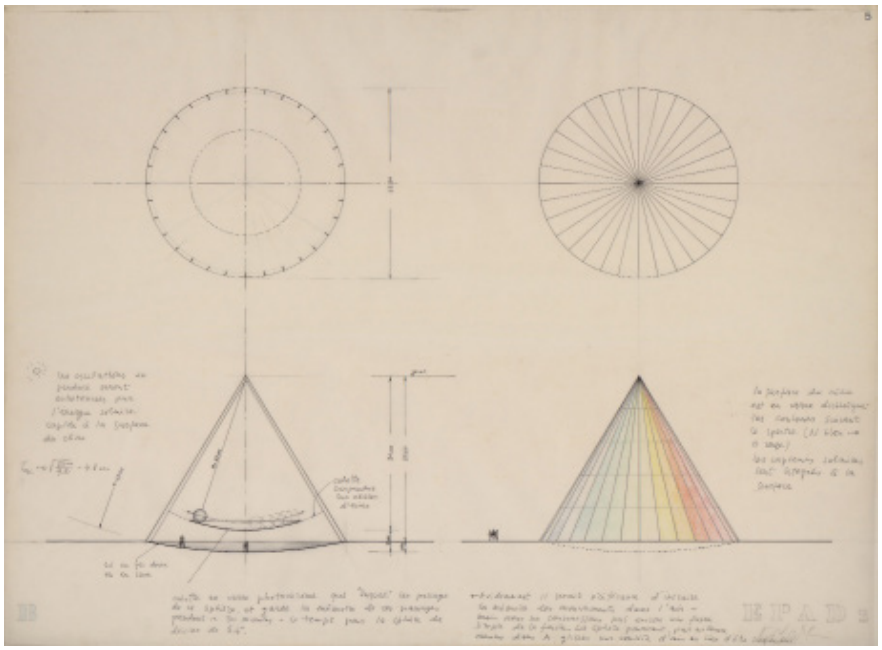
Chris Burden
Grönlund-Nisunen
Anne Marie Jugnet
+ Alain Clairet
Piotr Kowalski
Sophie Krier
Bertrand Lamarche
Carsten Nicolai
Guido van der Werve
John Wood & Paul Harrison
Raphaël Zarka



Gruel machine showing the mechanism of whirlwind and its action on divided materials, 1887
Charles Louis Weyher (1836–1916)
Brass, ferrous alloy, wood, glass, carton, fibre of vegetal origin (gruel)
103 x 60,5 cm
© Musée des Arts et Métiers – Cnam
Photo: Aurélien Mole



Raphaël Zarka
Padova (Réplique #4), 2008
Plywood and
Carrara marble
130 x 550 x 36 cm
Centre Pompidou
Musée national d'art moderne
Collection / Centre de création
industrielle, Paris
Donation of Ricard's foundation
2009, for the Ricard foundation
prize, 2008
© Raphaël Zarka /
Photo: Centre Pompidou,
MNAM-CCI, Dist.
RMN Grand Palais /
Philippe Migeat



Piotr Kowalski
L'Observatoire – Trois projets pour la Défense, 1974
La Défense, Projet n°2, 1974
Drawing for the version 2
Plans and photomontages, model
Pencil on paper, collage
53 x 68 cm
Collection Andrea Kowalski
© ADAGP, Paris, 2015 /
Piotr Kowalski

CHAPTER 1: MEASURING THE WORLD

UNFURLED FORMS

Since Antiquity, geometry, whose Greek etymology refers to the measurement of the Earth, has been one of the principle subjects of education. "Let no one ignorant of geometry enter here", ran the words, so legend has it, on the pediment of Plato's Academy. As one of the seven liberal arts in the Middle Ages, geometry was at the root of the understanding of the world and philosophy. In the modern period, it still plays an important role in our understanding of basic laws. It is in the continuity of this history that certain early 20th century artistic avant-gardes played a part, such as constructivism, proclaiming a geometric construction of space, and, more recently, Concrete Art and Minimalism.

For a long time, Plato's five solids were associated with the four elements as well as with the ether, the fifth element – the "quintessence" – providing the world's cohesion. In the 16th century, Kepler made these solids the models giving structure to the solar system. It is also these solids which Attila Csörgő, like a demiurge puppeteer, animates in his series of kinetic sculptures titled *Platonic Love*, where the symbolic charge incarnated by Plato's solids contrasts with the "tinkered" aspect of the construction. In a work like the *Catalogue raisonné des rhombicuboctaèdres*, Raphaël Zarka, for his part, is interested in the "migration of forms": how certain geometric forms are to be found in the most varied of historical and geographical contexts.

Descriptive geometry, which was theorised in the 18th century by the French mathematician Gaspard Monge, and finds direct applications in the field of industrial design, quickly became one of the foundations for the training of engineers. It is within the framework of this teaching that Théodore Olivier, professor at the Conservatoire des Arts et Métiers, came up with articulated geometric models designed for the study of surfaces and their curves, the point of departure for many practical applications, especially in civil engineering. Conceived as "drawings" in space, the installations which Kazuko Miyamoto has been producing since the 1970s based on tightened wool explore the whole perceptive potential of this type of interaction between different planes.

Collection of polyhedra to facilitate the study of geometry and drawing:
Stereometric geometry, 1849
Louis Dupin de la Guérinière (1810-?)
Molteni et Siegler
Paris, Musée des Arts et Métiers - Cnam

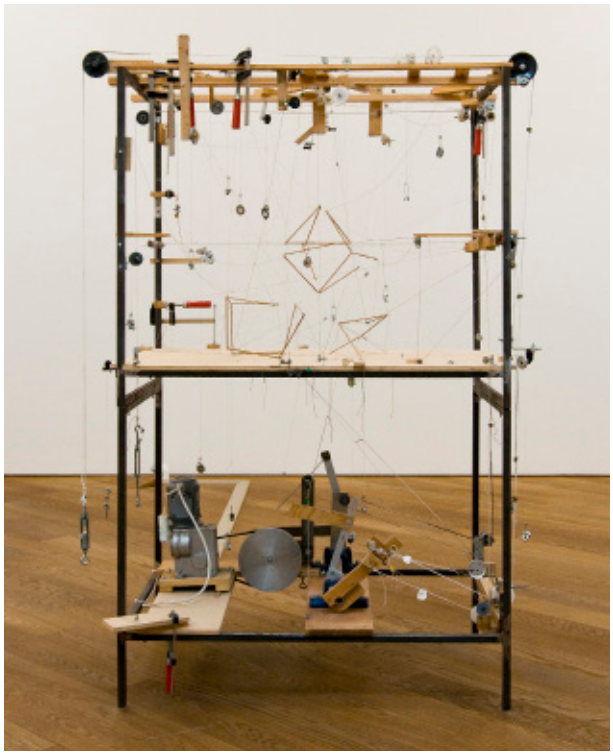
Collection of geometric solids on a tray, circa 1900
Paris, Musée des Arts et Métiers - Cnam

Hyperbolic paraboloid, double rectilinear generation, 1830
Théodore Olivier (1793-1853)
Pixii père et fils
Paris, Musée des Arts et Métiers - Cnam

Hyperbolic paraboloid, double rectilinear generation, 1830
Théodore Olivier
(1793-1853)
Pixii père et fils
Wood, brass, silk
90 x 54 x 57 cm
Musée des Arts et Métiers - Cnam
© Photo: Aurélien Mole

ARTISTS

Attila Csörgő
Gego
Kazuko Miyamoto
Raphaël Zarka



Attila Csörgő
Untitled (1 tetrahedron + 1 cube + 1 octahedron = 1 dodecahedron), 2000
Wood, string, spinning wheel, ferreous construction, electric motor
180 x 110 x 80 cm
Collection Mudam Luxembourg
Donation 2008 - KBL European Private Bankers

CHAPTER 1: MEASURING THE WORLD

SEIZING TIME

Time is an immaterial phenomenon which can be neither seen nor heard, and over which we have no hold. Its irreversible flow is its most tangible sign. The gesture made by Katinka Bock who, every day, moves a single enamelled block in the exhibition venue, and the film made by David Lamelas both correspond, in this respect, to the ancestral need to make its passage tangible. At the outset, it was elementary astronomical phenomena – the movement of the Earth and the Moon – which paced our days. The alternation of day and night thus defined units of measurement whose length nevertheless varied from season to season. This concept of so-called "unequal" hours was furthermore adapted to different forms of social organisation. Because in all periods, time, which is albeit elusive, is still a structuring element, and the fantasy of Jochen Gerner's drawings emphasises the degree to which the conception we have of time retains a dimension which is cultural and subjective alike.

Since Antiquity, astronomers would define regular units of time using their observation of the positions of stars. But it was not until the invention of the pendulum that the use of a homogeneous division of time became a general feature in European societies. Galileo and Christian Huygens in fact undertook research into the way clocks function by means of a pendulum. At the end of the 16th century, the former developed the principle of the oscillating pendulum, while, in 1657, the latter defined the cycloidal nature of its curve and thus guaranteed the isochronic nature of the system. From then on clocks and watches became increasingly precise: the second, which appeared at the end of the 17th century, is divided today into tenths of thousandths, an accuracy which is every bit as dizzy-making as the calculation of the sun's implosion made by Gianni Motti.

Inclined plane clock, circa 1780
Paris, Musée des Arts et Métiers – Cnam

Horizontal sundial with midday cannon, circa 1780
Unsigned
Paris, Musée des Arts et Métiers - Cnam

Huygens machine for the experimental demonstration
of the law of motion of the cycloidal pendulum,
late 18th century
Cabinet of Jacques Alexandre César Charles (1746-1823)
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

Darren Almond
Renaud Auguste-Dormeuil
Julien Berthier
Katinka Bock
Jochen Gerner
On Kawara
Alicja Kwade
David Lamelas
Katie Lewis
Gianni Motti
Francisco Tropa

Huygens machine for the experimental demonstration of the law of motion of the cycloidal pendulum, late 18th century
Cabinet of Jacques César Alexandre César Charles (1746-1823)
Steel, ivory, brass, wood, fibre
201 x 162 x 35,5 cm

Photo: Aurélien Mole

Julien Berthier, *L' horloge d'une vie de travail*, 2008
Steel, screen-printing, plexiglass, engine
36 x 213 x 19,8 cm.
Collection Frac Franche-Comté
© Julien Berthier / Photo: Pierre Guénat

Francisco Tropa, *Lantern*, 2011
Beechwood easel, platform, different parallelepipeds in white limestone that form the pedestal of the image-projection mechanism, brass cube with transformer, ventilator, condenser, halogen light bulb, brass support and glass cup, limestone cylinder, cylindrical glass tank with drip faucet, lens
Varying dimensions
Collection Mudam Luxembourg
Acquisition 2012
© Photo: Rémi Villaggi / Mudam Luxembourg

CHAPTER 1: MEASURING THE WORLD

SURVEYING SPACE

The introduction of the metre as a universal unit of length during the French Revolution was the introduction of the metre as a universal unit of length during the French Revolution was intended to unify a situation in which many different measurements coexisted in a chaotic way; at that time, there were more than 700 in France. Usually based on a part of the human body – thumb (inch), foot, cubit (elbow), etc. – they vary depending on region and guild. In 1791, the Académie des Sciences officially defined the metre as one ten-millionth of the quarter of the Earth's meridian. The precise length of this latter remained to be measured, a task undertaken in the following years by two teams headed by Jean-Baptiste Joseph Delambre and Pierre Méchain along the Paris meridian between Dunkirk and Barcelona, using the principle of triangulation and a new precision instrument, the repeating circle.

This saga, which continued until 1799, culminated in the registration, in the Archives de la République, of a standard metre in the form of a platinum rule. In the latter half of the 19th century, however, with gradual scientific advances and the subscription by a growing number of countries to the metric system, questions were raised about the limits of this reference, the accessibility of the standards, and the variations which they might undergo, in relation to temperature, for example. There followed the definition of different referents, permitting a greater accuracy each and every time. Since 1983, the value of the metre has been defined in relation to the speed of light (distance travelled by light in a vacuum in 1/299, 792, 458th of a second).

Artists enjoy putting the objective precision of the metric system into perspective. Conrad Shawcross thus transfers the definition of the metre as it was established in the Revolution to the scale of the other planets in our solar system. In another work, he presents the challenges associated with the conservation of the standard metre. In a conceptual approach geared to the relation of the body to space and the classification of its movements, Stanley Brouwn calls the "official measurement" into question by comparing it with subjective standards, linked, for example, to the size of his foot, or the size of his footstep. Lastly, through his *Atlas des Mouvements* – a project which encompasses all his works –, Christoph Fink develops a space-time, or "chronogeographical", mapping of all his movements, based on meticulous methods of notation. "Literally being part of time and space has a great poetic potential for me[3]", he explains.

[3] Eva Wittocx in a conversation with Christoph Fink, January 2012, brochure of exhibition *Atlas des mouvements* de Christoph Fink, M – Museum Leuven, 2012.

Theodolite and repeating circle, first half of the 19th century
Henry Prudence Gambey (1787-1847)
Paris, Musée des Arts et Métiers - Cnam

Rules with an X or H-shaped cross-section with graduated scales, 1872
Henri Édouard Tresca (1814-1885)
Paris, Musée des Arts et Métiers - Cnam

Rod with an X-shaped cross-section, 1872
Henri Édouard Tresca (1814-1885)
Paris, Musée des Arts et Métiers - Cnam

Fac-similé of the standard mètre à traits of 1889
Conférence Générale des Poids et Mesures
Paris, Musée des Arts et Métiers – Cnam

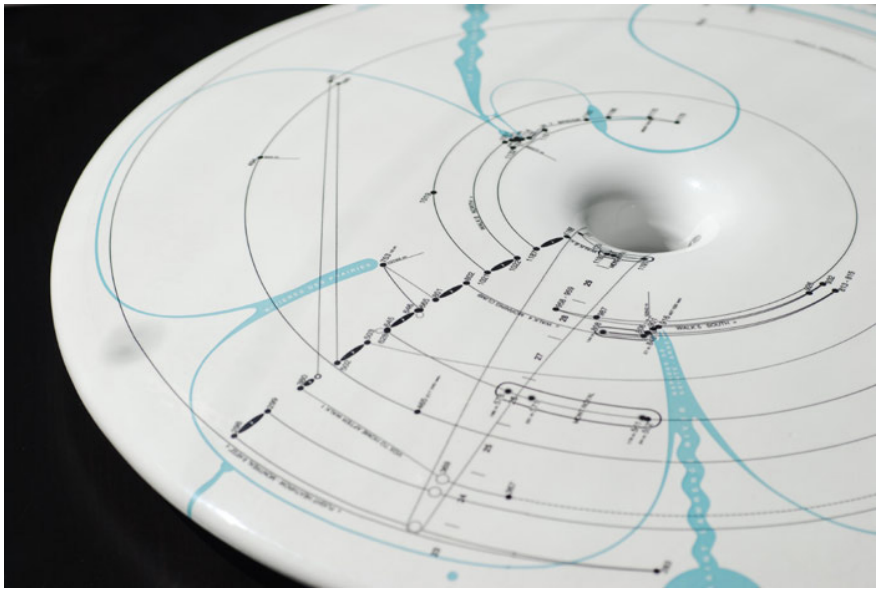
Fac-similé of the standard mètre à bouts of 1889
Conférence Générale des Poids et Mesures
Paris, Musée des Arts et Métiers – Cnam

Decameter or surveyor's chain, ten surveyor's arrows, 1851
Parent
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

Mel Bochner
Stanley Brouwn
Christoph Fink
Marco Godinho
Jorge Macchi
Kris Martin
Evariste Richer
Lasse Schmidt Hansen
Conrad Shawcross
John Wood & Paul Harrison

Rules with an X or
H-shaped cross-section
with graduated scales, 1872
Henri Édouard Tresca
(1814-1885)
Wood
2 x 7,7 x 2 cm,
1,6 x 1,6 x 7,6 cm,
2 x 1,9 x 7,6 cm
Paris, Musée des Arts et
Métiers - Cnam
© Photo: Aurélien Mole



Christoph Fink
Mouvement #85
The Montreal Walks, 2008
(12 254,94 km, 195 h 30'51"),
Ceramics
5,6 x Ø 47 cm
Courtesy of Christoph Fink
© Photo: Christoph Fink

Stanley Brouwn
1 m - 1 step, 1985
Aluminium bars
100 x 1,5 x 0,2 cm
73,6 x 1,5 x 0,2 cm
Collection 49 Nord 6 Est /
Frac Lorraine, Metz
Courtesy of the artist
© Stanley Brouwn
Photo: Rémi Villaggi

CHAPTER 2

MATTER REVEALED

WORLD SCALES

OPTICAL GAMES

ACOUSTIC FIGURES

SIGNS OF THE INVISIBLE

CHAPTER 2: MATTER REVEALED

WORLD SCALES

In 1610, when Galileo observed the movement of Jupiter's moons with the help of an astronomical telescope, he provided an initial proof of the heliocentric theory expounded by Copernicus in the 16th century, the starting point of what would, with hindsight, be described as the "Copernican revolution", to such an extent did it mark a break in the scientific and philosophical conception of the world. Thus forced to review his position in the Universe, man found himself–to borrow an idea developed by Blaise Pascal in a still famous section of his *Pensées* – caught between the infinitely small and the infinitely large, between "the extreme smallness of nature" and "the infinity in which he is engulfed". A ratio of scale which the visitor can experience through Chris Burden's work *Scale Model of the Solar System*, which reproduces the solar system on the scale of a city. Reduced to 1/4,200,000,000th, the sun has a diameter of 33 cm, the Earth, situated at 35 m, has a diameter of 0,3 cm, and Neptune, lying more than one kilometre away, has a diameter of 1,17 cm!

