

THE NEW ART EVENT IN THE DIGITAL AGE

GLOBAL

Exo-Evolution

30.10.2015
-28.2.2016

ZKM_Atrium 8+9

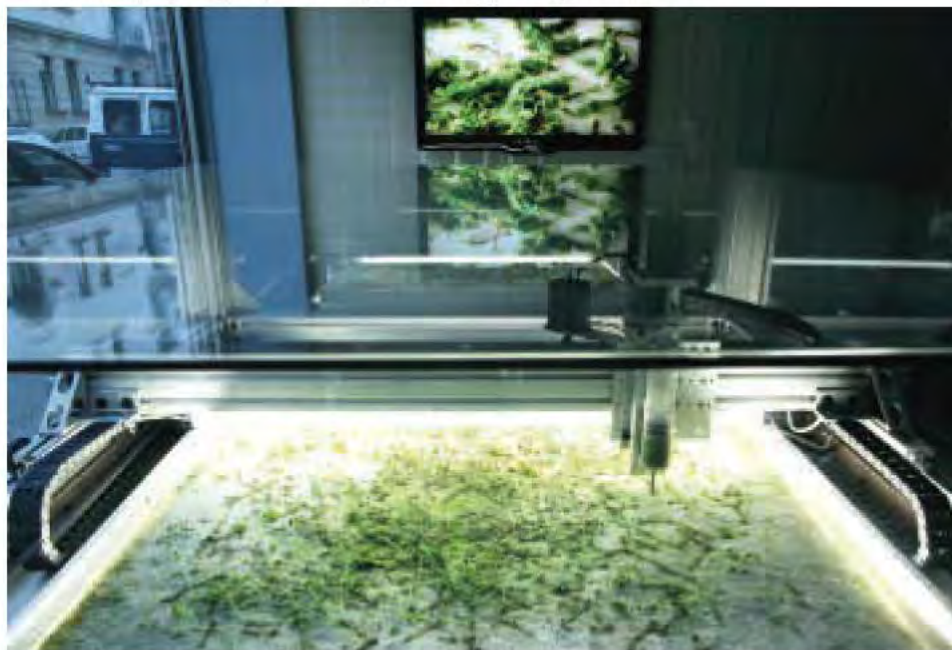
EXPERIMENTAL

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Artificial Nature (Haru Ji, Graham Wakefield), *Time of Doubles*, 2012

Allison Kudla, *Capacity for (urban eden, human error)*, 2009, photo: Miha Fras



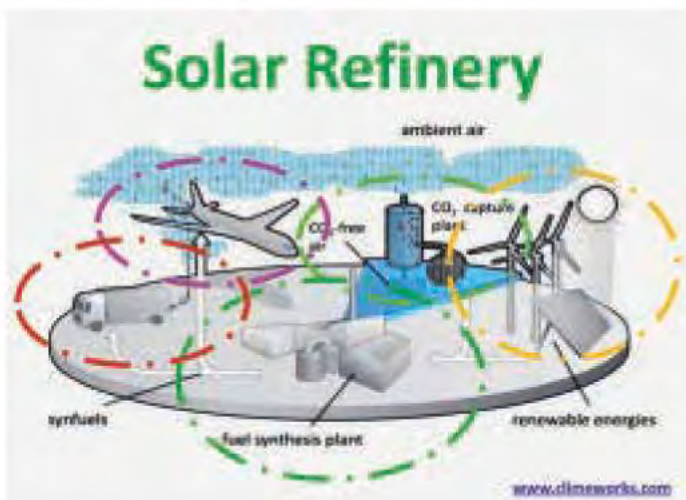


Alexandra Daisy Ginsberg, *Self-Inflating Anti-pathogenic Membrane Pump* from *Designing for the Sixth Extinction*, 2013–2015

Alisa Andrasek, *XenoCells*, 2015



Geoffrey A. Ozin, draft of a solar refinery, © Climeworks and G.A. Ozin



robotlab (Matthias Gommel, Martina Haitz, Jan Zappe), *the big picture*, 2014



Tue Greenfort, *Es grünt nicht mehr so grün* (2013) from *VIS VITALIS*, 2014,
Courtesy of Galerie König, Berlin



Lucy and Jorge Orta, *Orta Water – Zille Fluvial Intervention Unit*, 2008/2015,
© VG Bild-Kunst, Bonn 2015



Maja Smrekar, *Hu.M.C.C. – Human Molecular Colonization Capacity*, 2012,
Courtesy of Kapelica Gallery, Ljubljana



Yuri Ancarani, *Da Vinci*, 2012, Courtesy of the artist,
Isabella Bortolozzi Gallery, Berlin, and ZERO ..., Milan



Kitsou Dubois, *Perspectives, time for a new glance*, 2011, Courtesy of La Magnanerie



Louis-Philippe Demers,
Bill Vorn, *Inferno*, 2015

Peter Weibel

Exo-Evolution

“Medicine has not been able to cure me, so I rely on technology to help me communicate and live.”
(Stephen Hawking)

The industrial revolution was clearly machine-based. From the steam machine to automobile and film projector, it was dominated by a technology based mainly on the technical principle of the wheel. These machines were, on the one hand, accelerators; but, as artificial tools, they also assumed, in improved form, the tasks of natural organs: What the leg couldn't achieve, the wheel did; what the eye couldn't achieve, the telescope did; what the voice couldn't, megaphones and microphones achieved. The machine-based industrial revolution and the information-based postindustrial revolution have created the technical prerequisites for a development we may call the “exo-evolution.”

Already in 1791, Johann Gottlieb Herder presented a vision of the impact of the industrial revolution as a turn in the history of ideas, when he formulated: “The human is the first of creation *let free*; he stands upright. The scales of good and evil, of false and true, hangs inside him: He can research, he is to choose. Just as nature gave him two free hands as tools and an overlooking eye to guide his steps, he has the power not only to place the weights, but also, if I may say so, *to be a weight himself* upon the scale.”¹

Herder's equation “our earth is a star among stars”² prefigures Richard Buckminster Fuller's idea that the earth is a spaceship with limited resources and a missing operating manual: “So, planners, architects, and engineers take the initiative. Go to work, and above all cooperate and don't hold back on one another or try to gain at the expense of another. Any success in such lopsidedness will be increasingly short-lived. These are the synergetic rules that evolution is employing and trying to make clear to us. They are not man-made laws. They are the infinitely accommodative laws of the intellectual integrity governing universe.”³

It is not only the modern era that is an unfinished project – the human being, the earth, and the world are unfinished, open projects too, that will be transformed by further revolutions. We currently find ourselves at the beginning of the digital revolution.

Herder indicates the key idea, that the upright walk was nature's way of freeing humans' feet to become hands, allowing them to transform from natural organs into technical tools. This pre-formulates the development of humans during the industrial revolution; i. e. the transition from organs to tools; from natural sensory organs to machines, media and apparatuses; from nature to technology. Herder defines this transition positively, as a moment of freedom. Released from the prison of nature, human beings wind up as “free-handed cultural beings”⁴ (Kurt Bayertz) in the free port of technology. Yet this freedom of choice also always entails human beings submitting themselves to choice – and facing choices. Herder's metaphor, that the human being not only has the power to place the weights, but is himself a weight on the scale, highlights the idea of recurrence, of going back – the human being is part of the system that he observes, in which he selects and weighs.

Through the technical and industrial revolution, humans have once again become beings let free, namely let free from evolution. This process, this stepping out of the process of natural evolution, I call “exo-evolution.” From exo-biology to exo-planet, from exo-skeleton to exo-pregnancies – the increasingly differentiated contours of a new world appear, one with a profoundly technological stamp.

1 Johann Gottfried Herder, *Ideen zur Philosophie der Geschichte der Menschheit* [Outlines of a Philosophy of the History of Mankind], 1784–1791, 2 vols, vol. 1, Berlin, Weimar, 1965, p. 144; translated from the German by Lonnie Legg.

2 *Ibid.*, p. 17.

3 Richard Buckminster Fuller, *Operating Manual for Spaceship Earth*, Simon Schuster, New York, 1968, last paragraph.

4 Kurt Bayertz, *Der aufrechte Gang* [upright walking], C.H. Beck, Munich, 2012; translated from the German by Lonnie Legg.

The term exo-evolution is an extension of Michel Serres' term "exo-Darwinism": "But what is true of purely physical functions – with regard, for example, to hammer, wheel, etc. – is also true of intellectual functions (*fonctions intellectuelles*), and indeed you can clearly see that memory has become materialized: in writing, in printing, in computer science. The body actually loses – it loses these objects, which become conveyors of an evolution that we call technical evolution, scientific evolution, etc. I call this exo-Darwinism."⁵

In 1877, in his *Grundlinien einer Philosophie der Technik* [Principles of a philosophy of technology], Ernst Kapp formulates his organ projection theory, which states that, in the final analysis, all technical artifacts are reproductions and projections of organs; for example, the hammer reproduces the fist, the saw reproduces incisors, telegraphy reproduces the nervous system, and so on. Therefore, the technical evolution is a multiple exteriorization, an outsourcing of natural physical organs and functions, as well as mental functions, to technical machines: human arms to bow and arrow, speaking to writing, memory to clay tablets and computers, and so on. The media theory that follows this paradigm of extending bodily functions is thus an "organology," describing the transformation from natural organs to technical tools. The particular technology of an era is thus understood as the outsourcing – exteriorization and externalization – of already existing organic and intellectual human properties. At the same time, this understanding of technology and media is based on an anthropology that defines the human being as a deficient creature being improved by technology.

This dialectic of human being and mechanics, of nature and technology, of organs and tools was first formulated in ancient Greece and is still alive today, for example in psychoanalysis. The Greek goddess of helplessness was named Amechania. In Greek, "a" stands for negation (*atomos*, for example, being that which is not divisible). Mechania thus means help, helpfulness. If a rock is too heavy for a human, he uses a lever to move the stone – this is the idea of mechanics: an enhancer of human ability, or a compensation for lacking natural abilities. Technology is thus nature humanized by humans; in short: Technology is human-made nature.