Orreries, articulated devices depicting the "celestial mechanics" which drive the solar system, appeared at the end of the 17th century, and would play an important part in the popularisation of the Copernican conception. Their evocative power, which still exists to this day, is central to Björn Dahlem's work *The Expanding Universe (Big Bang)* and Daniel Gustav Cramer's film *Orrery*.

Combined with the advances of optics, the invention of photography would mark a turning point in the observation of stars. The latter half of the 19th century was thus a period of experiments, as is illustrated by the daguerreotypes of Venus's passage in front of the Sun, produced by the astronomer Jules Janssen in 1874, with the help of a "photographic revolver". It is these close links, which bring photography and astronomy together, that Lisa Oppenheim sheds light on in her series *Lunagrams*, a direct reference to the first daguerreotypes of the Moon, as does Thomas Ruff, who, conversely, is interested in the latest scientific imagery in his *Cassini* series.

The same process is at work as far as the infinitely small is concerned: at the end of the 19th century, the quality of lenses coupled with the development of photographic techniques permitted a systematic observation of a world whose immensity was being discovered little by little. Emblematic of the close collaboration that can exist between artists and scientists, the projects developed by Michel Paysant and Edith Dekyndt around nano-technologies extend the challenges of this observation in the field of the visual arts. In these works, the infinitely small becomes the terrain of a critical line of thinking about the way we see things, and about the very notion of visibility.

Uranographic mechanism, 1816
Charles Rouy
Paris, Musée des Arts et Métiers - Cnam

Passage of Venus over the Sun: Peking and St. Paul missions, 1874
Georges-Ernest Fleuriais (1840-1895)
Ernest Amédée Barthélémy Mouchez (1821-1892)
Paris, Musée des Arts et Métiers - Cnam

The Trouvelot astronomical drawings, 1881
Étienne Léopold Trouvelot (1827-1895)
Charles Scribner et fils
Paris, Musée des Arts et Métiers - Cnam

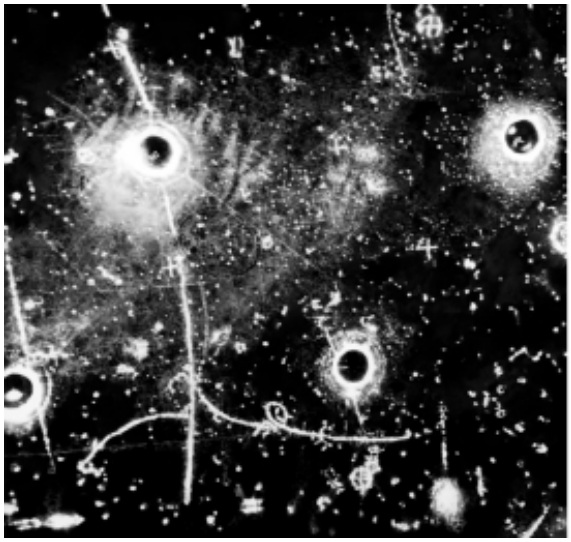
Telescope, circa 1730
John Dollond (1706-1761),
Cabinet of Jacques Alexandre César Charles (1746-1823)
Paris, Musée des Arts et Métiers - Cnam

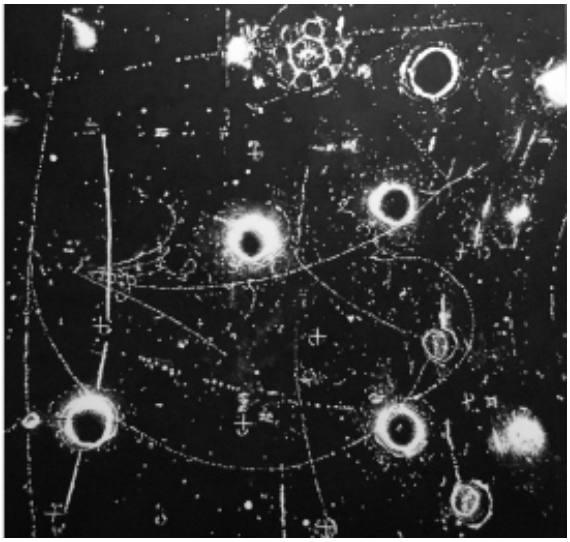
Microphotographic room, circa 1900
Fernand Monpillard (1865-1937)
Jean Alfred Nachet (1831-1908)
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

Chris Burden
Daniel Gustav Cramer
Björn Dahlem
Edith Dekyndt
Laurent Montaron
Lisa Oppenheim
Trevor Paglen
Miguel Palma
Michel Paysant
Thomas Ruff
Stéphane Sautour

Aurora Boréalis
as observed March 1, 1872
Étienne Léopold Trouvelot
(1827-1895)
Astronomical drawing
Pastel printed in chromolithography
70 x 95 cm
© Musée des Arts et Métiers – Cnam
Photo: Aurélien Mole





Stéphane Sautour
Alkeishuikkanen, 2012-2013
Diptych. Ink on paper
180 x 190 cm (each)
Production F93 as part of Propagation de la monotonie
Courtesy of Loevenbruck Gallery, Paris.

Trevor Paglen
Prototype for a Nonfunctional Satellite (Design 4; Build 3), 2013
Mylar, steel, (sphere : ø 365,7 cm)
Varying sizes.
Courtesy of the artist; Altman Siegel Gallery, San Francisco; Metro Pictures, New York; Galerie Thomas Zander, Cologne; Protocinema, Istanbul.

CHAPTER 2: MATTER REVEALED

OPTICAL GAMES

The experiments conducted by Isaac Newton between 1666 and 1672, using prisms, on the decomposition of light into a spectrum of colours, marked a turning point in the history of optics and physics: they demonstrated that colour is an intrinsic property of light, and not of the objects that we see. At that time, nevertheless, light was for the most part considered to be a substance composed of what Newton called "corpuscles". It was only during the 19th century, with the works of Thomas Young, Augustin Fresnel and James Clerk Maxwell, that the undulatory theory of light took precedence. One of the central themes of the Conservatoire des Arts et Métiers, the teaching of physics, was at that time based on pictorial representations to depict the phenomena created by these waves, which were difficult to reproduce in a lecture hall, and even difficult to photograph. It is in this framework that the astonishing series of pictures – abstract ahead of their time – was produced, illustrating phenomena of interference presented in the exhibition.

Because it concerns the very foundations of art – colour, perception, visibility –, research into the nature of light and, beyond that, into optics, would have a considerable influence on artistic production. As the point of departure for many colour theories, like the one put forward by the chemist Michel-Eugène Chevreul, it played, in particular, a key part in the advent of artistic moments such as Pointillism at the end of the 19th century, and abstraction at the beginning of the 20th. From the 1960s onwards, through movements like Op Art and Light and Space, colour and light became the area of investigation into the very notions of perception and space.

It is these investigations which Ann Veronica Janssens pursues through her installations involving colour, in which the spectator's perceptive and even physiological experience plays the leading role. Organised around stereoscopic geometric figures, a first group of works deals, for its part, with the visual and perceptive phenomena directly connected with the field of optics. Lastly, several works on view in this section refer to the actual history of these studies on the nature of light, such as Piotr Kowalski's spectacular installation *Lumière (arc-en-ciel)*, conceived as a tribute to Newton, and extending his experiments in the field of holography, and Véronique Joumard's piece, directly inspired by the lenses designed by Fresnel in 1822.

Superposed polyprism composed of seven different refrangible materials, Late 18th century
Cabinet of Jacques Alexandre César Charles (1746-1823)
Paris, Musée des Arts et Métiers - Cnam

Stereoscopic geometric figures, circa 1850
Louis Jules Duboscq (1817-1886)
Paris, Musée des Arts et Métiers - Cnam

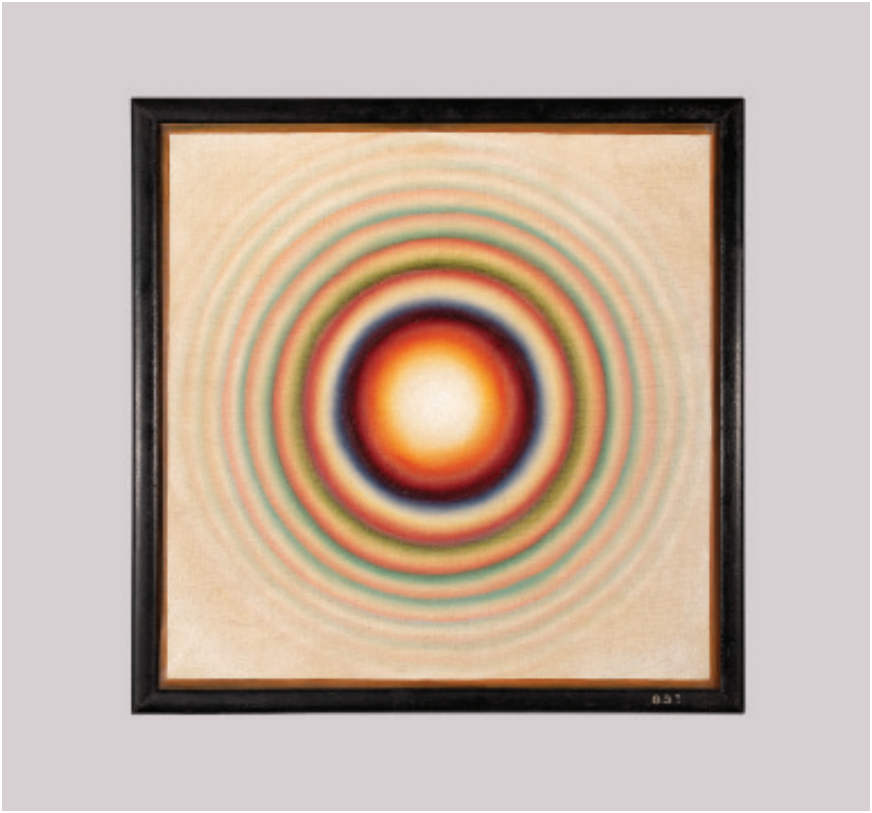
Plate of an actuated magic lantern featuring a Newton disc, circa 1850
Louis Jules Duboscq (1817-1886)
Paris, Musée des Arts et Métiers - Cnam

Apparatus with seven small flat mirrors for the recomposition of light, late 18th century
Cabinet of Jacques Alexandre César Charles (1746-1823)
Paris, Musée des Arts et Métiers - Cnam

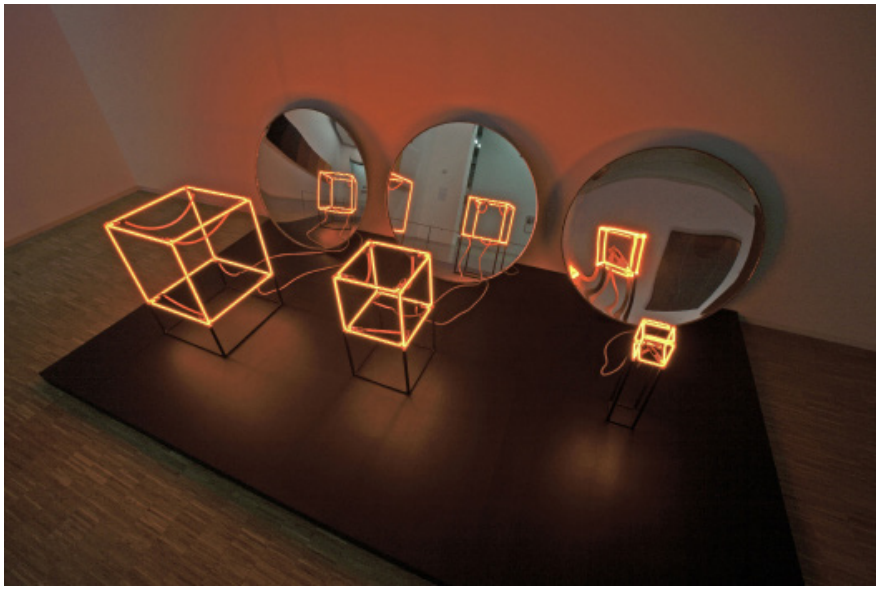
Phenomenon of interferences, 1882
Pierre Ernest Peuchot (1852 - circa 1897)
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

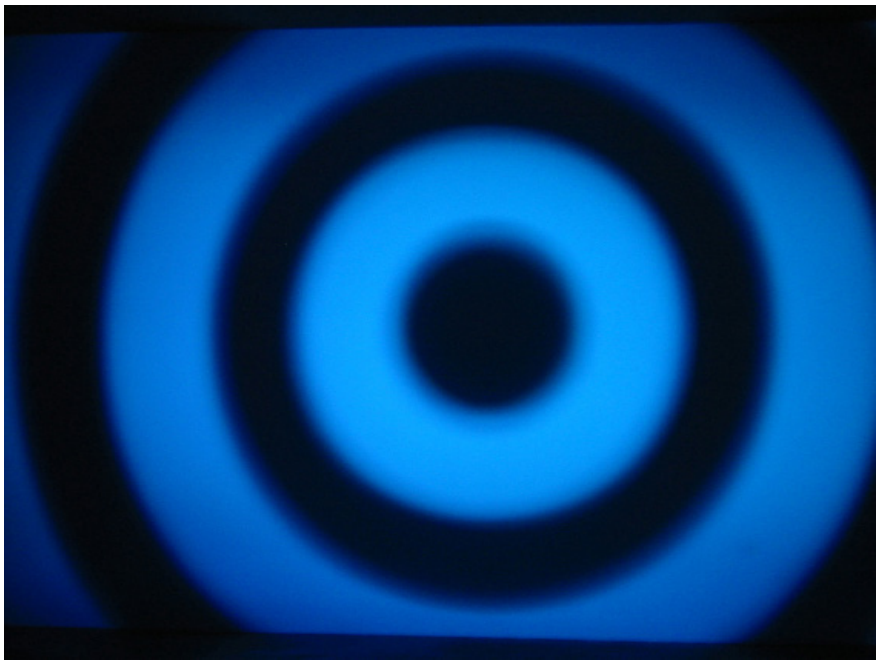
Edith Dekyndt
Ann Veronica Janssens
Véronique Joumard
Piotr Kowalski
Georges Rousse



Phenomenon of interferences, 1882
Pierre Ernest Peuchot (1852 - circa 1897)
Series of eight paintings
Oil on canvas, wood frame
62 x 62 cm
© Musée des Arts et Métiers – Cnam
Photo: Aurélien Mole



Piotr Kowalski
Identité n°2, 1973
Neon, steel, and mirrors
85 x 300 x 200 cm
Centre Pompidou, Paris
Musée national d'art moderne /
Centre de création industrielle
Achat de l'État, 1972
© ADAGP, Paris 2015 /
Piotr Kowalski
Photo: Centre Pompidou, MNAM-
CCI, Dist. RMN-Grand Palais /
Philippe Migeat



Ann Veronica Janssens
Donut, 2003
Programmed light projection, IT
program, projector, recorder and
console,
Varying dimensions
Centre National des arts plastiques
Courtesy of Micheline Szwajcer
Gallery, Brussels
© ADAGP, Paris, 2015 /
Ann Veronica Janssens / CNAP /
Photo: Courtesy Galerie Micheline
Szwajcer, Bruxelles

CHAPTER 2: MATTER REVEALED

ACOUSTIC FIGURES

Sound has been recognised since Antiquity as a vibration which moves in the air, but it was only in the 17th century that it became nothing less than an area of study, separate from musical theory. Drawing inspiration from the works of Greek thinkers on the vibration of strings, Galileo established the notion of frequency, while Marin Mersenne, in his *Harmonie universelle*, was interested in the "nature of sounds" and their propagation. It was in 1700 that the term acoustic appeared and, throughout the 18th century, there was a succession of studies about the speed of sound and vibratory phenomena.

In the continuity of the "acoustic figures" which Ernst Chladni elucidated in 1802, obtained by causing vibrations in metal plates covered with a thin layer of sand, the 19th century saw the appearance of devices which made certain sound phenomena visible, in order to make it easier to study them. In the latter half of the century, by means of a ray of light reflected successively on two tuning forks fitted with small mirrors, Jules-Antoine Lissajous thus discovered surprising "curves" visualising sound frequencies and their relations. Mechanically depicted by the lines of the Harmonograph, these curves are still visible today on the screens of oscilloscopes.

This basic research in the field of acoustics went hand in hand with many applications associated with the recording of sound and its transmission. In just a few years, between 1870 and 1880, two major inventions were developed: the phonograph and the telephone. Shortly thereafter, the inventor of this latter, Alexander Graham Bell, designed a device making it possible to transmit a sound by means of a ray of light: this was the Photophone, which seems to foreshadow wireless telephony as we know it today.

Since its appearance, this research into sound has found particularly lively echoes in the artistic arena. With the disappearance of the boundaries between disciplines which hallmarked the 1960s, that decade saw the emergence, in the field of visual arts, of practices which understood sound in its plastic and spatial dimension. In this spirit, from the 1980s onward, the German artist Rolf Julius devised installations in which sound was broached as a material, creating what he called "music for the eyes". The work of Carsten Nicolai is also part and parcel of the continuity of this approach. Like *wellenwanne lfo*, several of his works strive, via the waves that they produce, to display sounds situated beyond thresholds of perception. They thus offer a disturbing echo of the scientific works of the 19th century.

Telephonic apparatus called "Articulating Photophone" or "Talking Photophone", 1880
Alexander Graham Bell (1847-1922),
Charles Summer Tainter (1854 -1940)
Paris, Musée des Arts et Métiers - Cnam

Collection of forty tuning forks, circa 1860
Augustin Michel Henry-Lepaute (1800-1885)
Paris, Musée des Arts et Métiers - Cnam

So-called harmonograph apparatus, describing the curves composing two vibratory motions and a device for projecting figures, 1878
Tisley and Company Manufacturing
Paris, Musée des Arts et Métiers - Cnam

Box containing aniline inks for making layouts, 1878
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

Rolf Julius
Carsten Nicolai

Telephonic apparatus called "Articulating Photophone" or "Talking Photophone", 1880
Alexander Graham Bell (1847-1922)
Charles Summer Tainter (1854 -1940)
Wood, brass, glass, ferrous alloy
43 x 38,5 x 138 cm

Trumpet speaker, 1880
Rubber, fiber, copper, brass, ferrous alloy
11,5 x 14,7 x 67,5 cm

Receiver, 1880
Copper, brass, wood, tin, ferrous alloy
61,8 x 70 x 40 c

Tripod and shelf, 1880
Ferrous alloy, cast iron
72 x 56 x 56 cm
Wood, brass
14 x 21 x 71 cm

Carsten Nicolai
wellenwanne Ifo, 2012
Metal, glass, acrylic glass, mirror, audio equipment, water, light, sound, room installation
Varying sizes

Rolf Julius
Singing, 2000/2015
7 loudspeakers, cables, pigments, CD-player and amp
Varying dimensions
Courtesy of Thomas Bernard Gallery - Cortex Athletico, Paris

CHAPTER 2: MATTER REVEALED

SIGNS OF THE INVISIBLE

As phenomena whose natural signs can be observed in lightning, in the Aurora Borealis and in the electrostatic and magnetic properties of certain stones, electricity and magnetism have for a long time inspired questions, fascination and fear, until, in the 17th century, the sciences gradually started to master them. So salons and learned societies marvelled at them in spectacles described as "amusing physics". At that time, it was above all electrostatic machines like Ramsden's machine, which, often coupled with Leyden jars–ancestor of the capacitor–, provided the high voltage necessary for such experiments.

In 1864, preceded by illustrious researchers like Hans Christian Ørsted, Michael Faraday and André-Marie Ampère, James Clerk Maxwell managed to precisely describe the electrodynamic laws which govern electrical and magnetic fields, as well as the phenomena associated with electromagnetic waves. At the same time, advances in the mastery of electrical current and the gradual discovery of the range of the electromagnetic spectrum (which visible light is part of) gave rise to Geissler's electrode tubes (1857). These tubes, based on the ionisation of a rarefied gas, revealed the phenomenon of electro-luminescence and harbingered the cathode tubes which would lead not only to the discovery of X-rays but also to the invention of the fluorescent tube, and, at a later date, the television set. In 1887, Heinrich Hertz experimentally demonstrated the existence of electromagnetic waves, thus confirming the correctness of Maxwell's theories. This major discovery would be the point of departure for emissions of hertzian waves, or radio waves, an essential technology in our contemporary world.

Because these phenomena touch on the invisible, they have a special place in the field of art. In the 1950s, Takis introduced into the field of sculpture both energy and magnetic forces, forces whose artistic potential he would explore throughout his career. In 1965, the video art pioneer Nam June Paik became interested, in a work such as *Magnet TV*, in the disturbance of electron flows composing the video signal. In his *Mesures à prendre* and in other works devised to be handled which he grouped together under the notion of "energy (experienced) as matter", Piotr Kowalski, for his part, proposed that the spectator should undergo the direct experience of the phenomenon of the ionisation of gases, thus making electromagnetic fields tangible.

In the continuity of these historical pieces, the other works in this section explore the powers of fascination and enchantment contained in electricity, magnetism, and electric and electromagnetic fields. Like Evariste Richer and Dove Allouche's *La Terrella*, which borrows a device designed in 1895 by the Norwegian physicist Kristian Birkeland toreproduce the phenomenon of the Aurora Borealis in the laboratory, and Laurent Montaron's *The Invisible Message*, which re-enact the first experiment involving the transmission of a wireless message, they also pay homage to the discoverers of these invisible forces which are pivotal to the world surrounding us.

Electrostatic machine, 19th century
After Jesse Ramsden (1730-1800)
Paris, Musée des Arts et Métiers - Cnam

Coin ingots melted by lightning
Paris, Musée des Arts et Métiers - Cnam

Mirror tile perforated by a spark from a Holtz electrical machine, 1881
Wilhelm Holtz (1836-1893)
Eugène Ducretet (1844-1915)
Paris, Musée des Arts et Métiers - Cnam

Artificial magnet, circa 1750
Jean Antoine Nollet (1700-1770)
Paris, Musée des Arts et Métiers - Cnam

Geissler tube, 1860
Daniel Heinrich Ruhmkorff (1803-1877)
Paris, Musée des Arts et Métiers - Cnam

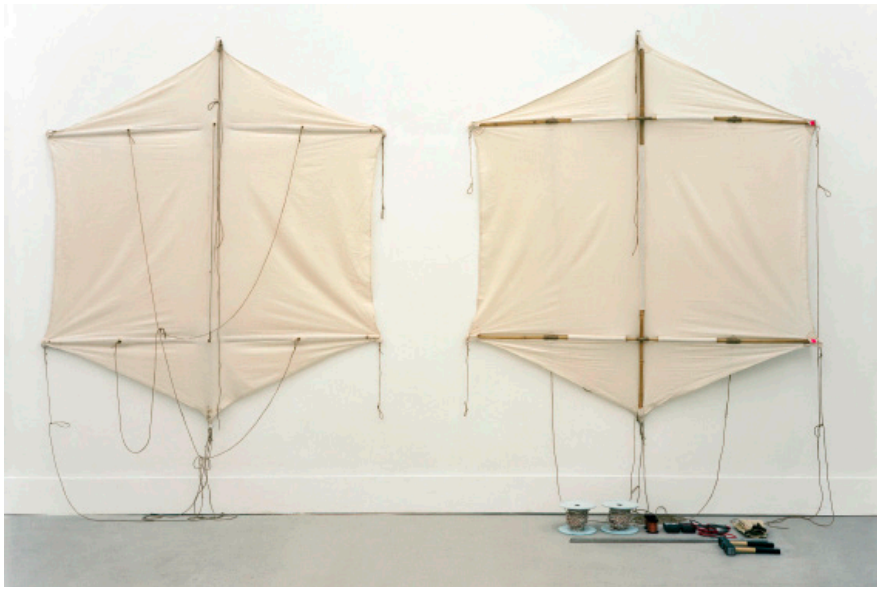
Experimental device emitting Hertzian waves for the wireless telegraph, 1905
Eugène Ducretet (1844-1915)

ARTISTS

Dove Allouche &
Evariste Richer
Nina Canell
Alain Clairet
Attila Csörgő
Ólafur Elíasson
Anne Marie Jugnet +
Piotr Kowalski
Laurent Montaron
Navid Nuur
Nam June Paik
Amalia Pica
Takis

Coin ingots melted by lightning
Cuprous alloy, wood, glass, paper
Ingots: 4,5 x 17 x 12 cm
Base and bell: 18 x 22,5 cm
© Musée des Arts et Métiers-Cnam / Photo: Aurélien Mole

Ólafur Elíasson
Trust compass, 2013
Driftwood, stainless steel, magnets
65 x 165 x 92 cm
Collection Mudam Luxembourg
Acquisition 2013
© Photo: Jens Ziehe
Courtesy of the artist et i8 Gallery, Reykjavik



Laurent Montaron
The Invisible Message, 2011
Two kites, ground rods, copper wires, electrical multimeters, ropes, gloves, hammers
© Photo: Courtesy of Laurent Montaron, Galerie Schleicher/Lange, Berlin et Monitor Gallery, Rome

CHAPTER 3

INVENTIONS APPLIED

PRODUCTION IN QUESTION

MACHINES ON THE MARCH

THE ELECTRICAL SPARK

LOCOMOTION, REAL AND DREAMED OF

DIZZY NUMBERS

THE FASCINATION OF LIVING THINGS

CHAPTER 3: INVENTIONS APPLIED

PRODUCTION IN QUESTION

With the Industrial Revolution, and the advances made in metallurgy, the qualities of tools were improved. World Fairs gave manufacturers a chance to demonstrate their expertise and display their products. It was in this context, for example, that the displays of tools made by a Viennese manufacturer, Franz Wertheim, were put together. They found their way into the collection of the Conservatoire des Arts et Métiers after the Paris World Fair of 1855.

Like the boom in mechanical looms, one of the spearheads of the Industrial Revolution, the 19th century was also marked by the development of automation processes. The growing use of machines gave rise to far-reaching changes by developing productivity. In an emblematic way, the model of a machine designed to fold and crimp artificial flowers introduced the initial factors that streamlined a trade hallmarked by manual dexterity. The use of a mechanical procedure making it possible to produce subtle and complex forms, and calling for a certain skill, calls to mind the work of an artist like Michael Beutler, whose sculptures are produced using "machine-tools" which he himself designs and makes. Dyeing, folding, shaping, etc.: the gestures that he puts at the heart of his praxis give rise to forms which he uses to occupy the exhibition space.

The development of relations to the tool is in itself paradoxical: starting from the ergonomic requirements of its use by man – the hand's ability to grip –, its form gradually grows apart as its complexity increases, and ends up demanding a human adaptation to its use. If Damián Ortega's *Tool Bones* play with the metaphorical idea of organic tools, stemming from the living world, Julien Prévieux more prosaically questions this reversal of the relation between man and tool. Devised as an "archive of gestures to come", his video installation *What shall we do next?* presents us with hypothetical movements of the hand on a touch screen, patented by major information technology groups even before an application had been found.

In staging Chinese craftsmen carving a Roman column from a block of marble during its transport between Asia and Europe, Adrian Paci's film *The Column* proposes, for its part, a poetic line of thinking about the issue of production in a globalised world which may not have got rid of all the crafts, but is still governed by the frenzied quest for profit and the streamlining of labour, and thus its costs.

Machine for holding and crimping ribbons of artificial flowers, 1832
Victor Athanase Pierret (1806-1893)
Paris, Musée des Arts et Métiers - Cnam

Turner's tool collection, before 1855
Franz Wertheim (1814-1883)
Paris, Musée des Arts et Métiers - Cnam

Turner's Tool Collection, before 1855
Franz Wertheim (1814 - 1883)
Steel, ferrous alloy, wood, brass, fiber of vegetable origin, paper, fixed on a wooden panel,
238 x 119,5 x 12 cm

ARTISTS

Michael Beutler
Wade Guyton
Damián Ortega
Adrian Paci
Julien Prévieux

Damián Ortega
Tool Bones 7, 2013
Bronze
54,9 x 107,3 x 101 cm
Courtesy of the artist and
Gladstone Gallery, New York
and Brussels
© Photo: Damián Ortega

Michael Beutler
La Cacahuète (workbenches), 2011
Printing press, bending machine,
crepe press, bent paper, crepe paper,
paint, shelves
Varying sizes
Courtesy of the artist and Nagel
Draxler Gallery, Berlin/Cologne
© Photo: Gregor Sailer

CHAPTER 3: INVENTIONS APPLIED

MACHINES ON THE MARCH

If the principle of gears has been around since Antiquity, it was not until the 19th century that their use became systematic in the construction of machines. Théodore Olivier, professor at the Conservatoire des Arts et Métiers, developed the science of gears and designed sumptuous models, on the borderline between the laboratory object and the educational object, illustrating the diverse range of combinations. From then on, industry in its entirety, from making clocks to making railways, would benefit directly from that research which helped machines to acquire greater reliability, efficiency and accuracy.

As gears became ever more highly developed, the fluidity and speed of movement and motion were such that these mechanisms seemed henceforth endowed with their own existence. Machines were on the march, so to speak, with their retinue of fantasies. Giving substance to this idea, in the 1950s the Swiss artist Jean Tinguely created his "metamechanics", a term coined by the art critic Pontus Hulten to convey the meta-physical, metaphorical and even "metamorphic" dimension of his kinetic works. In the direct tradition of the avant-garde cinema of the 1930s – Ralph Steiner's *Mechanical Principles*, for example –, Paul Kirps's video and Gusmão + Paiva's film both reflectartists' fascination with the perfection of animated mechanical bodies.

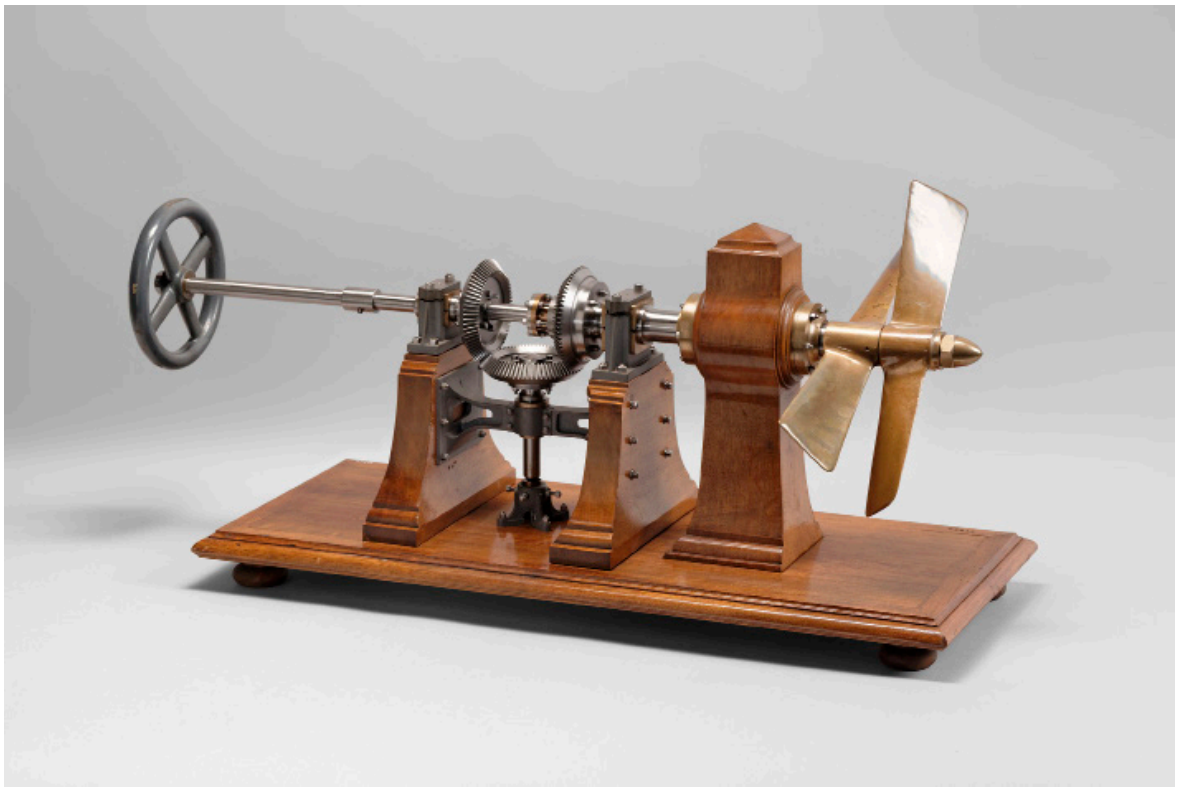
It is this overlapping history of cinema and machines that is also incarnated by Simon Starling's ambitious film installation *Wilhelm Noack oHG*, shot in the workshops of a metallurgical firm in Berlin, whose history is closely bound up with that of modernity, as well as Germany's history. Transformed into a 35 mm looper, the spiral staircase becomes a kinetic sculpture that projects a film plunging us into the heart of production lines and archival images of the factory whence it came; the film of its origins in a way.