In his 1924 "Notiz über den 'Wunderblock'" [A note upon the "Mystic Writing Pad"] Sigmund Freud writes, "Auxiliary apparatuses [...] are all built like the sensory organ itself or parts thereof [...]"⁶ And in his 1930 "Das Unbehagen in der Kultur" [Civilization and Its Discontents], he explains, "With all his tools, man is perfecting his organs – the motoric, as well as the sensory – or is removing the limits to their functioning. Motors place gigantic forces at his disposal, which, like his muscles, he can send in any direction [...]. With spectacles, he corrects defects of the lens of his eye, with the telescope he gazes into remote worlds, with the microscope he overcomes the bounds of visibility set by the construction of his retina. With the photographic camera, he has created an instrument that captures fleeting visual impressions, which he also demands from the gramophone record with respect to his equally ephemeral auditory impressions [...]. With the aid of the telephone, he can hear at distances that, even in a fairy tale, would be respected as unattainable; writing is originally the language of the absent person; the dwelling a substitute for the womb, the first housing, for which we probably still long, in which we were safe and felt so good.

It not only sounds like a fairy tale, it is a direct fulfillment of all his – no, of most – fairy tale wishes: the things that man through his science and technology has created on this earth, on which he first appeared as a weak animal creature, and on which each individual

⁵ Michel Serres, interview in: *Regards sur le sport. Michel Serres, philosophe imagess. Une documentaire de Benjamin Pichery*, Insep, Paris, 2009 (DVD); English translation by Lonnie Legg.

⁶ Sigmund Freud, "Notiz über den 'Wunderblock'" [A note upon the "Mystic Writing Pad"], 1924, in: *Studienausgabe*, vol. 3: *Psychologie des Unbewussten*, Fischer, Frankfurt am Main, 1975, pp. 363 – 369, here p. 366; translated from the German by Lonnie Legg.

of his species must once more make his entry as a helpless suckling ('oh inch of nature!'). [...] Man has, so to speak, become a kind of prosthetic God – quite magnificent when he dons all his auxiliary organs, but they have not grown onto him and still give him much trouble at times. He is entitled, by the way, to console himself with the thought that this development will not be completed precisely with the year AD 1930. Future ages will bring with them new, probably unimaginably great advances in this field of civilization, and will increase man's likeness to God even further.”⁷ Thus, every technology is tele technology, the overcoming of chronological and spatial distances (“tele” in Greek): telefax, telephon, television. With these machine or media supported, as well as unnatural or superhuman, skills of man, every tele technology – indirect and secretly – becomes a theo technology; a technology, that makes humans godlike in their imagination.

Marshall McLuhan laid out his understanding of media as an extension of the human sensory organs (an understanding that is quite similar to Freud) in 1964, in his *Understanding Media: The Extensions of Men*. Earlier, in a 1956 essay, he had written, “Each new technology is the reprogramming of sensory life.”⁸ What he meant was, firstly, that the relationships between the sensory organs are reprogrammed; and secondly, that the relationship of the sensory organs to their surroundings is reprogrammed. In a word, our entire sensory life is reprogrammed by the media, the machines, and technology.

Another witness of the connection between machines and life, exo-evolution and evolution, is Samuel Butler. A few years after the 1859 publication of Charles Darwin's theory of evolution – in *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life* – in 1872, Butler published his utopian novel *Erewhon* (the title is an anagram of the word “nowhere”). In the chapter “Book of the Machines,” he projected his concept of natural evolution onto the mechanical world. Nine years earlier, in the essay upon which this chapter is based, Butler had already described the idea of mechanical life, i. e. artificial life; and compared the idea of natural evolution with the evolution of machines: “We find ourselves almost awestruck at the vast development of the mechanical world, at the gigantic strides with which it has advanced in comparison with the slow progress of the animal and vegetable kingdom.”⁹

George Dyson expanded on this idea in two publications. In 1998, in *Darwin Among the Machines. The Evolution of Global Intelligence*, he presents the theory of the Internet being a conscious living creature. In *Turing's Cathedral. The Origins of the Digital Universe* (2012), he accurately describes the evolution of the digital universe.

Accordingly, from manual to mental tools, human beings have over the course of millennia evolved a tool culture, an engineering culture, extending the bounds of perception and of the world. From microscope to computerized tomography, the technologies of perception in science have advanced. Objects undetectable to the natural eye were made visible by means of apparatuses. The new media are introducing the technologies of apparatus-aided perception, from photography to computer, into the realm of art. This creates a new awareness of the interconnectedness of natural and apparatus-aided perception, of object world and media world, of art and science. Media are not merely image and sound machines, but also interfaces for constructing new realities and new communication forms. Now that artists and scientists have a certain range of tools in common, the studios of artists occasionally look like the laboratories of science, and vice versa. Modern-day

7 Sigmund Freud, “Das Unbehagen in der Kultur” [Civilization and Its Discontents], 1930, in: *Das Unbehagen in der Kultur und andere kulturtheoretische Schriften*, Fischer, Frankfurt am Main, 1994, pp. 57f; translated from the German by Lonnie Legg.

8 Marshall McLuhan, David Carson, *The Book of Probes*, Gingko Press, Corte Madera, 2003, pp. 162f.

9 Samuel Butler, “Darwin Among the Machines. To the Editor of the Press, Christchurch, New Zealand, 13 June, 1863,” in: idem, *A First Year in Canterbury Settlement With Other Early Essays*, A. C. Fifield, London, 1914, pp. 179–185, here p. 180.

artists are less focussed on seeking subjective expression; their frames of reference are social systems, as well as the structures and methods of the sciences. Against this background, such new research methods and perspectives as art-based research (AR) and art & science labs are evolving. A scientification of art like in the Renaissance epoch of art history is emerging: a Renaissance 2.0.

The exhibition *Exo-Evolution* sets its focus on the artistic application of new technologies, offering views of the future and the past with its modules. It shows us a new reality formed by 3-D printers and robots, cyborgs and chimeras, molecules and gene pools; by wearable technologies and medical miracles; by synthetic beings, bionic suits and silicon retinas, artificial tissue and biotechnical repairing methods; by findings from aerospace research, molecular biology, neurology, genetics, and quantum computing. And it shows us visions and solutions for problems of the 20th century; for example, splitting off oxygen from CO₂ (carbon dioxide) to cope with the climate crisis.

With their natural organs of perception, humans can only cover a limited frequency range, and operate in a narrow sphere. The eyes, the ears, the hands, and the lungs are evolution's responses to natural conditions including sunlight, sound waves, and atmosphere. Painting and music – the art forms of the hand and the mouth for the eye and the ear – are the human being's first responses to evolution that utilize these two natural sense organs, brought forth by evolution itself, and manufactured instruments contrived by human beings within the limited range of frequencies or wavelengths visibly or aurally accessible to humans. New electronic and digital art forms, such as film, video, and computers that use the extended spectrum of electromagnetic waves conquered by humans 130 years ago, began to appear around the mid-20th century. With these tools and meta-tools, man creates a new exo-universe. By not only leaving the field of engineering culture to the sciences, art follows up to other epistemic systems, which explain and change the world. This new form of art aims for solutions like the exo-evolution itself and thus itself becomes part of the exo-evolution.

Translated from the German by Lonnie Legg

Participating Artists

Exo-Evolution

1–36

- 1 ::vtol:: (1stf.)
- 2 1024 architecture (G. f.)
- 3 AIDA facility at the Institute of Meteorology and Climate Research, Atmospheric Aerosol Research Department (IMK-AAF), Karlsruhe Institute of Technology (KIT) (1stf.)
- 4 Jinsoo An (1stf.)
- 5 Yuri Ancarani (1stf.)
- 6 Alisa Andrasek and Jose Sanchez, *BLOOM* (1stf.)
- 7 Alisa Andrasek, *XenoCells* (1stf.)
- 8 Suzanne Anker (G. f.)
- 9 Anthropocene Observatory (G. f.)
- 10 A.N. (Haru Ji, Graham Wakefield) (G. f.)
- 11 Lise Autogena and Joshua Portway (G. f.)
- 12 Sonja Bäuml and Manuel Selg (G. f.)
- 13 Nurit Bar-Shai (G. f.)
- 14 Ursula Biemann and Paulo Tavares (G. f.)
- 15 Ecke Bonk /
typosophes sans frontières (1stf.)
- 16 Adam W. Brown and Robert Root-Bernstein (G. f.)
- 17 C-LAB (Howard Boland and Laura Cinti) (G. f.)
- 18 Oron Catts, Corrie Van Sice, and Ionat Zurr (G. f.)
- 19 Center for PostNatural History (G. f.)
- 20 Jürgen Claus (G. f.)
- 21 Sam Conran (1stf.)
- 22 Hermann Cuntz and Marvin Weigand (G. f.)
- 23 Theresa Dankovich (1stf.)
- 24 Robert Darroll (1stf.)
- 25 Caitilin de Bérigny (G. f.)
- 26 Frederick De Wilde (1stf.)
- 27 Thierry Delatour (G. f.)
- 28 Louis-Philippe Demers and Bill Vorn (G. f.)
- 29 Design Research Lab (1stf.)
- 30 Heather Dewey-Hagborg (1stf.)
- 31 Kitsou Dubois (ZKM_Subspace)
- 32 Anna Duwithriu (1stf.)
- 33 ecoLogicStudio, (G. f.)
H.O.R.T.U.S Karlsruhe
- 34 ecoLogicStudio, *Meta Follies* (G. f.)
- 35 Electronic Shadow (G. f.)
- 36 Peter Fend / Ocean Earth (1stf.)