Double screw with opposite pitches. Scale model, circa 1888
J.-B. Chevalier
Paris, Musée des Arts et Métiers - Cnam

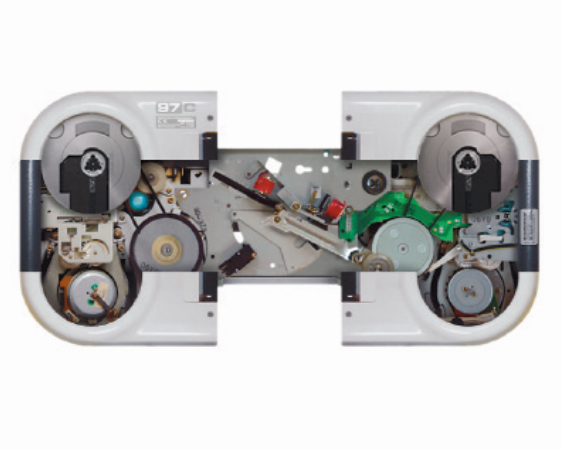
Cylindrical gears, straight rack and triangular teeth, 1853
Théodore Olivier (1793-1853)
E. Médard
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

João Maria Gusmão + Pedro Paiva
Paul Kirps
Thomas Ruff
Simon Starling
Jean Tinguely



Double screw with opposite pitches. Scale model, circa 1888
J.-B. Chevalier
Wood, ferrous alloy, brass
51 x 105 x 38 cm



Paul Kirps
autoreverse, 2005
Loop projection of 5 audiovisual sequences (screenshots)
RS 570, 2 min 42 sec
97 C, 2 min 13 sec
X1, 2 min 5 sec
FHW 64 D, 2 min 21 sec
AM A202, 1 min 23 sec
Ed. 1/2
Commissioned and Collection Mudam Luxembourg
Acquisition 2006
© Photo: Paul Kirps

Jean Tinguely
Fatamorgana, Méta-Harmonie IV, 1985
Iron frame, wooden wheels, plastic parts, percussion instruments, light bulbs, electric motors
420 x 1250 x 220 cm
Museum Tinguely Collection, Bâle
© ADAGP, Paris, 2015 / Jean Tinguely / Museum Tinguely, Bâle / Photo: Christian Baur

CHAPTER 3: INVENTIONS APPLIED

THE ELECTRICAL SPARK

The mastery of electricity depended not only on the capacity to produce it, but also to "store" it. After Werner Siemens, who, in 1866, established the dynamo electric principle, many inventors worked on improving electromagnetic machines. In 1871, the Belgian Zénobe Gramme constructed a dynamo electric machine using direct current which he presented to the Académie des Sciences in Paris. Driven by hydraulic power or a steam engine, this generator supplied current used for lighting, and permitted the regular use of small electrical motors.

In 1800, Alessandro Volta invented the electrical battery. Its principle, the flow of electrons between different metals in contact with an electrolyte, such as brine, was endlessly improved during the 19th century. In 1882, the Luxembourg engineer Henri Tudor developed the lead accumulator, which would distinctly step up storage capacity, thus making it possible to produce a direct electric current, meeting large-scale everyday energy requirements. So it was that, in 1886, Tudor installed a small accumulator factory at Rosport (L), which enabled Echternach (L) to become one of the first towns in the world to have electric public lighting. The Tudor company would then become a firm with a European dimension that would thrive, setting up plants in several countries. Among other products, it would produce vehicle batteries until very recently.

At the core of the work of the French artist Véronique Joumard lie, precisely, these invisible energies and forces, which are revealed solely through the effects that they produce. Heat, as well as magnetic and gravitational forces, not forgetting electric current and, needless to add, light as an essential condition of the visual arts, form the basis of the artistic material with which she creates works that have a sensory immediacy. Since the early days of her career, in the latter half of the 1980s, Véronique Joumard has thus been producing a series of installations which make the circulation of current both visible and perceptible, by means of stripped electric wires, electrical resistances, metal objects and light bulbs arranged in space. For the exhibition, she has reactivated her installation *4 ballons pour une pièce* that will dialogue with the objects of the Musée des Arts et Métiers.

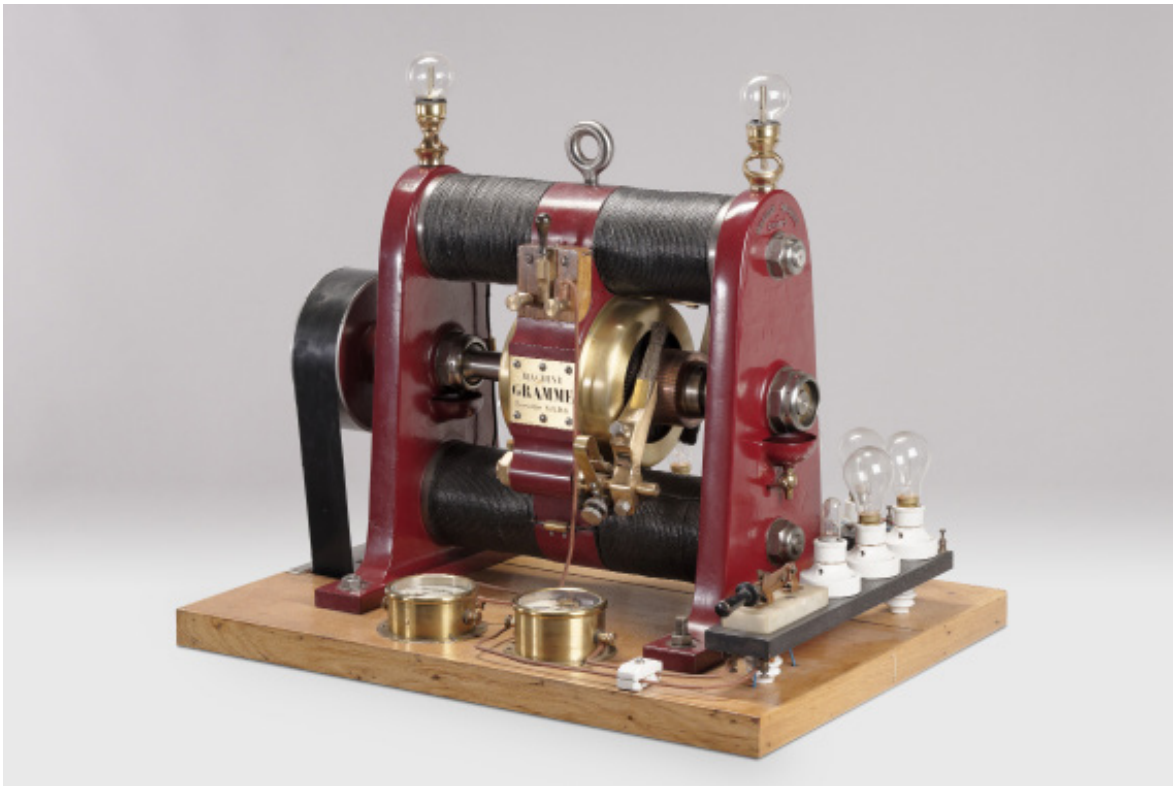
Electrochemical cells, assembled as a battery, circa 1890
Paris, Musée des Arts et Métiers - Cnam

Batterie Tudor modèle Cuirassé pour automobile, vers 1947
Société française de l'accumulateur Tudor
Paris, Musée des Arts et Métiers - Cnam

Gramme system dynamo electric machine, circa 1880
Zénobe Gramme (1826-1901)
Compagnie des machines Gramme et Fontaine
Paris, Musée des Arts et Métiers - Cnam

ARTIST

Véronique Joumard



Gramme system dynamo electric machine, circa 1880
Zénobe Gramme (1826-1901)
Compagnie des machines Gramme et Fontaine
Leather, ferrous alloy, cast iron, brass, copper, glass
143 x 80 x 60 cm

Véronique Joumard
4 ballons pour une pièce, 2006
4 lighting baloons, helium, black medium, electrical wiring
Varying dimensions

CHAPTER 3: INVENTIONS APPLIED

LOCOMOTION, REAL AND DREAMED OF

As a component part of the railway network that was developed in the 19th century, the rail itself is emblematic of the industrial revolution. At that time, the railway was the melting-pot of the major technological sectors: it encompassed the latest innovations in mechanical construction (locomotives), in metallurgy (improvement of alloys), in kinematics (adherence coefficient), and in thermodynamics (output of steam engines). The locomotives and the different types of rails (including the Vignole rail) developed in England spread throughout Europe and the whole world. Thus was ushered in a newindustrial age hallmarked by regularisation (track width), rules and regulations (circulation and traffic) and standardisation (timetables and schedules) on scales hitherto never encountered.

Because of the entrepreneurial and visionary spirit which dominated that period, industrial innovation, in all areas, would enjoy an unprecedented boom. Technological research followed a recurrent plan: encountering a shortcoming in a system (a weak mechanical point, for example) called for an answer; it was thus necessary either to improve what already existed, or to replace it by another solution, sometimes temporary. This was the case with the Acatène ("chainless") bicycle, which put forward a temporary solution for a problem posed by links in the transmission chains which were at that time too weak.

The technical adventure was thus staked out by forgotten inventions, which artists sometimes bring back to life, two such being Raphaël Zarka and Vincent Lamouroux, whose *Pentacycle* borrows the existing section of the prototype of Jean Bertin's French monorail, the Aérotrain, built in 1969; a technical innovation with no tomorrow, because it was not economically viable. Panamarenko, for his part, embodies this spirit of inventiveness, imagining every manner of means of locomotion – terrestrial, aerial, spatial and submarine – which are bold, utopian, often whacky, but sometimes ahead of their time.

Compared to the train, the automobile, in its early days, had more to do with luxury craftsmanship. In 1900, the De Dion-Bouton brand, which, in its technological innovations, foreshadowed the modern car, was the world's leading constructor, with 400 vehicles and 3 200 engines leaving the factory in that particular year. In Europe it was not until the 1950s that private methods of locomotion spread and became more democratic. In Italy, the Vespa – here masterfully presented by the artist Damián Ortega – was the icon of those massive productions designed for that "glorious" new postwar society.

Today, three vehicles are manufactured every second in the world. In tandem, however, there is a sector of a very exclusive production hailing directly from the research and development centres of the major manufacturers who, just like yesterday, are engaged in fierce competition. The artist Éric van Hove is interested in the distinctive feature of one of these technological showcases, represented by "supercars". The Laraki is made in its entirety in Morocco but, for want of technological skills, its engine, a Mercedes V12, is imported. To remedy this, it has thus been decided to have it reproduced identically, piece by piece, by Moroccan craftsmen, thus symbolically conjugating state-of-the-art industry and vernacular know-how.

12 CV automobile chassis in cross section, 1907
De Dion-Bouton
Paris, Musée des Arts et Métiers - Cnam

Acatène bicycle, circa 1896
La Métropole
Paris, Musée des Arts et Métiers - Cnam

Flat bottomed rail, known as the Vignoles rail, circa 1884
Compagnie des chemins de fer de l'Est
Paris, Musée des Arts et Métiers - Cnam

ARTISTS

Damián Ortega
Panamarenko
Éric van Hove
Raphaël Zarka &
Vincent Lamouroux

Flat bottomed rail, known as the Vignoles rail, circa 1884
Compagnie des chemins de fer de l'Est
Steel
12, x 10 x 40,5 cm

Damián Ortega
Miracolo Italiano, 2005
Steel cables and
3 Vespas PX150
Collection Teixeira de Freitas
Dépôt 2006 Fundação
Serralves – Museum de Arte
Contemporânea, Porto
© Serralves Foundation -
Museum of Contemporary Art,
Porto / Photo: Filipe Braga

Raphaël Zarka &
Vincent Lamouroux
Pentacycle, 2002
Video : colour, sound,
6'19"
Collection of
Frac Franche-Comté
© DR, Raphaël Zarka.

CHAPTER 3: INVENTIONS APPLIED

DIZZY NUMBERS

Numbers help to illustrate complex systems and extract a normalised expression from them. Because they call upon abstraction, their applications are many and varied: calculations, as used in everyday life, become algorithms in the applied sciences.

Resulting from the world of finance in the first half of the 20th century, the Loga-Calculator is evidence of a concern with simplicity and ergonomics in an object developed to simplify complex calculations. Reliable and thoroughly adapted to its use in accountancy, it numbers among the mechanical calculating machines which have been constantly improved since the Pascaline created by Blaise Pascal in 1642, and which were in use right up to the 1970s. For its part, the "universal calculating machine" designed by Louis Couffignal between 1946 and 1952 illustrates the shift from mechanical calculation to electronic binary calculation, and a switch of paradigm.
But if what should have been the first French electronic calculator never got beyond the prototype stage, we can see in this amazing object the ancestor of the "pocket calculators" that are now part and parcel of our everyday life, and gauge the extent of their calculating powers.

The power of computers may nowadays seem so obvious to us, but the faculty of mental calculation in certain people, such as the artist George Widener, is still surprising. His gift, linked to Asperger's syndrome, enables him to play with numbers and create "calendar-pictures" based on dates and historical events. With *Menace 2*, directly inspired by a machine devised in 1961 by one of the precursors of artificial intelligence, the artist Julien Prévieux, for his part, offers viewers the experience of "reinforcement apprenticeship", an automatic learning technique based on the principle of experience gradually acquired through trial and error. In tandem, Tatsuo Miyajima poetically illustrates the life cycle with his rhizomatic installation *Life (Corps sans Organes) No. 18*, conceived as a living organism made up of small interconnected digital LED displays. Ranging from one to nine, the figures in his system evoke the journey from life to death. Symbolising the end of this journey, zero is always absent from his works.

Calculating cylinder, known as "Loga-calculator" for financial calculations, 1925-1935
Société Daemon-Schmid / Loga, Zurich
Paris, Musée des Arts et Métiers - Cnam

Universal calculator – experimental model, 1946-1952
Louis Couffignal (1902-1966)
Paris, Musée des Arts et Métiers – Cnam

ARTISTS

Tatsuo Miyajima
Julien Prévieux
George Widener

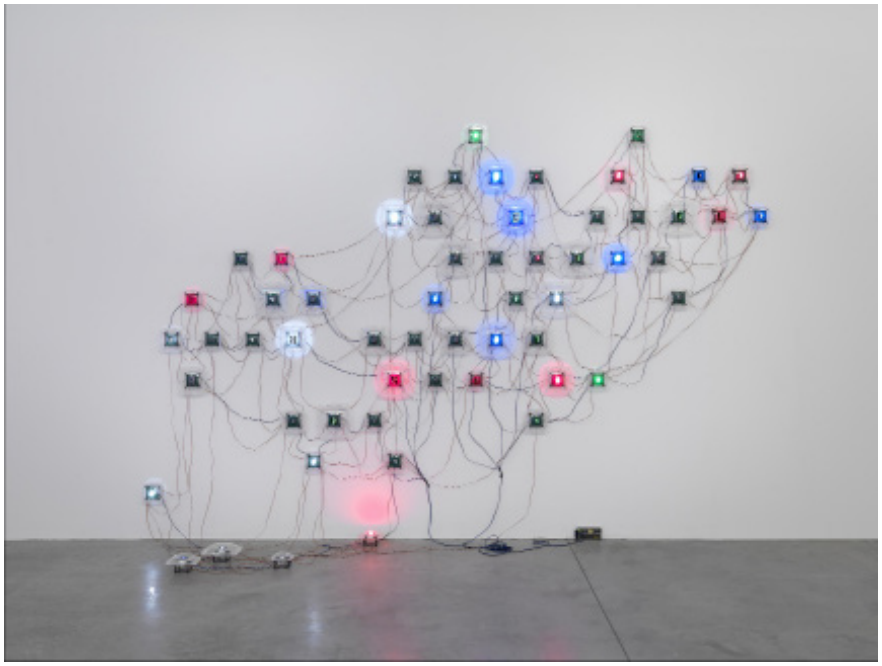
Universal calculator – experimental model, 1946-1952
Louis Couffignal (1902-1966)

External optical reader
Iron, plastic, glass, copper, aluminum,
Bakelite, rubber
49 x 69 x 32 cm, 20,5 kg

General supply
Iron, plastic, glass, copper, aluminum,
China, rubber
165 x 84 x 65 cm, 166,5 kg

Automatic sequencers
Iron, plastic, glass, copper, aluminum,
Bakelite, china, rubber
169,5 x 60 x 75 cm, 81,5 kg

Adding machine, memories and console
Iron, plastic, glass, copper, aluminum,
Bakelite, china, rubber
169,5 x 65 x 89 cm, 92,5 kg



Tatsuo Miyajima
Life (Corps sans Organes) No.18, 2013
LED, IC, microcomputer by Ikegami program, Steel, Plastic cover, passive sensor, electric wire,
LED type;
Life D-R(6),
Life D-BL(5),
Life D-W(7),
Life D-PG(7),
Life G-R(8),
Life G-BL(9),
Life G-W(8),
Life G-PG(8)
288 x 434,3 x 79,5 cm
© Tatsuo Miyajima and Lisson Gallery, London
Photo: Ken Adlard

Julien Prévieux
Menace 2, Machine Educable Noughs and Crosses Engine, 2010
Oak, plywood, metal, canvas and ball clay
200 x 180 x 70 cm
© Julien Prévieux
Courtesy of Jousse entreprise
Photo: Marc Domage

CHAPTER 3: INVENTIONS APPLIED

THE FASCINATION OF LIVING THINGS

In the early 18th century, people were developing automata whose working principle was that they should imitate living things. Between 1737 and 1739, the inventor and mechanic Jacques de Vaucanson produced three, which have remained famous, even though their current where abouts are unknown: the "digesting duck", the "tambourine player" and the "automaton flute-player". Over and above the mechanical sophistication that was their hallmark – the duck reproduced the digestive process while the player blew air into his instrument –, they demonstrated, through the curiosity they aroused, the human fascination with the reproduction and imitation of living things, using artificial mechanical organisms. The duck which "elongates its neck to take grain from the hand, swallows it, digests it, and renders it all digested through the ordinary channels[1]" could not fail to inspire a provocative artist like Wim Delvoye who, with his *Cloaca*, has managed to create works reproducing the digestive principle.

In 1947, Norbert Wiener coined the term "cybernetics" to describe a new transversal scientific dynamic trying to promote a unified vision of the emerging fields of the day – automation, electronics and the mathematical theory of information – based on a common approach to the living and the non-living. The theories defined by the field of cybernetics lie, incidentally, at the root of computer science and robotics, as we know them today. They are based, in particular, on the principle of "feedback", which implies "that the behaviour of an animate object is determined by the margin of error which separates it, at a given moment, from the objective it is trying to reach". Developed in the early 1950s, the electronic fox, nicknamed "Job", was one of the first objects illustrating the application of those theories. It was not a matter of creating an automaton or robot whose movements were programmed, but of ending up with an interactive object with the capacity to perceive its environment, and react in response to it.