37–70

- 37 Thomas Feuerstein (G. f.)
- 38 Verena Friedrich (G. f.)
- 39 Klaus Fritze (G. f.)
- 40 *Future Visions* (1stf.)
- 41 FZI Research Center for Information Technology & Humanoid Robotics Systems – High Performance Humanoid Technologies Lab (H2T) at the Institute for Anthropomatics and Robotics, Karlsruhe Institute of Technology (KIT) (G. f.)
- 42 Eyal Gever (1stf.)
- 43 Alexandra Daisy Ginsberg (G. f.)
- 44 Alexandra Daisy Ginsberg, Sascha Pohflepp and Andrew Stellitano (1stf.)
- 45 Niklas Goldbach (G. f.)
- 46 Andy Gracie (1stf.)
- 47 Tue Greenfort (G. f.)
- 48 History of Others (G. f.)
- 49 Terike Haapoja (G. f.)
- 50 Stephen Hawking (1stf.)
- 51 Ivan Henriques (1stf.)
- 52 Camille Henrot (G. f.)
- 53 Lynn Hershman Leeson (G. f.)
53a *Infinity Engine – Hybrid Room*, 2013–2014
53b *Infinity Engine – Screening Room*, 2013–2014
- 54 Bart Hess (1stf.)
- 55 Chris Jordan (G. f.)
- 56 Manfred P. Kage (G. f.)
- 57 Wanuri Kahiu (1stf.)
- 58 Felix Kemner (G. f.)
- 59 Allison Kudla (G. f.)
- 60 Nandita Kumar (G. f.)
- 61 Ebru Kurbak and Irene Posch (1stf.)
- 62 Christian Lölkes and Adrian Vielsack (1stf.)
- 63 Andy Lomas (G. f.)
- 64 Wolfgang Mally (1stf.)
- 65 Daria Martin (G. f.)
- 66 *The Antikythera Mechanism* (1stf.)
- 67 Mediated Matter Group (G. f.)
- 68 Agnes Meyer-Brandis (1stf.)
- 69 Yann Mingard (G. f.)
- 70 Dave Murray-Rust and Rocio von Jungefeld (G. f.)

71–103

- 71 MVRDV & The Why Factory with MOON Kyungwon & JEON Joonho (G. f.)
- 72 Michael Najjar (1st f.)
- 73 Geraldine Ondrizek
73a *Case Study 22 Chromosomes X & Y*, 2011 (1st f.)
73b *Cellular*, 2008–2009 (G. f.)
- 74 Lucy and Jorge Orta (1st f.)
- 75 Geoffrey Ozin (G. f.)
- 76 *Retooling Evolution: Nature at Work* (G. f.)
- 77 Reynold Reynolds (G. f.)
- 78 Byron Rich (G. f.)
- 79 Adam G. Riess (1st f.)
- 80 robotlab (G. f.)
- 81 Hermann J. Roth (1st f.)
- 82 Scenocosme (1st f.)
- 83 HA Schult (G. f.)
- 84 SEAD (Space Ecologies Art and Design) (1st f.)
- 85 Semiconductor (G. f.)
- 86 Conrad Shawcross (G. f.)
- 87 Maja Smrekar (G. f.)
- 88 Studio Swine (1st f.)
- 89 Luisa Székely (1st f.)
- 90 Yesenia Thibault-Picazo (G. f.)
- 91 Luca Trevisani (G. f.)
91a *Glaucocamaleo*, 2013
91b *As though repetition can legitimize the act (I, II, III)*, 2014/2015
- 92 Troika (1st f.)
- 93 Andrei Ujica (1st f.)
- 94 Koen Vanmechelen (G. f.)
- 95 Paul Vanouse (1st f.)
- 96 Aline Veillat (1st f.)
- 97 Martin Walde (G. f.)
- 98 Peter Weibel (G. f.)
- 99 Where Dogs Run (1st f.)
- 100 Pinar Yoldas, *Ecosystem of Excess* (G. f.)
- 101 Pinar Yoldas, *Archipelago* (G. f.)
- 102 New Tools, New Materials: 3-D Printing (1st f.)
- 103 Reading Room (1st f.)

Module

The Future Is Here

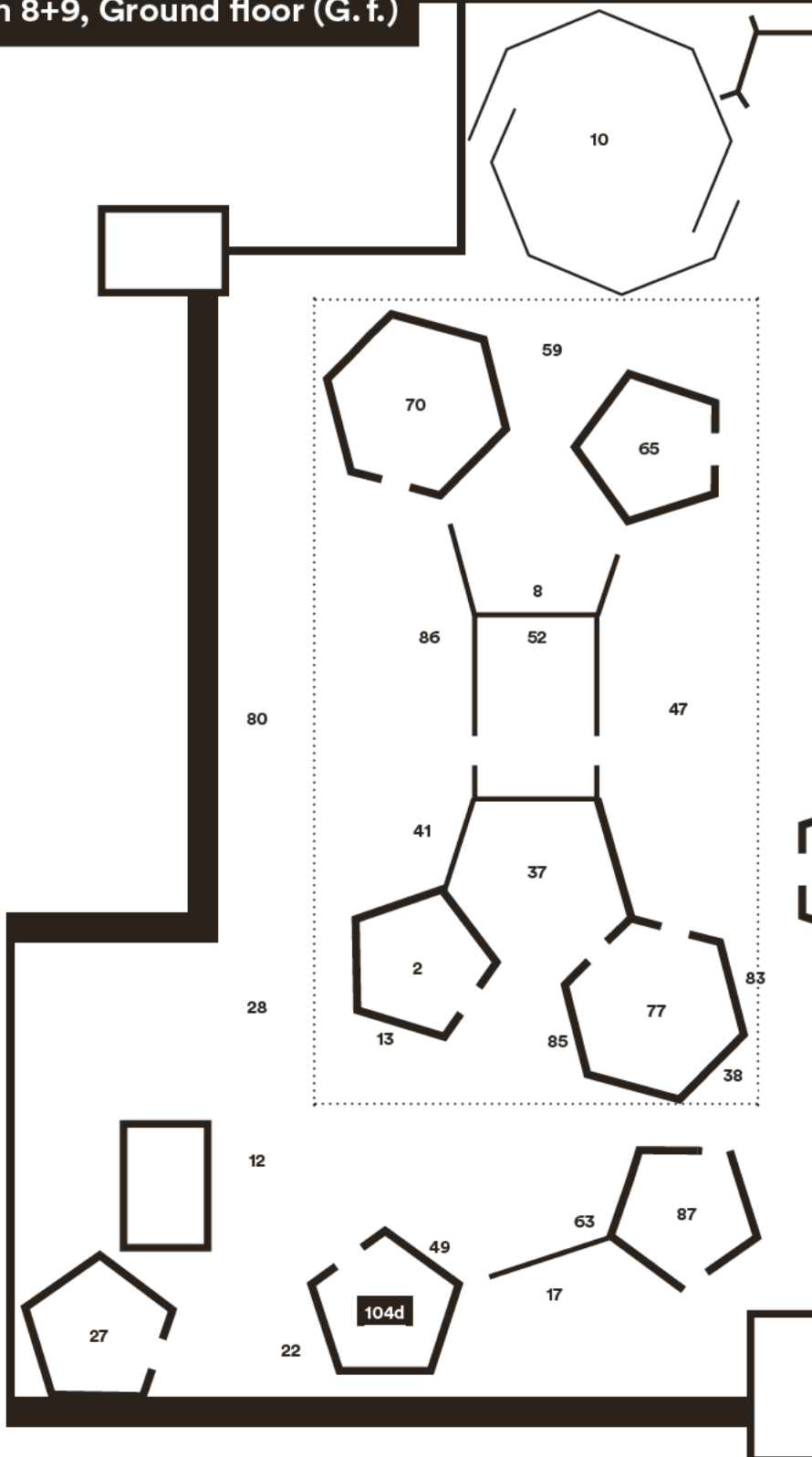
Allahs Automaten

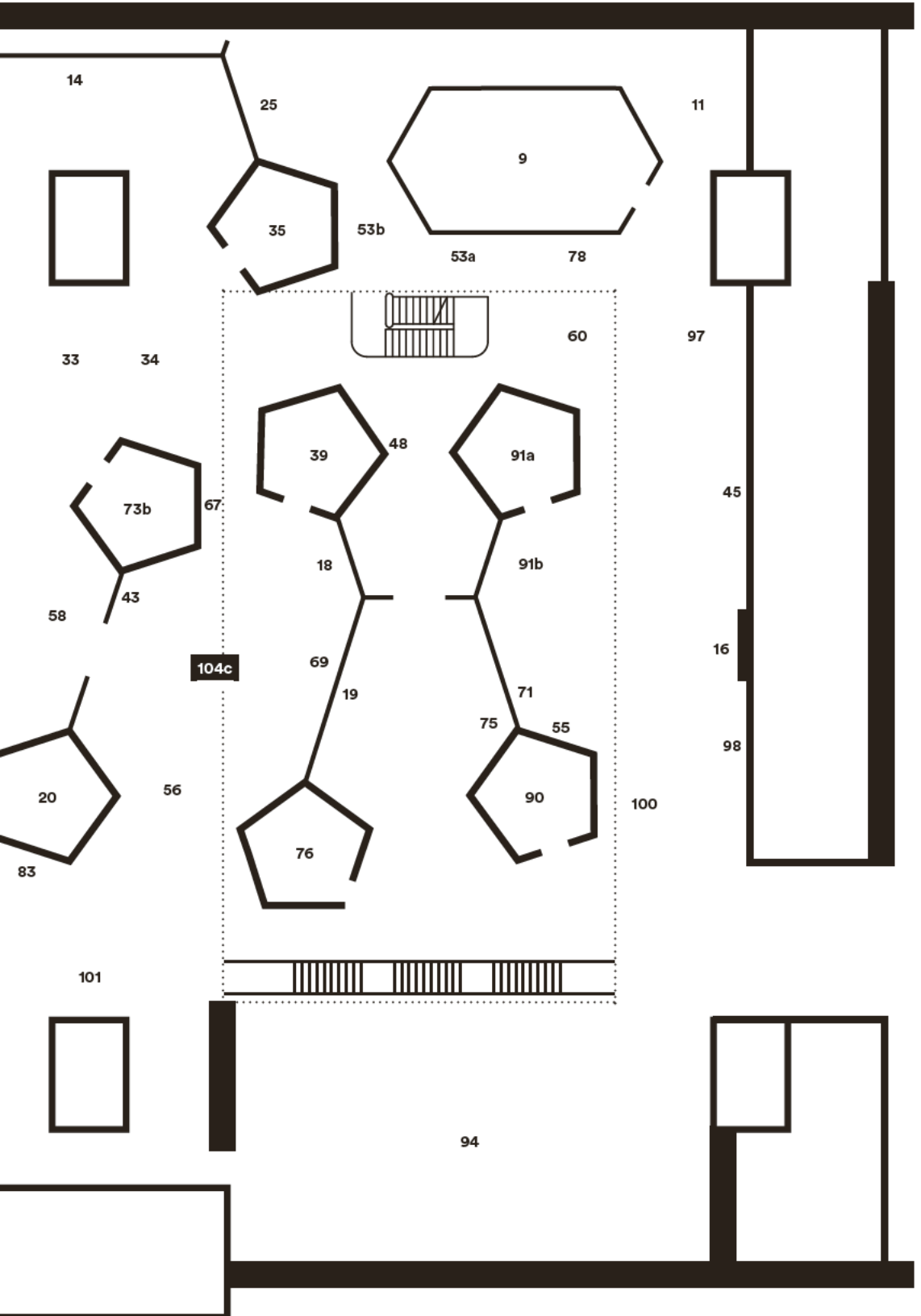
104/105

- 104** *The Future Is Here*
- 104a** Ljiljana Fruk, Bernd Lintermann, and Rüdiger Mach, *BANG/Matter/Dark Matter*, 2015 (1st f.)
- 104b** Ljiljana Fruk and Bernd Lintermann, *Seeing the Invisible*, 2015 (1st f.)
- 104c** Ljiljana Fruk and Bernd Lintermann, *Quintessence*, 2015 (G. f.)
- 104d** Ljiljana Fruk and Bernd Lintermann, *Molecules that Changed the World*, 2011 (G. f.)
- 105** *Allahs Automaten. Artifacts of the Arab-Islamic Renaissance (800–1200)* (1st f.)