These days, robotics is making it possible to develop ever more sophisticated tools. Often created like mirrors of the human body, they are shedding some of their mechanical limitations, and mere programming, and displaying a form of intelligence. Daria Martin's film *Soft Materials* questions the tactile relation between the human body and intelligent robotic objects, while Thomas Struth's photograph *Figure, Charité, Berlin 2012* conjures up the replacement of the human gesture by the robotised gesture, for its precision and its reliability. Lastly, Conrad Shawcross's *Trophy*, concludes the show, shrewdly mixes robotic technology and mythological narrative, and poetically questions us about our perpetual quest to mimic the living: somewhere between ancestral fascination and promise of technologies in the offing.

[1] Jacques de Vaucanson, *Le Mécanisme du flûteur automat*e, Paris, Jacques Guérin, 1738.

Job, the electronic fox, 1950-1953
Albert Ducrocq (1921-2001)
Musée des Arts et Métiers - Cnam, Paris

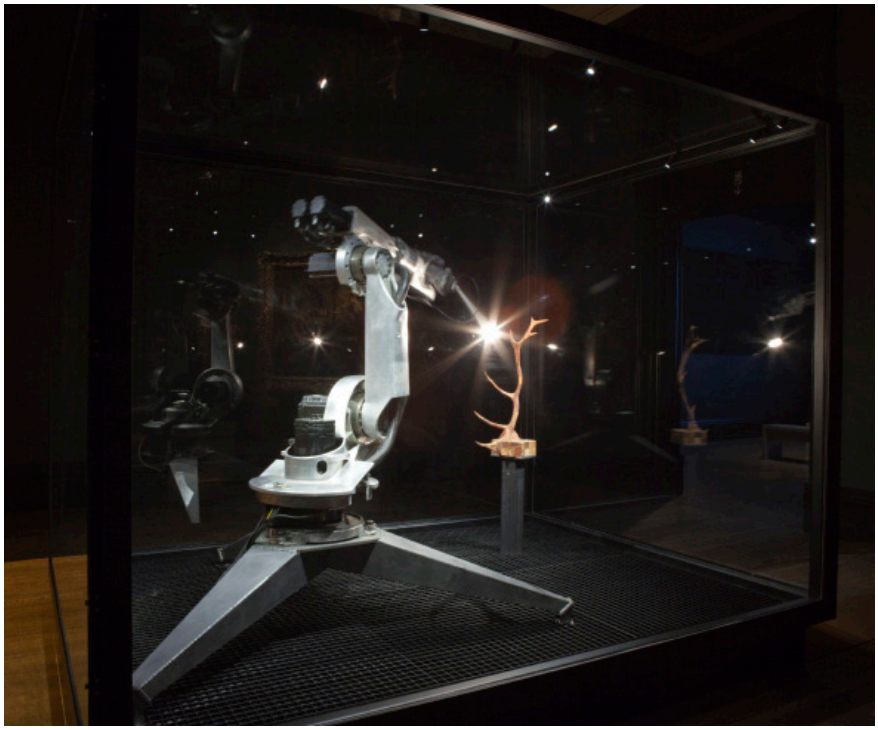
Apparatus for measirung the combustibility of tobacco leaves, known as a Smoke Machine, 1884
Henri Parenty
Paris, Musée des Arts et Métiers - Cnam

Jacques de Vancanson. An Account of the Mechanism of an Automaton, or Image playing on the German-flute [...] by M. Vaucanson. Londres, T. Parker, 1742, in-4. 4 De 7 Res

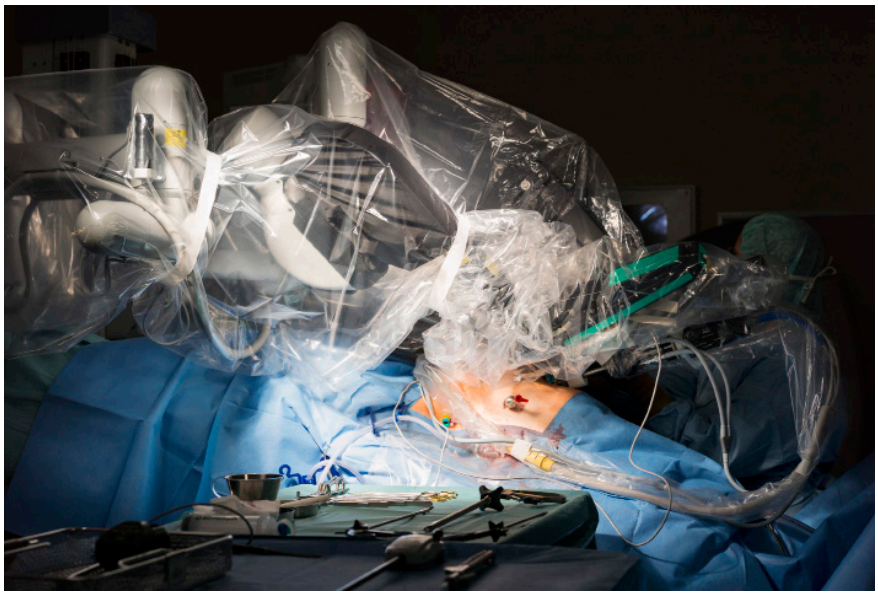
ARTISTS

Wim Delvoye
Paul Granjon
Rebecca Horn
Daria Martin
Conrad Shawcross
Stelarc
Thomas Struth

Job, the electronic fox, 1950-1953
Albert Ducrocq (1921-2001)
Wood, glass, plastic, cardboard, paper, aluminum, lead, copper, fox skin
16,5 x 53 x 31 cm



Conrad Shawcross
Trophy, 2012
Carved composite wooden block, computer controlled mechanical system, halogen light, steel, aluminium and glass
310 x 220 x 220 cm
© Conrad Shawcross
Courtesy of the artist and Victoria Miro Gallery, London
Photo: The national Gallery Photographic Department



Thomas Struth
Figure, Charité, Berlin 2012
chromogenic print
89,7 x 131,4 cm
Courtesy of Max Hetzler Gallery, Berlin / Paris
Photo: Thomas Struth

LIST OF EXHIBITS

Contemporary works

Dove Allouche et Evariste Richer
La Terrella, 2002
Inox, verre, canon à électrons, alimentation haute tension, pompe à vide, calendrier
Courtesy des artistes

Darren Almond
Perfect Time (8x3), 2012
24 horloges digitales synchronisées
Courtesy de l'artiste et White Cube, Londres

Renaud Auguste-Dormeuil
The Day Before _ Guernica _ April 25, 1937 _ 23 : 59, 2004. Impression jet d'encre sur aluminium
Collection Frac Languedoc-Roussillon

The Day Before _ Baghdad _ January 15, 1991 _ 23 : 59, 2004. Impression jet d'encre sur aluminium
Collection Frac Languedoc-Roussillon

The Day Before _ New York _ September 10, 2001 _ 23 : 59, 2012. Retirage en 2014
Impression jet d'encre sur aluminium
Collection Société Générale

Julien Berthier
L'Horloge d'une vie de travail, 2008
Acier, sérigraphie, plexiglas, moteur, système de mise en route à distance par téléphone
Collection Frac Franche-Comté

Michael Beutler
La Cacahuète (workbenches), 2011
Presse d'imprimerie, plieuse, presse papier, outils, peinture, colle, bois
Courtesy de l'artiste et Galerie Nagel Draxler, Berlin/ Cologne

Mel Bochner
If/And/Either/Both (or), 1998
Huile et caséine sur toile
Collection Frac Bourgogne

Stanley Brouwn
1 m – 1 step, 1985
Barres d'aluminium
Collection 49 Nord 6 Est – Frac Lorraine

1000 mm 881 mm 864 mm, 1974
Casier en métal, 1000 fiches
Collection 49 Nord 6 Est – Frac Lorraine

Chris Burden
The Frictionless Sled, 1983
Aluminium, métal, plexiglas, compresseur
Collection Mudam Luxembourg
Acquisition 2012

Scale Model of the Solar System, 1983
Plastique, roulement à billes en acier, plexiglas
Courtesy Chris Burden Studio

Nina Canell
Nerve Variation, 2009
Paratonnerre, globe en verre, béton, plâtre, tuyaux, câble, 2000 volts
AmC Collezione Coppola, Vicence

Daniel Gustav Cramer
Orrery, 2012
Vidéo HD, couleur, son. 20 min
Courtesy de l'artiste

Attila Csörgő
Untitled (1 tetrahedron + 1 cube + 1 octahedron = 1 dodecahedron), 2000
Bâtonnets en bois, ficelles, poulies, boulons, structure métallique, moteur électrique
Collection Mudam Luxembourg
Donation 2008 - KBL European Private Bankers

Magnet Spring, 1991
Plaques de verre, aimants, ficelle
Collection Mudam Luxembourg
Acquisition 2012

Björn Dahlem
The Expanding Universe (Big Bang), 2010
Bois, cuivre, horloge, assiette, verre, branchage, ampoule, bocaux, cerises, vernis
Collection Mudam Luxembourg
Acquisition 2011

Edith Dekyndt
A T P A P B L L E E, 2010/2011
Membrane composite (pomme et table), conçue avec le laboratoire de nanotechnologie de l'Adolphe Merkle Institute, Fribourg
Film réalisé avec un microscope électronique de type TEM, vues d'échantillons de la membrane composite (pomme et table), Adolphe Merkle Institute, Fribourg
Impressions jet d'encre sur papier chiffon, images de la table réalisées avec un microscope électronique de type STEM (ULB, Bruxelles)
Production Fri Art, Fribourg
Courtesy de Fri Art, Fribourg et Galerie Greta Meert, Bruxelles

Provisory Object 03, 2004
Vidéo, couleur, muet. 3 min 31 sec
Courtesy de la Galerie Greta Meert, Bruxelles

Wim Delvoye
Cloaca Travel Kit, 2009
Technique mixte
Collection de l'artiste, Gand

Ólafur Elíasson
Trust compass, 2013
Bois flotté, acier inoxydable, aimants
Collection Mudam Luxembourg
Acquisition 2013

Christoph Fink
Mouvement #85 Les Balades de Montréal, 2007–2008
Céramique émaillée
L'Histoire d'Istanbul, 2007
De la série d'*Istanbul*
Céramique émaillée
L'Histoire de la Terre (biscuit), 2005
Céramique
L'Histoire de la Terre (gravé) (2), 2005
Céramique
L'Histoire de la Terre (gravé) (1), 2005
Céramique
L'Histoire de la Terre (rouge), 2007
Céramique rouge/vernis
L'Histoire de la Terre (gravé/vernis), 2007
Céramique vernis
L'Histoire de la Terre (coloré), 2006
Céramique émaillée
L'Histoire de la Terre (encre), 2006
Céramique
L'Histoire de la Terre, 2007
De la série d'*Istanbul*
Céramique émaillée
Mouvement #79 Les Balades d'Istanbul, 2007
De la série d'*Istanbul*
Céramique émaillée
L'Histoire de la Terre (Black Matter), 2012
Céramique émaillée noire
La Totalité des Mouvements #1 – #112,
Les années analogues, 2012
Céramique émaillée
Courtesy de l'artiste

Gego
Reticulárea cuadrada, 1977
Acier et métal
Sense títol, 1970. Encre sur carton
Sense títol, 1970. Encre sur papier
Sense títol, 1970. Encre sur papier
Collection Macba. Macba Consortium
Dépôt Fundación Gego
Courtesy de Macba. Museu d'Art Contemporani de Barcelona

Jochen Gerner
(un temps.), 1999
Planches originales n°8 et n°9 de la bande dessinée (un temps), publiée dans le catalogue de l'exposition *Le Temps, vite*, Centre Pompidou, 2000
Feutre noir et correcteur sur papier
Courtesy de l'artiste

Marco Godinho
Navigation Instrument, 2012
Barre métallique, racine, sel
Collection Mudam Luxembourg
Acquisition 2013

Paul Granjon
Smartbot, 2005
Plexiglas, moteur électrique
Collection Mudam Luxembourg
Acquisition 2012

Grönlund–Nisunen
Antigravity Model, 2005
Tubes en aluminium, articulations et essieux en inox, roulements à billes, câble en acier
Courtesy des artistes et Esther Schipper, Berlin

João Maria Gusmão + Pedro Paiva
Water mill, 2012
Film 16mm, couleur, muet. 3 min 45 sec
Courtesy des artistes

Wade Guyton
Untitled, 2011
Impression jet d'encre sur lin
Ringier Collection, Suisse

Rebecca Horn
Federflügel, 1992
Plumes, métal, moteur
Collection Institut für Auslandsbeziehungen e.V., Stuttgart

Les Ailes de plumes chinoises, 1993
Sculpture murale mobile
Laiton, plume, moteur, transformateur
Collection Centre national des arts plastiques, France
Dépôt à la Maison de la Chasse et de la Nature, Paris

Two hands scratching both walls, 1974
Feathers dancing on shoulders, 1974
De la série *Berlin-Übungen in neun Stücken,* 1974–1975
Vidéo. 2 min 42 sec et 2 min 46 sec
Collection IAC – Institut d'art contemporain Villeurbanne / Rhône-Alpes

Éric van Hove
V12 Laraki Alternator, 2013
Technique mixte (13 matériaux)
V12 Laraki Air Filter, 2015
Technique mixte (13 matériaux)
V12 Laraki Camshaft Cogwheel Cover, 2013
Technique mixte (6 matériaux)
V12 Laraki Right Cylinder Head, 2013
Technique mixte (18 matériaux)
Matériaux : Cuivre jaune et rouge, étain, résine, peinture, alliage argent nickel, bois de cèdre blanc du Moyen Atlas, noyer, citronnier, thuya, acajou, bois marocain flotté, os de vache et de chameau, corne et cuir de vache, superglue chinoise, colle à bois
Courtesy de l'artiste

Ann Veronica Janssens
Donut, 2003
Projection lumineuse colorée en forme de cible
Programme informatique, projecteur, enregistreur et console.
Centre national des arts plastiques, France

Véronique Joumard
Paravent, 2013
Lentilles de Fresnel, plexiglas, laiton
Courtesy de l'artiste

4 ballons pour une pièce, 2006
4 ballons éclairants, hélium, médium noir, câbles électriques.
Courtesy de l'artiste

Anne Marie Jugnet + Alain Clairet
Nuage #2, 2006
Nuage #6, 2006
Nuage #7, 2006
Nuage #8, 2006
Nuage #11, 2007
Nuage #15, 2007
Marbre (statuario)
Collection privée
Dépôt Mamco, Genève

Santa Fe NM32c, 2003
Acrylique sur toile
Collection Mudam Luxembourg
Acquisition 2003

Santa Fe NM101b, 2003
Acrylique sur toile
Collection Mudam Luxembourg
Acquisition 2003

Rolf Julius
Singing, 2000/2015
7 haut-parleurs, câbles, pigment noir, lecteur CD, amplificateur
Courtesy Rolf Julius Estate et Galerie Thomas Bernard - Cortex Athletico, Paris

On Kawara
One million years (past and future), 1970-2001
Enregistrement sonore diffusé en continu
Collection Mudam luxembourg
Acquisition 2001

Paul Kirps
autoreverse, 2005
Projection en boucle de 5 séquences audiovisuelles
RS 570, 2 min 42 sec
97 C, 2 min 13 sec
X1, 2 min 5 sec
FHW 64 D, 2 min 21 sec
AM A202, 1 min 23 sec
Commande et Collection Mudam Luxembourg
Acquisition 2006

Piotr Kowalski
Pendule de Léon Foucault, 1980
Document vidéo de l'installation du Pendule de Léon Foucault lors du Symposium international de sculpture environnementale de Chicoutimi en 1980
Vidéo noir et blanc, son. 16 min

L'Observatoire – Trois projets pour la Défense, 1974
6 dessins, plans et photomontages, maquette
Crayon sur papier, collage
Maquette en bois, métal et verre
Collection Andrea Kowalski

Identité n°2, 1973
3 cubes en néon rouge montés sur piètement d'acier, 3 miroirs dont 1 concave, 1 plan, 1 convexe, montés sur coquilles d'acier inoxydable sablé, 1 socle-plancher en bois laqué noir, transformateurs de haute-tension
Centre Pompidou, Paris
Musée national d'art moderne/Centre de création industrielle
Achat de l'État, 1972

Lumière (arc-en-ciel), 1992
Dispositif holographique, ampoule halogène, écran hyperbolique
Collection Andrea Kowalski

Mesures à prendre, 1969
Plaque de plexiglas laminée et suspendue, générateur électronique, antenne, grillage, tubes de néon colorés, gaz
Collection Centre national des arts plastiques, France
Donation de M. Gilbert Brownstone en 2001
Dépôt à l'Espace de l'art concret, Mouans-Sartoux

Sophie Krier
En collaboration avec Franck Debouté
Table pour le pendule de Léon Foucault, 2015
Grès de Luxembourg, argile et paille
Commande et production Mudam Luxembourg
Réalisé avec l'aide de Téo Kersaudy, Zélie le Gardien (Collège privé Saint-Joseph, Audierne), Romain Ansquer, Elise Savina (Collège Notre-Dame de Roscudon, Pont-Croix)