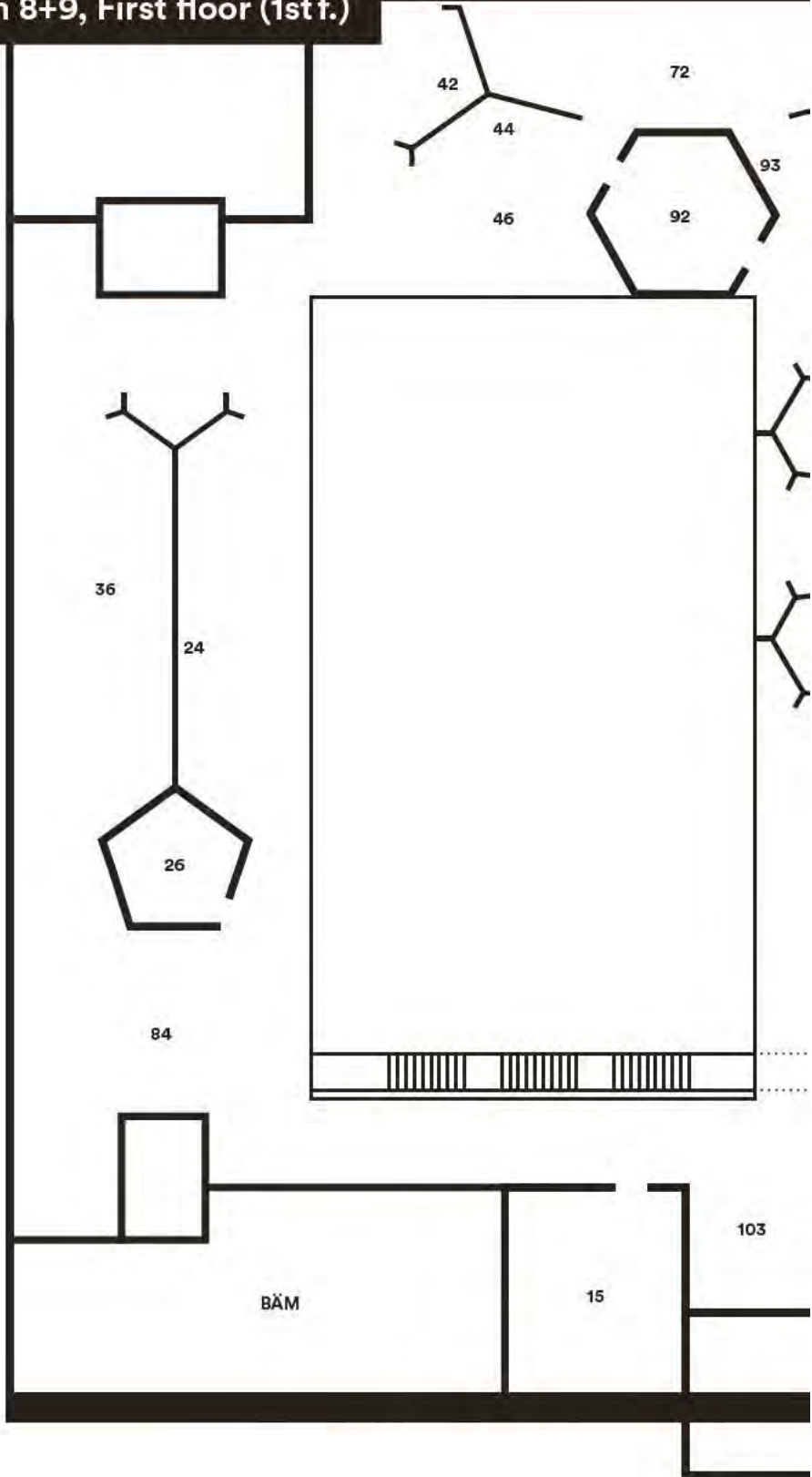
(G. f.) = Ground floor
 (1st. f.) = First floor

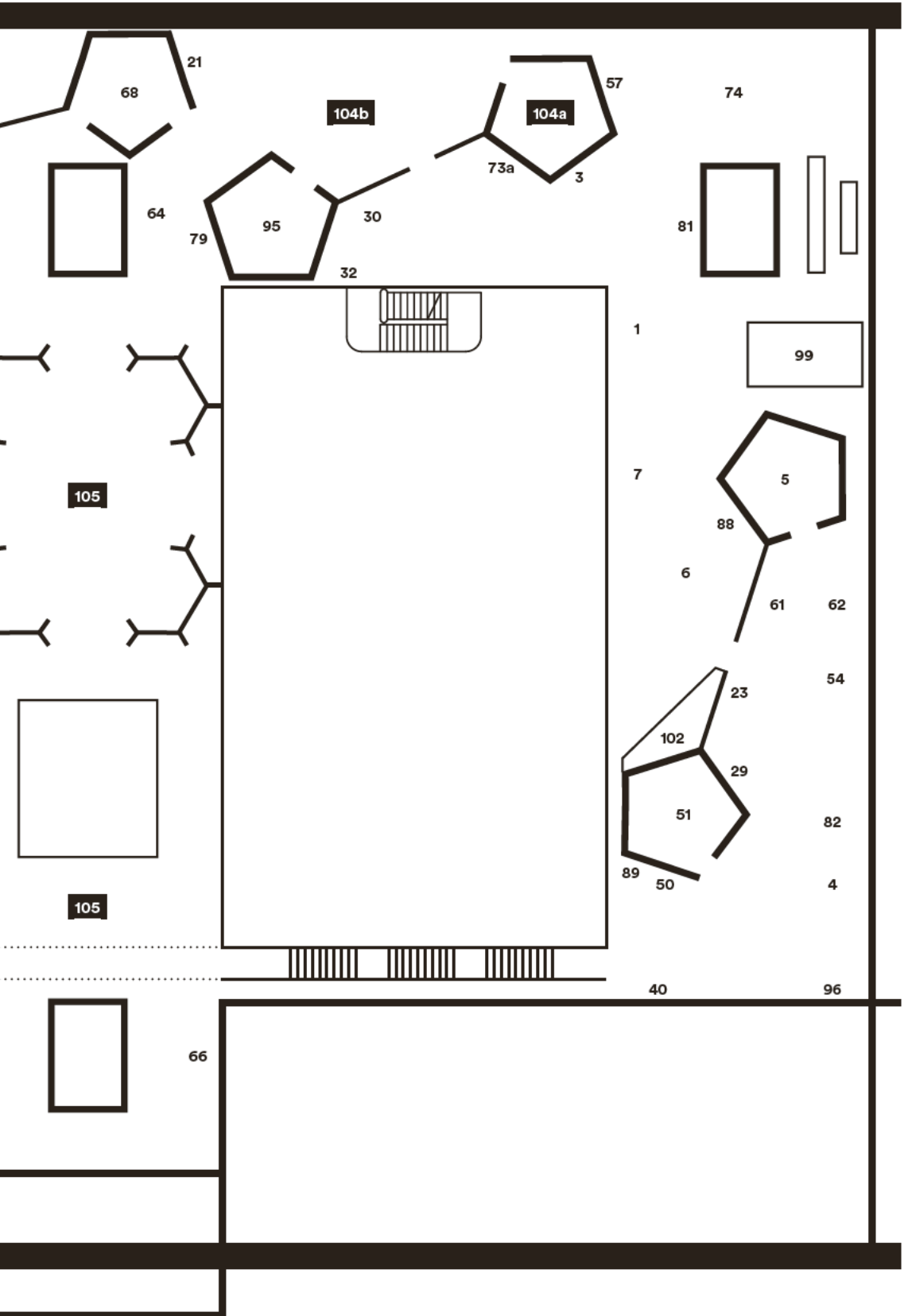
ZKM_Atrium 8+9, Ground floor (G. f.)





ZKM_Atrium 8+9, First floor (1st f.)





::vtol::

wing, 2015

1

*1986 in Moscow, RU, lives
and works in Moscow

Interactive kinetic installation

Under his pseudonym ::vtol::, Russian media artist and musician Dmitry Morozov explores the development of new electronic instruments that can be viewed as technological extensions of the human body. The interactive kinetic installation *wing*, created by the artist for the exhibition *Exo-Evolution*, has the form of a spread bird's wing. Attached to it is an electromyographic sensor, which measures the electrical activity of muscles. Once exhibition visitors have fitted the sensor behind one of their ears, they can move their ears to control the wing suspended above them: Regular, rhythmic muscular movements cause the wing to perform a full swing, while short, irregular contractions cause only a twitch. In a manner similar to those spiritual methods which use deep relaxation and the control of normally uncontrollable muscles to elevate the human soul, in *wing*, the metaphor of flight does indeed ironically animate us to solve an unusual task.

www.vtol.cc

1024 architecture (François Wunschel,
Jason Cook, and Pier Schneider)

WALKING Cube, 2015

2

Creative label founded in 2008 by François
Wunschel and Pier Schneider in Paris, FR
François Wunschel, Jason Cook, and Pier
Schneider live and work in Paris

Kinetic cube sculpture

The members of 1024 architecture focus on the interaction between the body, space, sound, and the visual, and between low-tech and hi-tech art and architecture. An erratic structure, the *WALKING Cube* is a simple cube brought to life by a series of mechanical agitations. Twelve pneumatic pistons filled with compressed air work to animate the jerking and convulsing structure. Subjected to the brutal force produced by air-powered mechanics, the cube undergoes a series of diverse transformations. The pistons are mapped to small controllers, which take commands from a motherboard. The motherboard is wired with the same software used to create music, making the entire structure behave as though it was musical instrument. Performing with twerks and tweaks, the cube grows and shrinks, folds and kinks.