Alicja Kwade
Asia (UTC +3 – +12), 2015
Bronze, acier inoxydable
Courtesy de l'artiste et Kamel Mennour, Paris

North America (UTC -10 – -4), 2015
Bronze, acier inoxydable
Courtesy de l'artiste et Galerie König, Berlin
South America (UTC -6 – -3), 2015
Bronze, acier inoxydable
Courtesy de l'artiste et Kamel Mennour, Paris

Bertrand Lamarche
Kathy, 2008
Moteurs, réservoir, caméra, eau, projection vidéo
Collection Musée des Beaux-Arts de Nantes

David Lamelas
Film 18 Paris IV. 70, 1970–2004
Vidéo, couleur, son. 9 min 26 sec
Courtesy de l'artiste et Jan Mot, Bruxelles/Mexico

Katie Lewis
760 Days, 2015
Épingles, crayon
Courtesy de l'artiste

Jorge Macchi
Liliput, 2006
Collage sur papier et sérigraphie
Collection privée

Tour, 2010
Acier inoxydable, bois
Courtesy de l'artiste et Alexander and Bonin, New York

Daria Martin
Soft Materials, 2004
Film 16mm. 10 min 30 sec
Courtesy de Maureen Paley, Londres

Kris Martin
Globus, 2006
Objet récupéré
Collection Teixeira de Freitas, Lisbonne

Kazuko Miyamoto
Archway to cellar, 1978/2015
Laine, clous
114 x 271 x 116
Collection Daimler Contemporary, Berlin

Archway to cellar, 1977
10 photographies noir et blanc
12 x 17 chacune
Collection Daimler Contemporary, Berlin

Chalkline Drawing (Blue), 1972
Craie et acrylique sur toile
Courtesy de l'artiste et Exile, Berlin

Tatsuo Miyajima
Life (Corps sans Organes) No. 18, 2013
L.E.D., IC, micro-ordinateur Ikegami, acier, capots en plastique, capteurs, câbles électriques, LED type ; Life D-R(6), Life D-BL(5), Life D-W(7), Life D-PG(7), Life G-R(8), Life G-BL(9), Life G-W(8), Life G-PG(8)
Courtesy de l'artiste et Lisson Gallery, Londres

Laurent Montaron
Minolta Planetarium MS-15, Memphis, 2011
Photographie couleur
Courtesy de l'artiste, Schleicher/Lange, Berlin et Monitor Gallery, Rome
The Invisible Message, 2011
Deux voiles, tiges, fil de cuivre, multimètres, cordes, gants, marteaux
Courtesy de l'artiste et Schleicher/Lange, Berlin

Gianni Motti
Big Crunch Clock, 1999–5'000'000'000
Horloge digitale, compte à rebours des 5 milliards d'années avant l'explosion du Soleil
Collection Migros Museum für Gegenwartskunst, Zürich

Carsten Nicolai
ora, 2007
Diasec sur aludibond
Collection Deutsche Akademie Rom Villa Massimo, Rome

wellenwanne lfo, 2012
Métal, verre, plexiglas, miroir, équipement audio, eau, éclairage, son
Courtesy de la Galerie Eigen+Art, Leipzig/Berlin et The Pace Gallery

Navid Nuur
Untitled, 1988–2012
Serpentinite, aimant neodymium, limaille de fer
Collection privée, Suisse

Damián Ortega
Tool Bones 2, 2013
Tool Bones 3, 2013
Tool Bones 4, 2013
Tool Bones 5, 2013
Tool Bones 6, 2013
Tool Bones 7, 2013
Bronze
Courtesy de l'artiste et Gladstone Gallery, New York/ Bruxelles

Miracolo Italiano, 2005
3 Vespa PX 150, câbles en acier
Collection Teixeira de Freitas
Dépôt 2006 Fundação Serralves – Museum de Arte Contemporânea, Porto

Adrian Paci
The Column, 2013
Vidéo couleur, son
25 min 44 sec
Courtesy de l'artiste et Kaufmann Repetto, Milan/ New York

Trevor Paglen
Prototype for a Nonfunctional Satellite (Design 4; Build 3), 2013
Mylar, acier, programme informatique, ordinateurs, éclairages
Courtesy de Altman Siegel Gallery, San Francisco
Production Trevor Paglen Studio et Mudam Luxembourg

Nam June Paik
Magnet TV / Life Ring Witch Manipulate The Face Of President Richard Nixon, 1964–2001
Technique mixte
Collection Dieter et Si Rosenkranz, Berlin

Miguel Palma
Pays/scope, 2012
Structure métallique, miroir, télescope, caméra, écran
Collection Mudam Luxembourg
Donation 2014 – Reginald Neuman

Panamarenko
Eendebek – Kleine Magnusvlieger, 2002
Objet-multiple présenté sur une planche, moteur à essence, bois, métal, caoutchouc, plastique
Courtesy de Deweer Gallery, Otegem

Batopillo (klein), 2005
Matériaux divers
Courtesy de Deweer Gallery, Otegem
Magnetische Schoenen + Pet, 1966–1967
Courtesy The Deweer Collection, Otegem

Zilverschijf, 1984
Disque en aluminium laminé, 3 aimants permanents, moteur, Perspex, tiges en cuivre, fil de fer
Collection du Musée d'Ixelles, Bruxelles

Verti-vortex, 1981
Fer, caoutchouc et aimant permanent
Collection Frac Nord–Pas de Calais

Michel Paysant
Nano-portraits de leurs Altesses Royales le Grand-Duc Henri et la Grande-Duchesse Maria Teresa, 2014–2015
Nano-fabrication par lithographie électronique
Dépôt d'or sur silicium
Commande et Collection Mudam Luxembourg
Acquisition 2013

Amalia Pica
Vitrine 1 (Unintentional Monument #10, 11, 12 and 13), 2010. Réplique d'une antenne analogique de télévision fait main, matériaux récupérés, vitrine
Collection Valeria et Gregorio Napoleone, Londres

Julien Prévieux
What shall we do next?, 2007–2011
Rétroprojecteur, écran LCD transparent, animation 3D, disque dur. 3 min 52 sec
Collection Frac Aquitaine

Menace 2, Machine Educable Noughs and Crosses Engine, 2010
Chêne, contreplaqué, métal, toile, billes en terre
Collection Frac Basse-Normandie

L'Argumentation universelle – Securitization, 2010
Médium, stratifié
Courtesy de la Galerie Jousse Entreprise, Paris

L'Argumentation universelle – Derivative Product, 2011
Médium, stratifié
Courtesy de la Galerie Jousse Entreprise, Paris

Evariste Richer
Mètre de mémoire, 2003
Encre sur papier
Collection Gensollen la Fabrique, Marseille

Fulgurite, 2008
Fulgurite, néon. Collection Freché, Belgique

Georges Rousse
Zonder titel (Kunst Raum Wine), 1985
Cibachrome sur aluminium
Collection M KHA, Anvers

Thomas Ruff
Cassini 23, 2009
C-Print
Collection Frac Haute-Normandie

0821, 2003
De la série Maschinen
Photographie couleur
Courtesy de l'artiste

Stéphane Sautour
Alkeishuikkanen, 2012–2013
Diptyque. Fusain sur papier marouflé
Production F93 dans le cadre du projet *Propagation de la monotonie*
Courtesy de la Galerie Loevenbruck, Paris

Lasse Schmidt Hansen
Scaled Paper, 2006
Impression, papier millimétré à une échelle de 1:0,8
Collection Mudam Luxembourg
Donation 2013 - Stephanie et Patrick Majerus

Conrad Shawcross
The Celestial Meters (Saturne), 2009
Contreplaqué, inox
Courtesy de l'artiste et Victoria Miro Gallery, Londres

Measurement and control for the infinite, 2002
Contreplaqué, chêne, miroir, cuir
Courtesy de l'artiste et Victoria Miro Gallery, Londres

Trophy, 2012
Sculpture en bois, bras robotique, lampe halogène, acier, aluminium, verre
Courtesy de l'artiste et Victoria Miro Gallery, Londres

Simon Starling
Wilhelm Noack oHG, 2006
Boucleur spécialement conçu, projecteur 35mm, film 35mm noir et blanc en boucle, son. 4 min
Collection Museum Folkwang, Essen

Stelarc
Parasite, Tokyo NTT, ICC, 1997
Documentation vidéo, couleur, son. 35 min 5 sec
Courtesy NTT - Inter Communication Center, Tokyo

Third Hand / Involuntary Arm, Yokohama, Melbourne, 1993. Impression 200 x 140 cm
Courtesy de l'artiste
Third Hand, Tokyo, Yokohama, Nagoya, 1980
Photographie couleur 155 x 140 cm
© Pamela Fernuik
Courtesy de l'artiste

Dans l'espace :
Third Hand, Tokyo, Yokohama, Nagoya, 1980
Aluminium, acier inoxydable, acrylique, latex, circuits électroniques, moteurs, électrodes, câbles, batteries
Courtesy de l'artiste et Scott Livesey Galleries, Melbourne

Thomas Struth
AGLAE, C2RMF, Paris 2013, 2013
Impression jet d'encre
Courtesy de la Galerie Max Hetzler, Berlin

Figure, Charité, Berlin 2012, 2012
Impression jet d'encre
Courtesy de la Galerie Max Hetzler, Berlin

Takis
Electromagnétique, 1966
Sphère en fibre de verre avec aimant permanent incorporé, suspendue par câble d'acier, électroaimant monté sur structure métallique, acrylique noire
Collection MAC/VAL, musée d'art contemporain du Val-de-Marne, France

Jean Tinguely
Fatamorgana, Méta-Harmonie IV, 1985
Roues en bois et éléments en tôle de différentes couleurs, cymbales, tambours, courroies, sandow, câbles, roulements à billes, douilles en plastique noir, 15 moteurs électriques, caoutchouc, aluminium, textile, plastique
Collection Museum Tinguely, Bâle

Chaos I, 1972
Hannibal II, 1971
Lithographies. Encre sur papier
Collection Frac Centre

Réflexion, 1969
Méta-Chaos, s. d. Lithographies. Encre sur papier
Collection Frac Centre

Francisco Tropa
Lantern (clock), 2014
Table en bois, chevalet en métal, bronze, matériel électrique, appareils optiques, mécanisme d'horloge
Courtesy de la Galerie Jocelyn Wolff, Paris
Lantern, 2011
Chevalet en hêtre, plateforme, cylindre et parallélépipèdes en pierre à chaux formant le piédestal du mécanisme de projection, cube en laiton (avec transformateur, ventilateur, condenseur, ampoule halogène, support en laiton et verre), réservoir cylindrique en verre avec robinet, lentille
Collection Mudam luxembourg
Acquisition 2012

Guido van der Werve
Nummer Negen (#9) The Day I Didn't Turn with the World, 2007
Images en accéléré, vidéo HD, couleur, son
8 min 40 sec
Collection Hirshhorn Museum and Sculpture Garden, Smithsonian. Institution, Washington, DC
Joseph H. Hirshhorn Purchase Fund, 2008

George Widener
Ship of Man (10 000 Years), 2009
Ruban vinyle, encre, marqueur sur serviette en papier. Courtesy de The Museum of Everything

Untitled, s. d. et 2003-2006
11 carnets de note
Courtesy de la Galerie Susanne Zander/Delmes & Zander

John Wood & Paul Harrison
Grey Painted Chair, 2014
Vidéo HD, couleur. 5 min 33 sec
Courtesy des artistes

One More Kilometre, 2009
Vidéo couleur, son. 2 min 45 sec
Courtesy des artistes

Raphaël Zarka
Riding Modern Art, 2015
Impressions pigmentaires sur papier fine art
Photographies : Guillaume Langlois, Marcel Veldman, Gaston Francisco, Tuukka Kaila, Ian O'Connor, Hendrik Herzmann, Éric Antoine
Production Mudam Luxembourg et les Abattoirs - Frac Midi-Pyrénées, Toulouse
Courtesy de l'artiste

Padova (Réplique #4), 2008
Contreplaqué de coffrage et marbre de Carrare
Centre Pompidou
Musée national d'art moderne/Centre de création industrielle, Paris
Don de la Fondation d'entreprise Ricard en 2009, dans le cadre du Prix Fondation d'entreprise Ricard 2008

Geometry Improved by Abraham Sharp, Plate 1 (The Bodleian Library, Oxford), 2009
Tirage lightjet
Courtesy de l'artiste et Michel Rein, Paris/Bruxelles

Bille de Sharp n°2, 2008
Bille de Sharp n°3, 2008
Bille de Sharp n°4, 2008
de la série Billes de Sharp
Poutres en chêne pyrogravées
Collection Michel Rein, Paris
Collection Cilles et Marie Françoise Fuchs, Paris
Collection du Frac des Pays de la Loire

Catalogue raisonné des rhombicuboctaèdres, 2013
Sérigraphie
Courtesy de l'artiste et Michel Rein, Paris/Bruxelles

Raphaël Zarka et Vincent Lamouroux
Pentacycle, 2002
Vidéo couleur, son. 6 min 37 sec
Collection Frac Franche-Comté

LIST OF EXHIBITS

Musée des Arts et Métiers - Cnam, Paris

J.-B. Chevalier
Hélice double à pas contraires. Modèle réduit, vers 1888. Bois, alliage ferreux, laiton
Musée des Arts et Métiers - Cnam, Paris

Louis Couffignal (1902-1966)
Machine à calculer universelle – maquette expérimentale, 1946-1952
Logabax -Machines comptables et Totalisateurs

1. Lecteur optique externe
Fer, plastique, verre, cuivre, aluminium, bakélite, caoutchouc

2. Séquenceurs automatiques
Fer, plastique, verre, cuivre, aluminium, bakélite, porcelaine, caoutchouc

Alimentation générale
Fer, plastique, verre, cuivre, aluminium, porcelaine, caoutchouc (élément non exposé)

3. Totalisateur, mémoires et pupitre de commande
Fer, plastique, verre, cuivre, aluminium, bakélite, porcelaine, caoutchouc

Musée des Arts et Métiers - Cnam, Paris

De Dion-Bouton
Châssis d'automobile 12 CV en coupe, 1907
Bois, alliage ferreux, acier, aluminium, cuivre, laiton, verre. Musée des Arts et Métiers - Cnam, Paris

John Dollond (1706-1761)
Lunette, vers 1730
Cabinet de Jacques Alexandre César Charles (1746-1823). Bois, laiton, verre
Musée des Arts et Métiers - Cnam, Paris

Albert Ducrocq (1921-2001)
Job, le renard électronique, 1950-1953
Bois, verre, plastique, carton, papier, aluminium, plomb, cuivre, peau de renard
Musée des Arts et Métiers - Cnam, Paris

Louis Dupin de la Guérinière (1810- ?)
Molteni et Siegler
Collection de polyèdres pour faciliter l'étude de la géométrie et du dessin : géométrie stéréométrique, 1849. Carton, papier, cuir
Musée des Arts et Métiers - Cnam, Paris

Louis Jules Duboscq (1817-1886)
Figures géométriques stéréoscopiques, vers 1850
Papier. Musée des Arts et Métiers - Cnam, Paris

Louis Jules Duboscq (1817-1886)
Plaque de lanterne magique animée figurant un disque de Newton, vers 1850
Bois, laiton, verre, alliage ferreux, papier
Musée des Arts et Métiers - Cnam, Paris

Eugène Ducretet (1844-1915)
Dispositif expérimental d'émission d'ondes hertziennes pour la télégraphie sans fil, 1905
Bois, verre, cuivre, laiton, fibre d'origine végétale, liège, alliage ferreux, papier
Musée des Arts et Métiers - Cnam, Paris

D'après Jesse Ramsden (1730-1800)
Machine électrostatique, XIXe siècle
Bois, laiton, verre, acier, alliage ferreux, ivoire, cuir, aluminium
Musée des Arts et Métiers - Cnam, Paris

Daniel Heinrich Ruhmkorff (1803-1877)
Tube de Geissler, 1860
Verre, bois, nylon, papier, alliage métallique
Musée des Arts et Métiers - Cnam, Paris

Henry Prudence Gambey (1787-1847)
Théodolite et cercle répétiteur, première moitié du XIXe siècle
Laiton, verre, papier, argent
Musée des Arts et Métiers - Cnam, Paris

Zénobe Gramme (1826-1901)
Machine dynamo-électrique système Gramme, vers 1880
Compagnie des machines Gramme et Fontaine
Cuir, alliage ferreux, fonte, laiton, cuivre, verre
Musée des Arts et Métiers - Cnam, Paris

Alexander Graham Bell (1847-1922)
Charles Summer Tainter (1854 -1940)
Appareils téléphoniques dits « Photophone d'articulation » ou « Photophone parlant » 1880
Bois, laiton, verre, alliage ferreux

1. Cornet parleur, 1880
   Caoutchouc, fibre, cuivre, laiton, alliage ferreux

2. Trépied et planchette, 1880
   Alliage ferreux, fonte
   Bois, laiton

3. Récepteur, 1880
   Cuivre, laiton, bois, étain, alliage ferreux

Musée des Arts et Métiers - Cnam, Paris

Augustin Michel Henry-Lepaute (1800-1885)
Collection de quarante diapasons, vers 1860
Alliage ferreux, bois, verre, laiton
Musée des Arts et Métiers - Cnam, Paris

Wilhelm Holtz (1836-1893)
Eugène Ducretet (1844-1915)
Carreau de glace perforé par l'étincelle d'une machine électrique de Holtz, 1881
Musée des Arts et Métiers - Cnam, Paris

Fernand Monpillard (1865-1937)
Jean Alfred Nachet (1831-1908)
Chambre microphotographique, vers 1900
Bois, laiton, alliage ferreux, aluminium, acier, verre, papier, carton, cuir
Musée des Arts et Métiers - Cnam, Paris

Jean Antoine Nollet (1700-1770)
Aimant artificiel, vers 1750
Bois, laiton, acier
Musée des Arts et Métiers - Cnam, Paris

Théodore Olivier (1793-1853)
E. Médard
Engrenage cylindrique, crémaillère rectiligne et dents triangulaires, 1853
Bois, acier, laiton, alliage ferreux
Musée des Arts et Métiers - Cnam, Paris

Henri Parenty
Appareil pour mesurer la combustibilité des feuilles de tabac dit Machine à fumer, 1884
Bois, zinc, laiton, cuivre, alliage ferreux, verre,fibre d'origine végétale, caoutchouc, papier
Musée des Arts et Métiers - Cnam, Paris

Victor Athanase Pierret (1806-1893)
Machine à plisser et à gaufrer les rubans des fleurs artificielles, 1832
Laiton, verre, bois, acier, fibre d'origine végétale, papier. Musée des Arts et Métiers - Cnam, Paris

Pierre Ernest Peuchot (1852 - vers 1897)
Phénomènes d'interférences, 1882
Série de huit toiles
Huile sur toile, cadre en bois
Musée des Arts et Métiers - Cnam, Paris

Charles Rouy
Mécanisme uranographique, 1816
Bois, laiton, fer, acier, carton, papier, argent
Musée des Arts et Métiers - Cnam, Paris

Henri Édouard Tresca (1814-1885)
Profils de mètres à traits en X et en H, 1872
Bois

Henri Édouard Tresca (1814-1885)
Longueur de profilé en X, 1872
Musée des Arts et Métiers - Cnam, Paris

Étienne Léopold Trouvelot (1827-1895)
Charles Scribner et fils
The Trouvelot astronomical drawings, 1881
Atlas
Papier, carton
Dessin au pastel imprimé en chromolithographie

The great nebula in Orion
From a study made in the Years 1875-76

Total eclipse of the Sun
Observed July 29, 1878 at Creston, Wyoming Territory

Mare humorum
From a study made in 1875

The planet Jupiter
Observed November 1, 1880 at 9h.30m

Musée des Arts et Métiers - Cnam, Paris

Jacques de Vaucanson (1709-1782)
Le Mécanisme du fluteur automate, presenté [sic] à Messieurs de l'Académie royale des sciences par M. Vaucanson, auteur de cette machine. Paris, Jacques Guérin, 1738
Paris, Jacques Guérin
Bibliothèque centrale du Conservatoire national des arts et métiers

Franz Wertheim (1814-1883)
Collection d'outils de tourneur, 1855
Acier, alliage ferreux, bois, laiton, fibre d'origine végétale, papier
Musée des Arts et Métiers - Cnam, Paris

Charles Louis Weyher (1836-1916)
Collection d'appareils de démonstrations et d'expériences sur les tourbillons permettant de reproduire un grand nombre de phénomènes naturels tels que : trombe marine, tempêtes et sphères tournantes, les propriétés des aimants etc., 1887

1.Tableau représentant une pomme de pin, 1887
Gouache sur papier
Carton, papier

2.Tableau représentant l'expérience avec la sphère tournante, 1903
Gouache sur papier
Carton, papier

3.Appareil à gruau montrant le mécanisme d'un tourbillon et son action sur des matières divisées, 1887
Bois, verre, carton, laiton, alliage ferreux, fibre d'origine végétale (gruau)

4.Pomme de pin avec spirales montrant deux veines tourbillonnaires, 1887
Laiton, bois, papier, alliage ferreux

5.Sphère tournante permettant de faire évoluer ou d'immobiliser un anneau en papier, 1887
Fonte, bois, carton, laiton, alliage ferreux

6.Spécimen montrant la figure que dessinent des poussières sous l'action d'un tourbillon, 1887
Bois, laiton, alliage ferreux, papier

7.Quatre écailles de pomme de pin sous verre dans un cadre et d'autres écailles dans un tube à essai, 1887
Bois, verre, papier, liège, alliage ferreux

8. Appareil reproduisant un cyclone avec toutes ses particularités, 1887
Bois, laiton, alliage ferreux, carton, verre, caoutchouc

9.Reproduction complète des propriétés des aimants au moyen de combinaisons tourbil lonnaires, 1887
Fonte, bois, laiton, verre, carton, papier, alliage ferreux, fibre

10.Reproduction complète des propriétés des aimants au moyen de combinaisons tourbillonnaires, 1887
Alliage ferreux, fonte, bois, laiton, verre, papier, carton, fibre

11.Sur les tourbillons, trombes, tempêtes et sphères tournantes.
Études et expériences, 2e édition, 1889
Charles Louis Weyher (1836-1916) Gauthier-Villars et fils
Papier, cuir, carton, or

12.Tableau représentant un cyclone, vers 1887
Huile sur toile

Musée des Arts et Métiers - Cnam, Paris

Appareil de Huygens pour la démonstration expérimentale de la loi du mouvement du pendule cycloïdal, fin XVIIIe siècle
Cabinet de Jacques Alexandre César Charles (1746-1823). Bois, acier, ivoire, laiton, fibre
Musée des Arts et Métiers - Cnam, Paris

Appareil de sept petits miroirs plans pour la recomposition de la lumière, fin XVIIIe siècle
Cabinet de Jacques Alexandre César Charles (1746-1823). Laiton, verre
Musée des Arts et Métiers - Cnam, Paris

Batterie Tudor modèle Cuirassé pour automobile, vers 1947
Société française de l'accumulateur Tudor
Plastique, aluminium, alliage ferreux
Musée des Arts et Métiers - Cnam, Paris

Bicyclette Acatène, vers 1896
La Métropole
Acier, caoutchouc, cuir, aluminium, fer
Musée des Arts et Métiers - Cnam, Paris

Cadran solaire horizontal avec canon de midi, vers 1780
Non signé
Marbre, laiton, verre
Musée des Arts et Métiers - Cnam, Paris

Cylindre à calcul, dit « Loga-calculator » pour calculs financiers, 1925-1935
Société Daemen-Schmid/Loga, Zurich
Aluminium, papier, carton, acier, caoutchouc, plastique, fonte
Musée des Arts et Métiers - Cnam, Paris

Collection de solides géométriques sur un plateau, vers 1900
Plâtre
Musée des Arts et Métiers - Cnam, Paris

Décamètre ou chaîne d'arpenteur, dix fiches, 1851
Parent
Alliage ferreux
Musée des Arts et Métiers - Cnam, Paris

Fac-similé du pendule de Léon Foucault, 2015
Réalisation et installation : Jean-Luc Chazoule, Klaus Lorenz
Laiton, électroaimant
Musée des Arts et Métiers - Cnam, Paris

Fac-similé du mètre étalon à bouts de 1889
Conférence générale des Poids et Mesures
Alliage ferreux
Musée des Arts et Métiers - Cnam, Paris

Fac-similé du mètre étalon à traits de 1889
Conférence générale des Poids et Mesures
Alliage ferreux
Musée des Arts et Métiers - Cnam, Paris

Horloge à plan incliné, vers 1780
Email, laiton, alliage ferreux, bois
Musée des Arts et Métiers - Cnam, Paris

Lingots de monnaie fondue par la foudre
Alliage cuivreux, bois, verre, papier
Musée des Arts et Métiers - Cnam, Paris

Passage de Vénus sur le Soleil :
missions de Pékin et de Saint-Paul, 1874
Georges-Ernest Fleuriais (1840-1895)
Ernest Amédée Barthélémy Mouchez (1821-1892)
Daguerréotypes
Cuivre, argent, verre, papier, carton
Passage de Vénus devant le Soleil, Pékin n°27
Passage de Vénus devant le Soleil, Pékin n°29
Musée des Arts et Métiers - Cnam, Paris

Paraboloïde hyperbolique, génération rectiligne double, 1830 Théodore Olivier (1793-1853)
Pixii père et fils
Bois, laiton, soie
Musée des Arts et Métiers - Cnam, Paris

Piles à sac montées en batterie, vers 1890
Bois, céramique, zinc
Musée des Arts et Métiers - Cnam, Paris

Polyprisme superposé composé de sept matières différentes réfrangibles, fin XVIIIe siècle
Cabinet de Jacques Alexandre César Charles (1746-1823)
Laiton, verre, acier
Musée des Arts et Métiers - Cnam, Paris

Portant de sept billes d'ivoire égales suspendues et montées sur un guéridon d'acajou, fin XVIIIe siècle
Cabinet de Jacques Alexandre César Charles (1746-1823). Bois, ivoire, laiton
Musée des Arts et Métiers - Cnam, Paris

Rail à patin, dit rail Vignole, vers 1884
Compagnie des chemins de fer de l'Est
Acier
Musée des Arts et Métiers - Cnam, Paris

Appareil, dit Harmonographe, inscrivant les courbes de composition de deux mouvements vibratoires et dispositif pour projeter les figures, 1878
Tisley and Company Manufacturing
Bois, laiton, fer, métaux non ferreux
Coffret contenant des encres d'aniline pour la réalisation des tracés, 1878
Bois, alliage ferreux, laiton, verre, papier, cuir, fibre, caoutchouc, encres

Musée des Arts et Métiers - Cnam, Paris

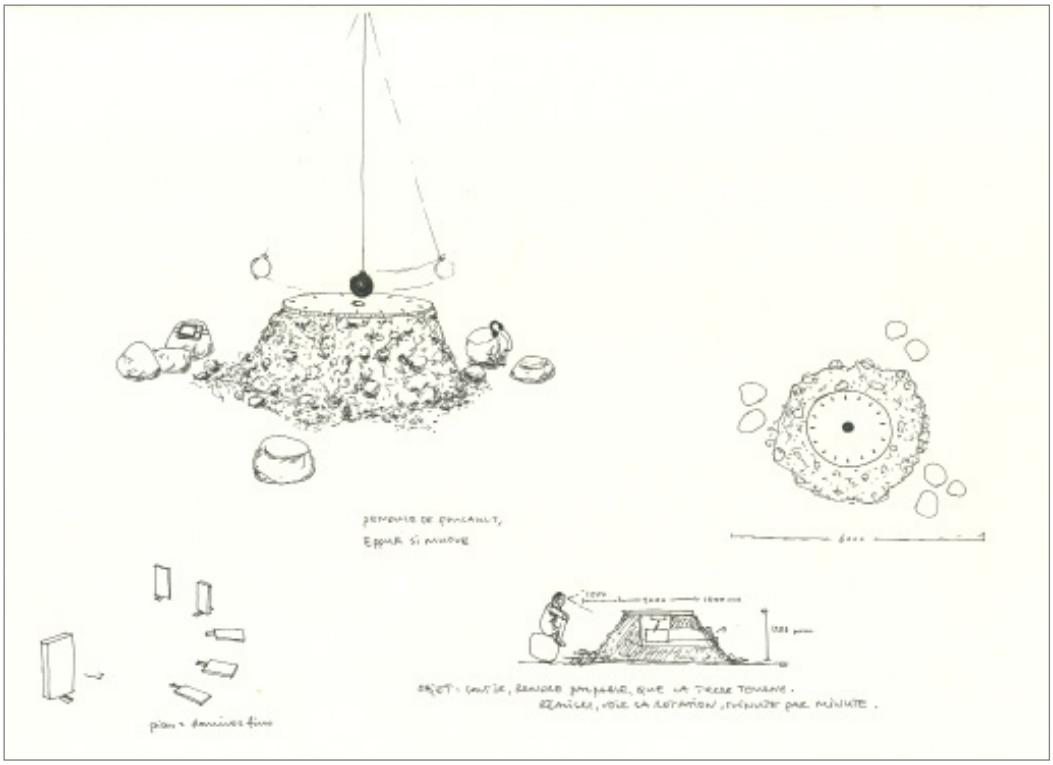
SPECIFIC PROJECTS

In the context of Eppur si muove, Art and Technology, a shared sphere, the Mudam has brought together artists, researchers, students and other partners around specific projects, which will be presented for the first time in the exhibition.

SOPHIE KRIER
TABLE FOR LÉON FOUCAULT'S PENDULUM, 2015

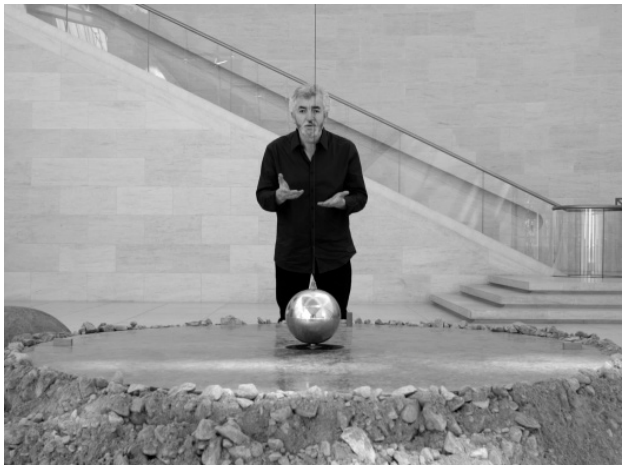
Sophie Krier studied textile design at the Design Academy of Eindhoven, and has since followed a career that combines research, education, art, and design. Her editorial activities enable her to present various subjects in ways that create collective tools of analysis and explication (exhibitions, symposiums, workshops, and books).

The 'table' that she has devised to present a replica of Léon Foucault's pendulum at Mudam was conceived as a reminder of the special connection between this instrument and Earth. The table takes for the form of a mound of raw, clayey soil, topped by a large disk of clay that has been hand-polished with a stone (an ancient technique that brings out clay's reflective properties). Seats of cob enable visitors to watch the pendulum swing. In making these components, Krier worked with Franck Debouté, an architect specializing in clay construction, plus four middle-school students from Collège Saint-Joseph (in Audierne) and Collège Notre-Dame de Roscudon (Pont-Croix), both in Brittany.



Sophie Krier (in collaboration avec Franck Debouté)
Table pour le pendule de Léon Foucault, 2015
Luxembourg sandstone, clay and straw 50 x Ø 400 cm
Commissioned and produced by Mudam Luxembourg
Produced with the help of Téo Kersaudy, Zélie le Gardien (Collège privé Saint-Joseph, Audierne), Romain Ansquer, Elise Savina (Collège Notre-Dame de Roscudon, Pont-Croix)

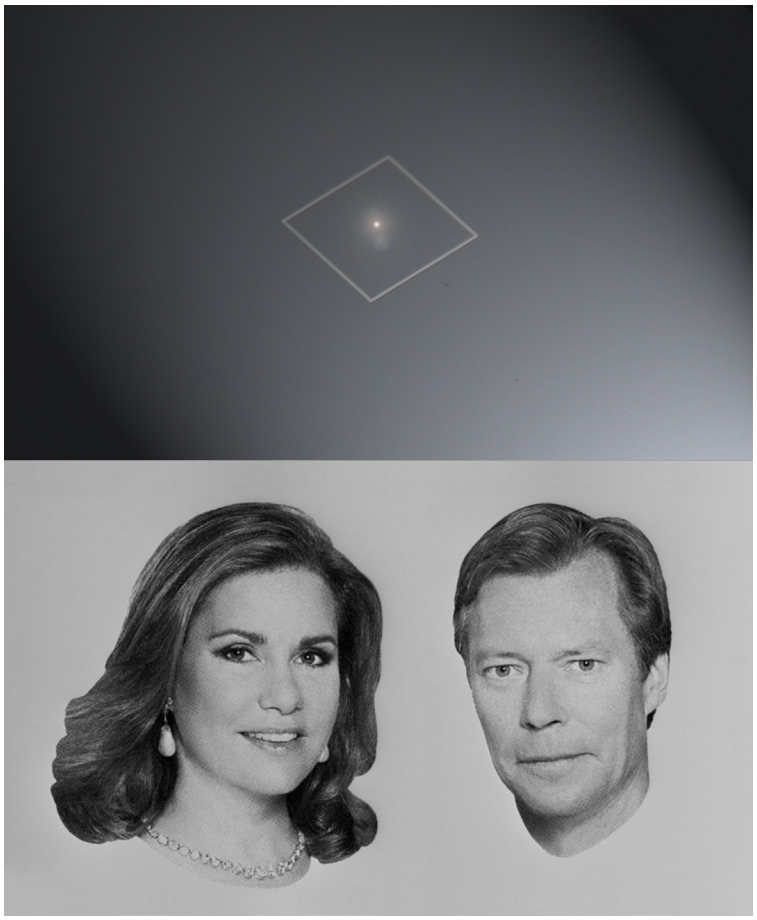
A movie in sign language, interpreted by Nasro Chab, mediator within the educational department of the Museum of arts and crafts, proposes a poetic reading of the functioning of the pendulum. The table so becomes the site of a transmission of know-how as much as to know.



MICHEL PAYSANT
NANO PORTRAITS DE LEURS ALTESSES ROYALES LE GRAND-DUC HENRI ET DE LA GRANDE-DUCHESSE MARIA THÉRESA DE LUXEMBOURG 2014-2015

The French artist Michel Paysant is developing a nano-production project using electronic lithography for portraits of the Grand Duke and Grand Duchess of Luxembourg, made in gold layering on a silicium plaque with a diameter of two inches. At the limit of retinal perception, the dimensions of these portraits will be about 150/250 microns by 150/250 microns.