The *WALKING Cube* is the result of collaborative research on physical movement. It demonstrates the chaotic possibilities of the deconstruction of a common and minimal form.

www.1024architecture.net

Guidance in mechanical developments: Laurent Bolognini
Council in pneumatics control: Simon Laroche
Original design sketches for functionality: Gregoire Lauvin

AIDA facility at the Institute of Meteorology and Climate Research, Atmospheric Aerosol Research Department (IMK-AAF), Karlsruhe Institute of Technology (KIT)

3

High speed video recordings of freely levitated freezing droplets
Ice crystals growing on feldspar mineral in electron microscope
1-channel-video, b/w, silent

The IMK-AAF of KIT pursues the understanding of the various roles of aerosols in the complex climate system of our planet. Aerosols, tiny particles suspended in air are emitted into the atmosphere in various natural processes, for example when mineral dust uplifts from arid areas. In the Earth's atmosphere, these particles scatter and absorb sunlight, transport allergens, and serve as condensation nuclei for cloud droplets – there would be no clouds without aerosol. Clouds bring precipitation, and here the aerosols are needed again, this time to nucleate ice in the super cooled droplets that are predestined to become rain, snow, or hail on their rush to the ground. Such processes are subject to IMK-AAF, for example in the aerosol and cloud simulation chamber AIDA.

The microscopic video recordings presented at ZKM show water droplets freely levitated in an electrodynamic trap as they freeze due to the collisions with tiny ice crystals. The freezing droplets show fracturing, expulsion of air bubbles and ice fragments due to the pressure build-up inside the ice shell. This phenomenon is envisioned as one of the possible pathways of ice multiplication in the glaciating cloud.

The ice crystals shown in the second video series have been captured in the Environmental Scanning Electron Microscope while they were growing on the surface of feldspar, the rock-forming mineral constituting over 60% of the Earth's crust and one of the most active inorganic ice nucleators.

www.imk.kit.edu

Scientific staff: Prof. Dr. Thomas Leisner, Dr. Thomas Pander, Dipl. Phys. Patricia Handmann, Dr. Alexei Kiselev, Mona Schätzle

Jinsoo An

Project Nourished, 2015

4

*1984 in Seoul, KR, lives and works in Los Angeles, CA, US

Mixed-media installation,
video, 3-D print

Consuming food is more than simply going through the motions of eating. In fact, our perception of food is created by threading together various sensory inputs stemming from sight, scent, flavor, texture, sound, and memory.

By isolating various odor and flavor compounds and recreating their scent, taste, and textural profiles – using virtual reality, aromatic diffusion, and bone conduction – *Project Nourished* attempts to diversify the ways in which we consume food.

Using a virtual reality headset outfitted with multiple sensors to track user movement and to detect objects, participants can feast within a simulated dining experience. The simple flick of a finger even enables participants to select their very own preferred dining environment. The rheological and textural qualities of these “virtual” foods are articulated by hydrocolloid polymers and gums, which are made by 3-D printing. Using a medium comprised of ingredients such as agar, pectin, konjac, and gum arabic – all of which are naturally derived from sources such as algae, seaweed, fruits, vegetables, seeds, and microbials – we replicate the textural properties unique to the various food items. In addition to these base ingredients, flavoring agents such as nutritional yeast are infused into the mixtures to impart umami. The easily emulsifiable and low-caloric properties of hydrocolloids make them the perfect base for a virtual dining experience.

www.projectnourished.com

Thanks to: Vahan Baladouni, Yasaman Barmaki, David Blumenthal, Julien Delarue, Eric Hoover, Masahana Kato, Brad Kent, Rachel Koukal, Tuan Lee, Andy Lesniak, Daniel Lim, Gabriel Lopez, Michael Resendez, Nick Todd, Nguyen Tran, Thi Tran, Camellia Tse, Cheryl Vu, Andrew Yoon, Amethyst Zhang

Yuri Ancarani

5: *La malattia del ferro*,
2010–2012

5a: *Il capo*, 2010

5b: *Piattaforma luna*, 2011

5c: *Da Vinci*, 2012

*1972 in Ravenna,
IT, lives and works
in Milan, IT

5: Film trilogy, 1-channel HD
video, transferred from 35mm
film, color, sound

5a: 15:00 min.

5b: 25:00 min.

5c: 25:00 min.

5

La malattia del ferro [The Disease of Iron] is a film trilogy in which artist Yuri Ancarani explores the relationship between man and machine.

Il capo [The Chief] is about a man who coordinates and guides quarrymen and heavy-duty machines using a language consisting solely of gestures and signs.

Piattaforma Luna [Platform Luna] features six scuba diving technicians who work in deep below the ocean. For several weeks the technicians carry out an off-shore operation aboard the platform Luna, living either at depths of 100 meters beneath the surface of the water or in a hyperbaric chamber.

Da Vinci takes us into a robotic surgery department, in which a surgeon conducts an entire operation using the Da Vinci system, a sophisticated robot which the doctor controls through a joystick.

Shot in three differently evocative and unusual locations, the films delineate the developments and possibilities disclosed by scientific and technological achievements, simultaneously showing the professionalism of the protagonists and the hidden poetry of their daily working life.

Courtesy of the artist and Zero..., Milan

Alisa Andrasek and Jose Sanchez

BLOOM, 2012

Live and work in London, GB

Installation, 1-channel video,
color, sound, 2:34 min.

6

BLOOM is an urban toy, a social game, and a collective “gardening” experience that seeks out the engagement of people in order to construct fuzzy *BLOOM* formations from recyclable plastic cells. *BLOOM* cells are all equal, but by recombining their three connections, an infinite number of formations can emerge. None of the pieces can do anything alone – it is only by putting them together that the actual “design” emerges.

www.bloom-thegame.com

BLOOM. Design Team: Marija Van de Warp, Salih Topal, Daghham Cam, Andres Darko, Pallari Sharma, Nicolo Friedman, Vincenzo D'Avria, Mark Muscat

Alisa Andrasek
***XenoCells*, 2015**

7

3-D printed column, 1-channel video, color, sound

In 2001, architect and designer Alisa Andrasek founded the cross-disciplinary laboratory Biothing, which focuses on the generative potential of computational design systems to experiment with rare, unexplored forms.

At the core of Alisa Andrasek's work is a steadily growing library of scripts, applicable to the constraints of materials, structure, fabrication and assembly, plus methods for their transcoding. Evolving algorithmic infrastructure allows Andrasek to work with information linked to various forms of materialization. Computational patterns are understood as deep in terms of their potential to produce expressions at various scales.

XenoCells proposes design language at multiple scales (ornamental detail, furniture, architectural elements, and larger structures), based on the algorithms simulating biological cellular growth (i.e. Morphogenesis). In such process cells are able to locally differentiate, reacting to "nutrients" and "inhibitors." The result is an enchanting complex design world where unseen intricacy populates familiar objects and chunks of architecture. The number of building cells is counted in millions and beyond, organized through fractalized resolution.

www.biothing.org

In collaboration with Wonderlab research lab at the Bartlett UCL / Research, Design: Daghan Cam, Ningzhu Wang, Jong Hee Lee, Zhong Danli, Feng Zhou, Amirreza Mirmotahari / Fabrication: B-Made / Materials: Form Futura

Suzanne Anker

***Laboratory Life*, 2004–2007**

8

*1946, in Brooklyn, NY, US, lives and works in New York City, US

4 Ink-jet prints on watercolor paper

In *Laboratory Life*, images of gardens and scientific apparatuses mingle, creating a tapestry effect that could not be achieved by a single exposure. Both laboratories and gardens are artificially created. They are constructed spaces which are either framed with pastoral delight in mind or as sites where nature is scrutinized and expected to surrender its secrets. Gardens can be playful but they also accommodate roving bands of plant and animal life. Gardens cannot possibly be contained. They function as a slice of arcadia on whose surface nature seems to be cultivated. Laboratories require stricter controls in order to avoid the contamination of research results, and are equipped with sealed doors, sterilization units, and filtered air.

These open and closed spaces, located in the nature/culture nexus, represent current osmotic flow as each side impinges on the other's domain. As nature becomes "culturized," that is, manipulated and transformed, nature absorbs and expands upon these changes. What gardens do in fact have in common with laboratories is the everyday care needed to sustain life. Nature is in continual flux, repositioning its elements constantly. In both gardens and laboratories, caretakers of various sorts are required to maintain the premises.

www.suzanneanker.com

**Anthropocene Observatory
#4 The Dark Abyss of Time,
2014**

Armin Linke, *1966 in Milan, IT, lives and works in Berlin, DE
Territorial Agency (John Palmesino, *1970 in Lugano, CH,
lives and works in London, GB, and Ann Sofi Rönnskog,
*1976 in Vasa, FI, lives and works in London)
Anselm Franke, lives and works in Berlin

9

Mixed-media installation

Operating as an observatory, the Anthropocene Observatory project #4 *The Dark Abyss of Time* traces the development of the Anthropocene thesis on various levels, from the practices that shape landscapes and territories to those that shape political institutions, both historically and today. It observes how the thesis of a man-made geological epoch is being debated and employed within scientific and political institutions. The Anthropocene Observatory was founded in early 2013 and has presented its work and archives in four episodes at the HKW in Berlin and at BAK in Utrecht. It combines film, photography, documentation, interviews, spatial analysis, and fieldwork to create an archive and a series of installations, seminars, debates, and cultural interventions. Across a number of international agencies and organizations, information about scientific research is acquired and organized. These complex behind-the-scenes processes and practices, which are followed by equally complex decision-making procedures, form new discourses and new patterns of change. The Anthropocene Observatory documents these practices in a series of short films, interviews, and documentary materials. The aim of the project is to illustrate in detail the unfolding of the Anthropocene thesis and its many areas of influence.