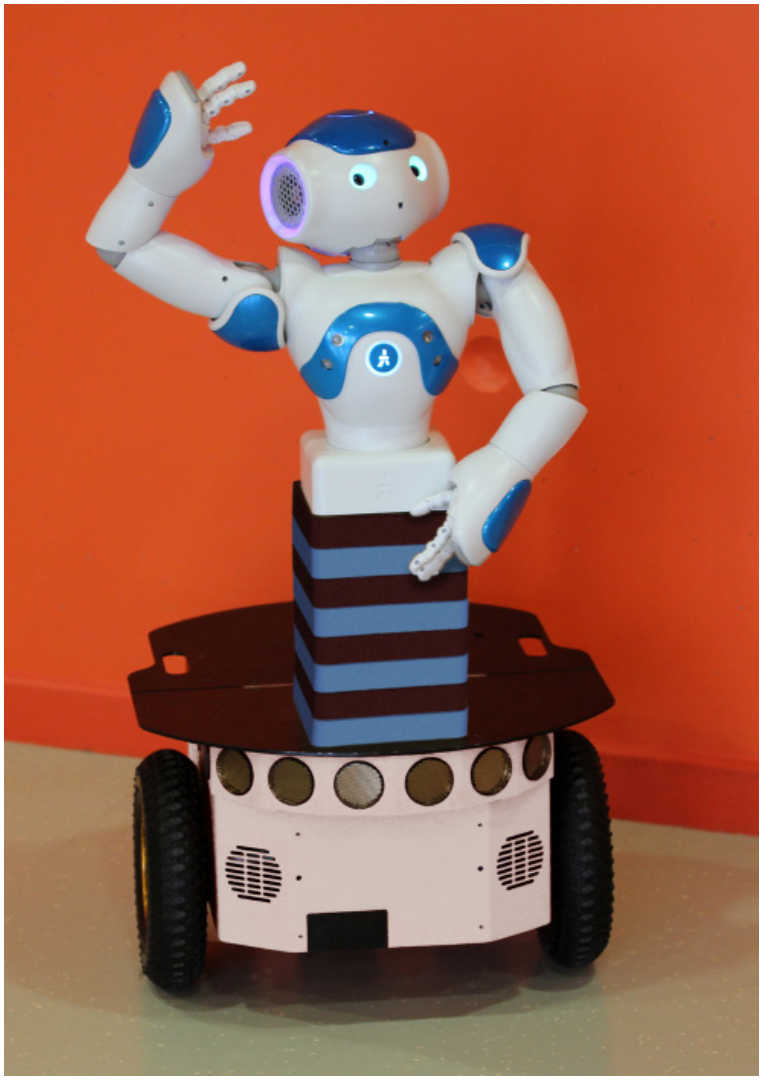
Referring directly to the traditional art of medal-makers and medal engravers, the work will be created with the most state-of-the-art techniques in terms of prototyping on a nanometric scale. It will thus represent nothing less than a technical and technological innovation. The final work also include the design of a set.



Nano portraits de leurs Altesses Royales le Grand-Duc Henri et de la Grande-Duchesse Maria Théresa de luxembourg, 2014-2015
Nano-manufacturing by electronic lithography
Seen in the optical microscope
Gold deposit on silicon
Diameter of the silicon: 100 mm
Dimensions of portraits:180 et 200 µm (hight)
Commissioned and Collection Mudam Luxembourg
Acquisition 2013

PAUL GRANJON
GUIDO, LE ROBOT GUIDE, 2015

The artist Paul Granjon is developing the *Guido, le Robot Guide* project in partnership with the Alliance ARTEM Nancy which, for the occasion, has set up a workshop for 17 students from the École nationale supérieure d'art de Nancy, École nationale supérieure des Mines de Nancy and the ICN Business School Nancy-Metz. Including an artist, researchers and art, engineering and business students, this project is planning the design, construction and programming of a centaur robot called *Guido*. Throughout the exhibition, *Guido* will introduce the public to his "ancestors" on view, such as Jean Tinguely's monumental installation *Fatamorgana, Méta-Harmonie IV* and Job, the electronic fox, which comes from the collection of the Musée des Arts et Métiers. *Guido* will not just organise a visit, he will also communicate verbally with the public.



Guido, le Robot Guide, 2015
© P. Granjon and A. Désaubliaux

MEDIATION PROJECTS

MEDIATION PROJECT FOR A 21ST CENTURY MUSEUM

The SNT research department (Interdisciplinary Centre for ICT Security, Reliability and Trust) of the Université de Luxembourg is currently working on an ambitious mediation project for a 21st century museum, initiated by the researcher Dr.Patrice Caire, which consists in "robotically" supporting the Mudam's Publics Department. Developed over three years, this programme will in due course consist in enabling robots to welcome and interact with museum visitors. The project's first phase will be unveiled at the exhibition.

CoRobots is a project of the Interdisciplinary Center for ICT Security, Reliability and Trust (SnT) in collaboration with the Ville de Luxembourg.

TECNIFICIO – MAKE ART WITH SCIENCE

Through the eyes of *a maker, Make Art With Science* creates a connection between art and science.

Produced with the help of a digital manufacturing technology for low-tech materials, a set of three interactive installations will be exhibited at the Mudam Luxembourg.

The first concept is *Pendulum*, showing the curves of an oscillating motion through different techniques (3D printed pendulum with ink).
The second is titled *Optics* and represents different optical phenomena.
Circuit, the third concept, for its part illustrates the principle of information transmission.

This project is being produced by Tecnificio in collaboration with Sharazad, Lino's Type (Verona) and Diego Quetti (Politecnico of Milan).

MOBILE APPLICATION

In collaboration with Bunker Palace, the Mudam is proposing a free application, whose purpose is to encourage a dialogue between prestigious objects, works and visitors.

This new application will enable the public to have all the information associated with the exhibition, thanks to a connected visit which will give the objects an interactivity with the human factor.

Each visitor will thus be able to install the application dedicated to the exhibition. With the help of interactive "beacons", placed in the different rooms, visitors will be advised when they pass close by a contemporary work and/or an object from the collection of the Musée des Arts et Métiers, in order to have access to additional explanations.

A game will be accessible to every visitor, following their circuit, and offering to answer questions about the binomial technical objects/works. At the end of the visit, all the participants will be able to share their results on social networks, if they so wish.

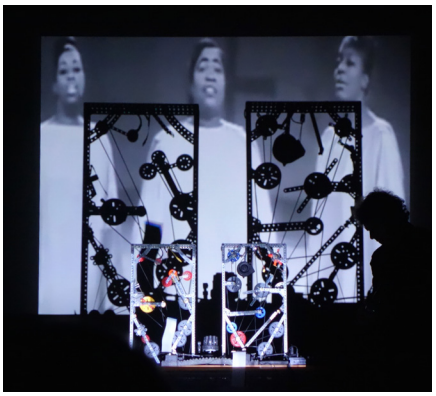
OTHER EVENTS TO COME AS PART OF THE EXHIBITION

PERFORMANCES/CONCERTS
MUDAM AUDITORIUM

18.10.2015, 2pm
PIERRE BASTIEN, *SILENT MOTORS*

Pierre Bastien's concerts and installations, organised around traditional instruments, miniature and fragile machinery, as well as shadows, images and superpositions, are at the crossroads of scholarly and popular music, offering a space of visualisation.

For *Eppur si muove, Art and Technology, a shared sphere*, Pierre Bastien will show his new set, *Silent motors* organising paper instruments (organs, flutes...), machines and musicians of the past in the form of video images, in a poetic and delicate world.



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25.11.2015, 7pm
GAUTHIER KEYAERTS, *FRAGMENTS #43-44*

© DR

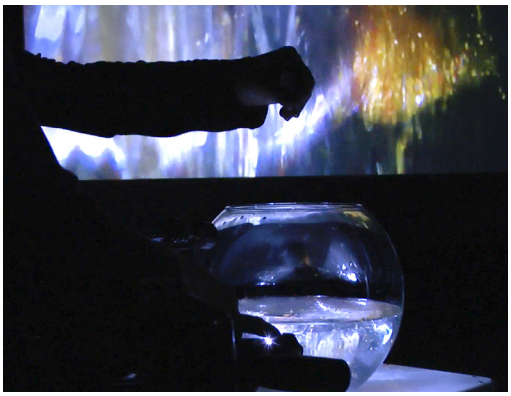
As a musical instrument of a new generation, *FRAGMENTS #43-44* makes it possible to control sounds and modify them, with the help of body displacement, and gestures, all without any tangible stringed instruments.
These physical impulses also have repercussions on generative visuals, projected onto a screen, i.e. a graphic score being forever renewed.

Project financed by the Fédération Wallonie Bruxelles (digital arts unit), jointly produced by the Institut Numediart/ UMonsetTranscultures (Centre des cultures numériques et sonores).

13.12.2015, 2pm and 4 pm
OMPRODUCK, *RÊVERIES MAGNÉTIQUES/MAGNETIC DAYDREAMS*

Magnetic Daydreams invites us to embark on a motionless journey and takes us into worlds at once near and far, giving full rein to daydreams. Different kinds of matter and fluids are handled live under the keen eye of a camera which recreates these unusual worlds with their multiple facets by projecting them onto a screen.

Flamboyant alchemy, landscapes frozen in a slow transformation; poetry blazes a trail. We are invited to a sensory walk evoking microcosm and macrocosm, a plunge into the infinite which tries to suspend the passage of time.



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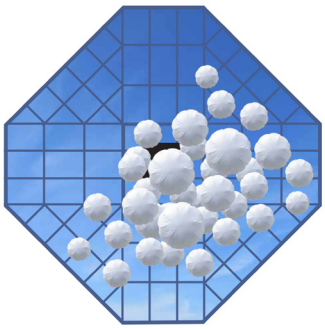
MUDAMINI OPENING

With workshops involving art, technology and science, as well as music and things to nibble.

Saturday 11 July 2015 from 1.30 to 5.30pm

CUMULUS
The Mudamini opening is also the official inauguration of the new Mudam Studio after its move to the museum pavilion: space, light and a nice surprise to make these sunny days pleasant ones beneath the glass roof, specially designed by the Toer design studio.



© DR

APPARAT
While freely expressing himself, production of a machine based on simple graphic forms proposed by the artist Paul Kirps.

AUTOMATA DRAWING !
Like a mad scholar and handyman, creation, with the engineer and artist Fabrice Cotinat, of a robot-artist capable of making drawings all on its own!

ROBOPLASTIC
With Samuel Levy, a young artist and energy catalyst, make your futuristic three-dimensional robot with the help of simple everyday things.

PROFESSOR JAUMET'S SYNTHES WORKSHOP
Etienne Jaumet, the saxophonist and collector, will introduce children to his analog toys: analog synthesizers, organs, theremin, and rhythm boxes.

THE SCIENCE OF ART MAKING
With Tecnificio (Patrizia Bolzan and Marcello Pirovano)
Come and try out the three instruments of the Tecnificio group to understand the secrets hidden behind physical phenomena, electrical circuits and optical illusions!

VISITE ROBOTIQUE (en français)
Discover the exhibition *Eppur si muove* with *Guido*, the little futuristic robot, whose father is the artist Paul Granjon. *Guido* will also serve little nibbles!

"LA VISITE" CONCERT (new album)
Etienne Jaumet at the helm of his ship, moving merrily from alto saxophone to rhythm box (his dear TR 808), while turning the modulation knobs of his synthesizers, or sending his voice into an echo... A solitary journey where the listener is caught up in a galactic voyage.

BAR A SMOOTHIES
For the Mudamini opening, come and relax on deckchairs designed by Andrea Blum and sample a refreshing Smoothie made fresh on the spot in the SUMMER CAFE. (If the weather turns bad, the Bar will be set up in the Mudam Café.)

Places are limited, by invitation only and reserved for members
More information on www.mudam.lu/mudamini/vernissage

15 - 17 OCTOBER 2015
SYMPOSIUM

SCIENCE IN THE MAKING, ART IN THE MAKING

The issue of research in the scientific, technical and artistic spheres

In a desire to give greater coverage of the exhibition *Eppur si muove* and make the most of this exceptional collaboration with the Conservatoire national des Arts et Métiers in order to create a moment of reflection around the cross-disciplinarity of the themes broached, the Mudam is keen to give the floor to people from different fields around notions of creativity and invention. The idea is to highlight shared points between artistic and scientific approaches, as well as underscoring the importance of the research and experimental processes peculiar to them.

Researchers, academics, scientists, engineers, artists, curators, art critics, as well as historians, philosophers, and writers... fifteen or so participants from different backgrounds will follow each other turn by turn over three days, in the course of individual presentations and exchanges chaired by one or more moderators who will guarantee the continuity of the discussions.

Jörg Rheinberger
Science Historian, former director of the Max Planck Institute in Berlin

Jean-Christophe Bailly
Writer, author of a book about Piotr Kowalski

Jean-Marc Lévy-Leblond
Physicist, essayist, epistemologist, professor emeritus of the University of Nice

Todd Lubart
Professor of psychology at Paris V, director of the Laboratoire Adaptations Travail, researcher into creativity

Marie-Sophie Corcy
Research engineer at the Musée des Arts et Métiers (Cnam) in Paris

Steven Shapin
Historian of science and sociology, attached to the History of science department at Harvard

Michel Menu
Engineer in optical physics and head of the Research department at the Centre de recherche et de restauration des musées de France

Michel Paysant
Artist, collaborates regularly wiht the CNRS

Pierre Cassou-Noguès
Philosopher, in charge of research at the CNRS

Christoph Fink
Künstler

15 - 17 OCTOBER 2015
SYMPOSIUM

SCIENCE IN THE MAKING, ART IN THE MAKING
The issue of research in the scientific, technical and artistic spheres

SCIENTIFIC COMITTEE

President
Patricia Falguières
Associate professor, École des Hautes Etudes en Sciences Sociales, Paris

Bruno Bachimont
Research director from l'Université de technologie de Compiègne

Christian Debize
Director at l'École nationale supérieure d'art de Nancy

Jean-Jacques Dumont
Artist, professor at l'École Supérieure d'art de Lorraine, Metz

Patrick Hénaff
Professor at l'École nationale des Mines de Nancy - ARTEM, department of «Information et Système»

Guy Keckhut
Deputy director at Conservatoire national des Arts et Métiers en Lorraine

Marc Lemmer
Member of the executive comitee, Luxembourg Institute of Science and Technology (LIST)

Massimo Malvetti
Officer for the scientific and technical literacy, professor at Université du Luxembourg

Michel Menu
Research engineer, head of research from the center of research and restauration of France museums, Paris

Michel Paysant
Artist

Jean-Claude Ruano-Borbalan
Director of history of technoscience in society lab from Conservatoire national des Arts et Métiers

Marc Schiltz
General secretary of Fonds National de la Recherche Luxembourg

Lionel Dufaux
Curator of energy and transport collection, Musée des Arts et Métiers, Paris

Enrico Lunghi, Marie-Noëlle Farcy, Christophe Gallois, Clément Minighetti
Curators of the exhibition *Eppur si muove, Art and Technology, a shared sphere,* Mudam Luxembourg

Nadine Erpelding
Head of Publics, Mudam Luxembourg

PARTNERSHIPS

EXHIBITION PARTNERS

Fonds National de la Recherche Luxembourg, The Loo & Lou Foundation, under the aegis de la Fondation Luxembourg, CFL - Société Nationale des Chemins de Fer Luxembourgeois

MEDIA PARTNERS

PARTNERSHIPS AND EXCEPTIONAL SUPPORT

Jean Tinguely, *Fatamorgana, Méta-Harmonie IV*, 1985
Project realised with the support of Goeres Horlogerie, Kneip, CBP Quilvest S.A., Pro Helvetia and Edmond de Rothschild (Europe)
Particular thanks to H.E.Mr Urs Hammer, Swiss Ambassador in Luxembourg and to Monsieur Robert Goeres, director of Goeres Horlogerie

Paul Granjon, *Guido, le robot guide*, 2015
Project developed in collaboration with Artem Alliance (École Nationale Supérieur d'Art de Nancy, ICN Business School Nancy-Metz, École des Mines de Nancy) and Laboratoire Loria (CNRS Université de Lorraine-INRIA), under the leadership of Patrick Hénaff.
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Sponsored by KPMG Luxembourg

Trevor Paglen, *Prototype for a Nonfunctional Satellite (Design 4; Build 3),* 2013
Project sponsored by SES

Mobile Application
Application developped by

Project sponsored by POST Luxembourg

Michel Paysant, *Nano-portraits de leurs Altesses Royales le Grand-Duc Henri et la Grande-Duchesse Maria Teresa,* 2014-2015
Project realised with the support of Olympus Microscopie

With the support of Institut Français du Luxembourg

PRACTICAL INFORMATION

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Opening hours
Wednesday - Friday: 11am-8pm
Saturday - Monday: 11am-6pm
Public holidays: 11am-6pm
Closed on Tuesday and 25.12
Opened on 24.12 and 31.12 : 11am - 3pm

Entrance fee

Adults	7 €
Under 26 years old, groups	5 €
Mudami card (valid 1 year for 2 persons)	50 €
Under 21 years old	free
Students under 26 years old	free
Wednesday, 6pm-8pm	free

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MUDAM THANKS

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as well as

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