Produced by Haus der Kulturen der Welt [House of World Cultures] (HKW), within the framework of The Anthropocene Project / Co-produced by basis voor actuele kunst [basis for current art] (BAK), Utrecht / Team: Giulia Bruno, Saverio Cantoni, Jacopo Costa, Claudia Fea, Laura Fiorio, Tom Fox, Anselm Franke, Giuseppe Ielasi, Armin Linke, John Palmesino, Stavros Papavassiliou, Sarah Poppel, Renato Rinaldi, Ann-Sofi Rönnskog, Roland Shaw, Graham K. Smith, Arianna Visani, Lisa Bergmann, Felix Mittelberger, Sven Zedlitz / Interactive display developed for the ZKM | Karlsruhe by Donato Ricci with Robin De Mourat, Giorgio Uboldi, and Matteo Azzi (Calibro)

Artificial Nature (Haru Ji and Graham Wakefield)

***Time of Doubles*, 2012**

Haru Ji, *1971 in Seoul, KR,
lives and works in Seoul
Graham Wakefield, *1975
in Burnley, GB, lives and
works in Toronto, CA

10

Interactive immersive video
installation

Time of Doubles invites visitors to experience mirror doubles of themselves, taking on new roles as sources of energy and kinetic disturbances within a perpetually changing virtual ecosystem. Visitors encounter their doubles in an immersive world, in which the visitors' doubles appear as energy fields emanating numerous bright fluid particles, which are food sources to be consumed by virtual organisms. Visitors can see, hear, and feel these particles being fed to unknown species within this virtual ecosystem. Without visitors, the "world-fluid" is filled with living seeds that cannot grow, but in the presence of humans the populations explode into alien orchestras of evolutionary growth. Larger organisms hunt smaller ones, leaving physical residues and films behind as they pass, which constrain the means by which the fluid can flow and which can be sculpted by visitors' doubles as they approach them.

www.artificialnature.net

Lise Autogena and
Joshua Portway

Untitled (Superorganism), 2014

Lise Autogena, *1964 in Aarhus, DK,
lives and works in London, GB
Joshua Portway, *1967 in Penzance,
GB, lives and works in London, GB

Ants, 1-channel video, color, sound

11

In this project, Lise Autogena and Joshua Portway deal with a specific behavior predominantly observed among army ants: the so-called ant mill or circle mill. Nearly blind, army ants follow the pheromone trail of the ants preceding them. Occasionally, when their trails cross, individual ants begin to walk in a circle. When other ants follow these scent trails, they become reinforced – until a large number of ants finally wind up moving in a circle. For the ants caught in the mill, this behavior can lead to death through exhaustion.

www.autogena.org

Sonja Bäümel and Manuel Selg

*Metabodies. Exploring Social Networks
on Our Body*, since 2013

Sonja Bäümel, *1980 in Vienna, AT,
lives and works in Amsterdam, NL
and in Vienna

Manuel Selg, *1971 in Sigmaringen,
DE, lives and works in Wels, AT

Mixed-media installation

12

The project *Metabodies* investigates the unexpected diversity of the human ecosystem and its “social network” by focusing on the language of the billions of bacteria that populate it. For Sonja Bäümel’s experiment, two people made hand prints in three specially prepared petri dishes: one after athletic activity, the second directly after sex, and the third fresh out of the shower. Over a period of eight days, she photographed the impressions on an hourly basis, documenting the resulting growth process of the individual skin bacteria.

In this way, *Metabodies* offers an alternative portrait of our bodies, showing that we differ from one another not only genetically but also bacterially, revealing a new perspective from which to observe our daily life. At the same time, the work uncovers a new possible scenario, creating a space in which the potential of bacteria to act as cooperative partners can be re-imagined.

www.sonjabaeumel.at

The project was realized in collaboration with the Ars Electronica Future and Biolab.

Nurit Bar-Shai

*Objectivity [tentative]:
The Soundscapes, 2012–2013*

*in Israel, lives and works
in New York, NY, US

Petri dishes, nutrient media,
lifeless microorganism

Nurit Bar-Shai's *Objectivity [tentative]* explores the intersection of art, science, and technology, combining scientific methodologies and artistic inquiries in order to depict the "chemical tweets" of microorganisms as exceptionally beautiful and rare image patterns. It is inspired by the research and the work of Professor Eshel Ben Jacob of Tel Aviv University. Jacob studies the social life of bacteria, exploring the complex network and communication systems of "smart" microorganisms known for their advanced social behavior, a behavior which is reflected in the development of colonies with highly complex architectural structures.

This body of work explores the biological systems of self-organization and of collective decision making, the immense complexity within seemingly simple structures, creativity and problem solving among billions of microorganisms, and the process of achieving dramatically varied results with slight alterations in initial settings.

The *Soundscapes* series, part of the body of work *Objectivity [tentative]*, explores both morphogenesis and the complex social behavior and decision making of microorganisms using sound waves and a range of frequencies as variables to replace traditional scientific settings, and the visualization of complex structures within bacteria.

www.nuritbarshai.com

In the memory of Prof. Eshel Ben Jacob

Ursula Biemann and Paulo Tavares

Forest Law, 2014

Ursula Biemann, *1955 in Zurich, CH,
lives in Zurich and works internationally
Paulo Tavares, *1980 in Campinas, BR,
lives and works in Quito, EC

Mixed-media installation

14

Forest Law is a collaborative project based on research carried out by Ursula Biemann and Paulo Tavares into the oil and mining frontier of the Ecuadoran rain forest. This area is situated at the border of the Amazonian floodplains and the Andes, and is one of the most biodiverse and mineral-rich regions on Earth. It is also currently under great pressure due to the dramatic expansion of large-scale mineral extraction. The installation enters a conversation about such areas of the tropical rain forest threatened by the impact of these activities. *Forest Law* follows a series of landmark legal battles unfolding in the Ecuadoran Amazon, in which the rights of nature are being considered. A particularly important trial, in which the forest was discussed in court for the first time, has recently been won by the indigenous people of Sarayaku based on their cosmology of the "Living Forest." *Forest Law* consists of a synchronized video projection shot with two cameras, and a photo-text assemblage explaining the unfolding background of the cases. Taken together, the collection of personal testimonies and factual evidence expose the multiple dimensions of the tropical forest as a physical, legal, and cosmological entity. Speculative and essayistic, academic and interdisciplinary, this installation at once bridges and disrupts the partitions that define our systems of knowledge and the modes by which we perceive, represent, and relate to the world of which we are a part.

www.geobodies.org
www.paulotavares.net

Commissioned by the Eli and Edythe Broad
Art Museum, Michigan State University

Ecke Bonk / typosophes sans frontières***Chaosmos Soundings III, 2005–2015*****15**

1953 in Kairo, EG, lives and works in Austria and New Zealand

Experiment / installation, control electronics, PC, Yamaha Disklavier DC3M4PRO

Ecke Bonk's installation *Chaosmos Sounding III* is a sound experiment conveying a sensory experience of something humans cannot ordinarily perceive: cosmic radiation. An electric concert grand piano is connected via a computer to a Geiger counter, which relays the ever-present radioactive background radiation to the instrument. Instead of our hearing the typical clicking of a Geiger counter, we perceive the radiation as played acoustic tones, whose production is controlled by the chance event of nuclear decay. In using the title "Chaosmos" – a term coined by James Joyce, combining the opposites chaos and cosmos ("cosmos" is ancient Greek for "order") – Ecke Bonk poses the question, what holds the world together inside, and how do the natural sciences, philosophy and religions deal with the phenomenon of chance. For clearly, chance nuclear decay and the resulting radiation both require the aid of an apparatus to be perceived by our sensory organs.

Supported by:



Programming in collaboration with Martina Haitz

Adam W. Brown and Robert Root-Bernstein***ReBioGeneSys – Origins of Life, 2015*****16**

Adam W. Brown, *1972 in Chicago, IL, US, lives and works in East Lansing, MI, US

Robert Root-Bernstein, *1953 in Washington, D.C., US, lives and works in East Lansing

Mixed-media installation

ReBioGeneSys – Origins of Life is a hybrid installation that combines sculpture, chemistry, alchemy and conservation to evolve an extreme minimal ecosystem. It is an automated, self-contained installation that creates the first simulated prebiotic system capable of actual evolution. All known natural conditions – such as desiccation/hydration, freeze/thaw and day/night cycles, exposure to UV light, electrical energy and heat – are incorporated into one apparatus so that any possible environment can be simulated or invented. Prebiotic compounds are not only synthesized, but selectively destroyed, some surviving to participate in further Darwinian evolution, others going extinct. Materials are constantly replenished and recycled within a "mashed-up" minimal ecosystem that evolves, and might even evolve life.

Like Pygmalion's sculpture, the materiality of the apparatus must embody the means by which the processes of life emerge, independent of the human beings that sculpted it, unaffected by the transience of the audiences that view it, over spans of non-human time. The installation is an artifice designed not to mimic, but to produce or re-produce nature, through self-sustaining autopoiesis.

www.adamwbrown.net

Thanks to: Barry Tigner – Physics and Astronomy Electronics Shop, MSU / Scott Bankroff – Scientific Instrument Facility, Chemistry Department, MSU / Thomas Palazzolo and Thomas Hudson – Physics

C-LAB (Howard Boland and Laura Cinti)

Living Mirror,
2013

17

Howard Boland, *1975 in Ålesund, NO, lives and works in London, GB
 Laura Cinti, *1979 in Johannesburg, ZA, lives and works in London

Interactive bio-electronic installation, living bacteria cultures, hardware coil system, software, kinect sensor

Living Mirror attempts to produce real time images or patterns by magnetotactic bacteria being exposed to alternating magnetic fields.

A large liquid display containing bacteria culture is exposed to fluctuating magnetic fields that cause the bacteria to rotate synchronically, and create visible shimmers. A kinect sensor is used to capture images of the audience's faces and translate these into small pixelated icons. Its values cause specific magnetic coils to fluctuate, while programmatically harmonizing hundreds of light pulses in order to reproduce the image in a liquid culture. As a liquid biological mirror, *Living Mirror* builds upon the idea that water was our first interface, and points to the myth of Narcissus while also highlighting the the discovery that we are mostly made up of nonhuman bacterial cells, which has shattered our conception of our own body.

www.c-lab.co.uk



Image acquisition and interactive software: C-Lab, Sas Schilten, Age of Wonder, Natlab, Eindhoven, NL

Oron Catts, Corrie Van Sice, and Ionat Zurr

The Mechanism of Life – After Stéphane Leduc, 2013

18

Oron Catts, *1967 in Helsinki, FI, lives and work in Perth, AU
 Corrie Van Sice, *1984 in Dallas, TX, US, lives and works in Dallas
 Ionat Zurr, *1970 in London, GB, lives and works in Perth

Custom-made protocell print, chemicals, dyes

In *The Mechanism of Life*, published in 1911, French biologist Stéphane Leduc drew on a series of experiments in order to prove that life was merely a chemical process. Leduc attempted to challenge vitalism, the theory that life's phenomena are dependent on a principle distinct from purely chemical or physical forces. With the recent advent of synthetic biology, we are experiencing a resurgence of similar ideas from a century ago, including the concept of creating the cell, the most basic unit of life, out of non-living materials. The result is the so-called "protocell."

Echoing the simplest protocell protocols conceived by Leduc, *Mechanism of Life* reenacts Leduc's experiments, using a custom-made rapid prototyping printer to create protocells. The work seems to be paving the way towards being able to print actual life. But the printed protocells seem to represent an unstable and temporary natural form, surviving for a few moments before succumbing to entropy and dissolving into a murky liquid.

The original artwork was made possible by: SymbioticA, School of Anatomy, Physiology and Human Biology, The University of Western Australia; Biofilia – Base for Biological Arts, School of Arts, Design and Architecture, Aalto University, Finland; The State of Western Australia through the Department of Culture and the Arts.

Center for PostNatural History

That was then. This is now., 2015

19

Founded 2008 in
Pittsburgh, PA, US

Mixed-media installation

The Center for PostNatural History is a museum based in Pittsburgh, Pennsylvania, dedicated to the collection and exhibition of life forms intentionally and consistently altered by human culture through processes such as domestication, selective breeding, and genetic engineering. The idea of the post-natural includes familiar organisms such as farm animals, pets, decorative flowers, and laboratory organisms. By breeding plants and animals for traits that we desire, humans also influence their evolutionary path. In doing so, we alter the form and function of the living world in ways that are often surprising.

That was then. This is now. is a selection of specimens representing points of interest in a chronology of guided evolution over the last 10,000 years. Beginning with the first domesticated animal, the dog, and the agricultural innovation of corn, the chronology covers a more recent genetic modification, a goat which produces spider silk in her milk, and ends in the present, examining the ongoing real-time evolution of bacteria in the Heurisko evolution machine. Each of these specimens has a rich evolutionary history, but unlike specimens on display in a natural history museum, post-natural organisms may also be viewed as artifacts of culture. They are living embodiments of human desire, hunger, power, and fear.

www.postnatural.org



Design and fabrication:
Mason Juday, Berlin, DE

Jürgen Claus

Planet Ocean / Sea Flowers,
1983 / 1986 / 2015

20

*1935 in Berlin, DE, lives
and works in Baelen, BE,
and Aachen, DE

2-channel video installa-
tion, documentary material

The films *Sea Flowers* and *Planet Ocean* both revolve around the idea of a “Center Submarin,” an experimental diving center designed to offer audiovisual access to theory. For the films, Jürgen Claus went under water: Off the Spanish coastal town of Almería, at a depth of ten meters, artificial gardens of sea anemones were created. The video *Sea Flowers* shows a night dive, in which dimensions blur and space loses its definition. In *Planet Ocean*, a sextet of divers explore the underwater world. The artificial submarine garden is defined by 16 star and 18 teardrop forms, like those found in nature.

Burning underwater flares and stationary spotlights create special lighting effects, which are then heightened in the digital postproduction processing of the movie scenes: Natural (coral) and artificial forms (stars, teardrops) blend, blurring the distinct separation of the worlds. Jürgen Claus observes the divers’ various visual, acoustic, and haptic perceptions; while examining the connection between their behavior and cerebral mechanisms. In his underwater work, Claus sets out to discover the point where two unknown spaces coincide – the external space of the “upper world” and the inner space of the sea.

www.juergenclaus.de

Sound composition: Paul Earls

Sam Conran

Electromagnetic Signals from Bacterial DNA, 2014

21

*1989 in London, GB, lives and works in London

Sonogram EMF from bacterial DNA

This audio installation imagines the sound of electrons moving through the “loops” of a bacterial DNA molecule. The sound itself evolves, mimicking bioacoustic environments. It is inspired by recent theoretical research in biochemistry, which speculates that the electrons in bacterial DNA emit electromagnetic signals which might be audible through an electrocoil microphone. The installation is a fictional experiment using sound design to translate this concept into a physical experience.

www.samconran.com

This work was created using Max/MSP and SuperVP processing, diffused over an array of four loudspeakers. This installation was originally commissioned for the Synthetic Aesthetics takeover at the Victoria and Albert Museum in May 2014.

Hermann Cuntz and Marvin Weigand

Computational Cajal, 2012

22

Hermann Cuntz, *1974 in Bielefeld, DE, lives and works in Frankfurt am Main, DE

Marvin Weigand, *1984 in Offenbach, DE, lives in Offenbach and works in Frankfurt am Main

4 light boxes, Oculus Rift, digital copy

In his time, Santiago Ramón y Cajal (1852–1934), capitalized on a wave of novel staining techniques in order to carefully observe and immortalize neural circuits in drawings, which ultimately led to the most fundamental neuroscientific discoveries to date. Today, thanks to a flood of technical innovations, we have access to a wealth of data on brain structure. Using computational methods, we have been able to disentangle this complex data and produce computer models that are remarkably accurate. Apart from delivering stunning visualizations of the inner functions of our brains, these computer models allow us to understand our brains to an unprecedented level of complexity. The modern-day computer models are reminiscent of the circuit drawings by Cajal, and here Cuntz and Weigand aim to juxtapose the original drawings by Cajal with the immersive visualizations of brain structure produced using modern computer models.

www.treestoolbox.org

Sponsored by: Federal Ministry for Education and Research (BMBF), German Research Foundation (DFG), Ernst Strüngmann Institute (ESI) for Neuroscience in Cooperation with Max Planck Society, Frankfurt Institute for Advanced Studies (FIAS)

Theresa Dankovich

The Drinkable Book, 2014

23

* 1981 in Syracuse, NY,
US, lives and works in
Pittsburgh, PA, US

Book, 1-channel video,
color, sound, 2:00 min.

The Drinkable Book is a transformative tool for water purification. The pages of the books are printed using plant-based ink. The text appears in English and in the language local to the place where the books are distributed. The paper contains silver nanoparticles, which are a disinfectant and highly toxic to bacteria in very low concentrations, killing them upon contact and making filtered water safe to drink. Accordingly, the book will directly provide clean drinking water at the very low cost of a few cents per sheet. Each sheet can filter enough water to meet a family's needs for several days, more for an individual. Providing clean water is just the first step in improving health, and will transform the lives of millions. The book's impact will be especially tangible in crucial areas such as poverty eradication, environmental improvement, quality of life, and child development. *The Drinkable Book* is a collaboration with WATERisLIFE, a nonprofit organization dedicated to the goal of providing clean water and sanitation in developing countries.

www.pagedrinkingpaper.com

pAge Drinking Paper, WATERisLIFE, DDB NY
Design: Brian Gartside, DDB
Production: Kristine Bender, WATERisLIFE

Robert Darroll

The Imperium of Koom Posh, 2014

24

*1946 in GB, † 2014 in DE

5-channel video instal-
lation, sound

With its five-part projection, Robert Darroll's experimental animated film *The Imperium of Koom Posh* visualizes the state of human existence in a world where social life is dominated by global media technology and capitalist systems. The name *Koom Posh* refers to the novel *The Coming Race* by English author Edward Bulwer-Lytton. The latter derived the name from a homonymic Chinese term roughly meaning "government of the many," or "government of the most unknowing." Robert Darroll's artistic interest was concentrated on the audiovisual rendering of the alienation of human beings in a thoroughly technological world, in which every individual's perception is defined by such media technology as surveillance cameras. In parallel projection, each of the five projected panels thematizes a different vision – in which socially standardized human beings, driven by time and lost in endless space, find themselves in various states of impotence. Darroll develops a world plagued by drone warfare, violence and terror, in which human life has been reduced to leading a hollow, puppet existence, far from using one's own mind.

Sound composition: Sean Reed
Sound mixing and mastering: Duane Shi and Nate B.
Aldrich at the Innovative Media Research and Commer-
cialization Center, University of Maine and Orono

Caitilin de Bérigny

Das letzte Riff, 2012

25

*1972 in Sydney, AU, lives
and works in Sydney

Mixed-media installation

Das letzte Riff is an interactive artwork which uses a cross-media platform to experiment with scientific data as well as underwater photographs, video, and sound, much of which was collected at One Tree Island Reef, located on the Great Barrier Reef off the northeastern coast of Australia. This collaborative work combines art and science in order to investigate the ways in which coral reef habitats and ecosystems are being threatened by the effects of climate change. Using tangible user interface technologies as well as multi-channel video, painting and sound, Caitilin de Bérigny's work creates a multi-sensory interactive experience. It evokes the atmosphere of an uncontaminated natural environment while subtly commenting on the global consequences of irresponsible environmental policies.

www.caitilindeberigny.com

Design TUI objects and table: Phillip Gough and Adityo Pratomo
Video editing: Ge Wu
Soundscape: Michael Bates

Frederick De Wilde

*EOD 02 (Electric Organ
Discharge)*, 2006

26

*1975 in Aalst, BE, lives
and works in Brussels, BE

Mixed-media installation,
fish, fish tank, antennas,
speaker, strobe pulse

EOD 02 is a media installation based on special species of fish which perceive their environment and communicate with each other by emitting electrical signals in water, either in pulses or waves. The project explores the communication mechanisms of electrical fish including *Jamming Avoidance Response* (JAR), which is the means by which a fish avoids attempts by other fish to jam its frequency. Thus communication and non-communication between individual fish as well as between fish and people may be investigated. The installation is based on four mirrored fish tanks on a pedestal with an integrated audio system. The fish signals in each tank are captured by antennas directly linked to four speakers, which transform these signals into sound. What the viewer hears is the electro-communication and sensing apparatus of the fish. Furthermore, an LED light placed underneath each aquarium pulses according to the intensity and rhythm of the signals emitted by the almost-blind fish. In this manner, the electrical impulses of the fish become tangible, visible, and audible.

www.frederik-de-wilde.com

ZKM | Center for Art and Media Karlsruhe

Thierry Delatour
***Molecular Songs*, 2015**

27

*1956 in Paris, FR, lives and works in Nancy, FR

Mixed-media installation,
3 posters, sound, computer

Molecular Songs is an installation which translates molecules into sound. Using experimental and/or computed vibrational spectra data, the work showcases a new method of converting molecular vibrations into acoustic sounds, allowing us to detect the non-audible oscillations which naturally occur in molecules.

This method produces molecular sounds, molecular scales, and even molecular musical pieces.

An interactive interface allows the visitor to discover a variety of chemical substance families and related vibrational spectra, and to listen to the respective molecular sounds and musical pieces.

As the work shows, vibrational spectra are non-harmonic, meaning that molecular sound perception is unusual – revealing the complexity and variety of the smallest units which constitute our environment. Produced in cooperation with the ZKM | Karlsruhe, and positioned on the border between music and science, Thierry Delatour's research unveils an unexpected and innovative way of accessing scientific content while creating a musical experience extending beyond the classic rules of melody, harmony, and the perception of physical phenomena.

Installation design and concept of the interface: Matthias Gommel and Daniel Heiss / software engineering and programming: Daniel Heiss and Johannes Degenhard / ZKM | Center for Art and Media Karlsruhe

Louis-Philippe Demers and Bill Vorn

***Inferno*, 2015**

28

Louis-Philippe Demers, *1959 in Montreal, CA, lives and works in Singapore, SG

Bill Vorn, *1959 in Montreal, lives and works in Montreal

Object from interactive robotic performance, 1-channel video, color, sound

Inferno is a participative robotic performance inspired by the concept of control and the representation of hell as described in Dante's "Inferno" (the first part of the *Divine Comedy*) and in the Singaporean Haw Par Villa's *Ten Courts of Hell* (which is based on a Chinese Buddhist representation). In *Inferno*, "the circles of hell" concept is a framework, a theme under which the different parts of the performance are regrouped.

The specificity of this performance resides in the fact that the different machines involved in the performance are retrofitted on the body of raptured audience members who become performers. A selected group of the audience therefore becomes an active part of the performance, giving a radical instance of immersive and participative experiences. Shifting the exoskeleton's command from the authors, to the computer, to the audience, and to the performers, *Inferno* questions the nature of control – either mechanic or human, either coerced or voluntary – where either utopian or dystopian futures radiate, both real and fictional.

www.processing-plant.com
www.billvorn.concordia.ca

The performance took place at the opening event of *Exo-Evolution* at ZKM.

Design Research Lab

Mobile Lorm Glove, 2011

29

Founded 2005 in Berlin, DE

Object, 1-channel video,
color, sound, 2:22 min.

The Design Research Lab (DRLab) is an interdisciplinary design research project initiated by, and based at, the Berlin University of the Arts (UdK). The DRLab works on projects that try to align technological innovations with people's real needs.

The *Mobile Lorm Glove* is a mobile communication and translation device for deaf-blind persons. The glove translates the hand-touch alphabet Lorm, a common form of communication used by people with both hearing and sight impairment, into text, and vice versa. Textile pressure sensors located on the palm of the glove enable the user to use the Lorm alphabet on his or her own hand and thus compose text messages. A Bluetooth connection transmits the data from the glove to the user's handheld device. It is then automatically forwarded to the receiver's handheld device in the form of an SMS. If the wearer of the *Mobile Lorm Glove* receives a text message, it will be forwarded via Bluetooth from his or her handheld device to the glove. Small vibration motors located on the back of the glove produce tactile feedback patterns, which allow the wearer to perceive incoming messages.

The *Mobile Lorm Glove* is part of the project DESIGNABILITIES – Disability-inspired Interaction Design, which seeks to enhance information-communication technologies and human-computer interaction.

www.design-researchlab.org

External Partners: Allgemeiner Blinden- und Sehbehindertenverein Berlin (ABSV) and Oberlinhaus Potsdam, DE

Heather Dewey-Hagborg

30a: *Stranger Visions*, 2012–201330b: *Invisible*, 2014

30

*1954 in France,
lives and works
in Paris, FR30a: Found genetic material,
custom-built software,
3-D print30b: Object, 1-channel video,
color, sound, 1:47 min.

In *Stranger Visions*, a critical project based on emerging science, the American artist and bio-hacker Heather Dewey-Hagborg creates 3-D resin portrait busts from analyses of genetic material collected in public places. Working with droppings that strangers unwittingly leave behind (gum, cigarette butts, hair), she extracts DNA to create genetic profiles that are then put through a facial algorithm. The resulting portraits bring attention to the developing technology of forensic DNA phenotyping, and the potential for a culture of biological surveillance.

In addition, Dewey-Hagborg founded a new genetic privacy company, BioGenFutures. The company's premier product line, *Invisible*, comprises a set of sprays that can be used to remove or obfuscate undesirable residual DNA. BioGenFutures promises to alleviate emerging concerns that the biological surveillance state will mirror the existing electronic surveillance culture. By allowing customers to choose where, how, and with whom they share their genetic information, BioGenFutures guarantees that no one will have access to our genetic material without our consent.

www.biogenfuture.es

Courtesy of Catherine Edelman Gallery, Chicago

Kitsou Dubois

Perspectives, time for a new glance, 2011

31

*1954 in France, lives and works in Paris, FR

1-channel video, color, sound, 3:22 min.

French choreographer and dance studies scholar Kitsou Dubois has been working with human movement in weightlessness since the early 1990s. In collaboration with the French space agency, CNES, she has taken part in several parabolic flights, during which various choreographies were performed. Parabolic flight is the aeronautic term for a special flight maneuver, in which acceleration and steep dives are performed to briefly simulate a state of weightlessness or a reduction of gravity. In scientific research, parabolic flights are used for performing experiments under weightless conditions. "On Earth we are constantly confronted with falling," says Dubois – the elimination of the forces of gravity allows her a freedom of physical expression never before experienced in dance.

www.kitsoudubois.com

Sound: Benjamin Furbacco, based on music by Pierre Boscheron
In the video: Kitsou Dubois, Damien Fournier, Boris Gibé, and Chloé Moglia
Production: La Magnanerie

Anna Dumitriu

The Communicating Bacteria Dress, 2011

32

*1969 in Shoreham-by-Sea, GB, lives and works in Brighton, GB

Antique whitework dress with embroidery, bacteria, video-mapped projection

Bacteria can work collectively to pass on information to neighboring cells. This antique whitework embroidered dress was patterned using *Chromobacterium violaceum* and a genetically modified strain of *Chromobacterium violaceum* called CV026. *Chromobacterium violaceum* is white in its natural state but turns purple when it receives a communication signal. Since bacteria grow in colonies and an individual bacterium continually sends and receives signals, it always appears purple to the eye. But CV026 is effectively mute. It can receive a chemical communication signal but cannot send one, so it only turns purple in the presence of communication from another bacterium. When exposed to unmodified *Chromobacterium violaceum*, CV026 slowly turns purple before one's eyes as the chemical signal spreads. The red color on the dress is *Serratia marcescens*, which has communication abilities but cannot be "heard" by CV026. Because the bacteria the artist worked with are genetically modified, they had to be killed prior to leaving the laboratory where they were created. Dumitriu brings the dress back to life again using video-mapping techniques and software to precisely map a time-lapse film of the bacterial communication process taking place back on to the dress.

www.normalflora.co.uk

Made in collaboration with Dr. Simon Park, Dr. John Paul, and Alex May
The work was created through support from 

ecoLogicStudio (Claudia
Pasquero and Marco Poletto)

H.O.R.T.U.S Karlsruhe, 2012–2015

Claudia Pasquero, *1974 in Turin,
IT, lives and works in London
Marco Poletto, *1975 in Turin,
lives and works in London

33

Installation, water-cut aluminum, laser-cut acrylic,
PVC hoses, living clorella culture

ecoLogicStudio is an architectural and urban design studio specializing in environmental design, urban self-sufficiency and the integration of building and nature.

The studio considers cities as global networks of matter, information and energy that make up our current urban civilization's fundamental habitat. Rather than seeking a return to nature, the artists aim for a complete biotechnological overhaul of urban infrastructure and architectural material systems, and want to achieve a new and higher degree of efficacy in the combined living potential of biology and technology.

With *H.O.R.T.U.S Karlsruhe*, the artists have built a prototype of a novel biodigital form of gardening, an urban practice which uses renewable energy and nutrients for human consumption. The architectural apparatus connects the human metabolism to the proliferation of life within micro-algal ecologies such as cyanobacteria cultures. Visitors are invited to engage directly with *H.O.R.T.U.S Karlsruhe*, experiencing biodigital micro-ecologies and acting as the embodiment of future urban cyber-gardening practices.

www.ecologicstudio.com

ecoLogicStudio

Meta Follies, 2012–2013

34

Installation, plastics, textile
fiber, caoutchouc, technical
equipment

ecoLogicStudio's *Meta Follies* is a sonic environment which aims to establish a playful dialogue with the user, enabling the development of a form of meta-language based on material experience, patterns of recognition, and real-time meta-conversation. It revisits the concept of the architectural "folly," as a synthetic organism.

For *Meta Follies*, ecoLogicStudio has programmed 300 piezo buzzers with four different tones, so that they operate like a swarm of crickets reacting to the speed of visitors' movements.

Meta Follies argues that computational cyber-artificiality should substitute nature as the reference for the development of new architectural codes. Offering refuge and consolation to the emerging crowd of urban post-ecologists, it abandons the search for a green Arcadia and strives to embody an abstract and mathematical vision.

The project paves the way for a future convergence of cybernetics and environmental psychology, digital computational design and craftsmanship, and radical ecological thinking and material activism.

Commissioned by the FRAC Centre in Orleans.

Electronic Shadow (Naziha Mestaoui and Yacine Aït Kaci)

Echo & Narcisse, 2009/2015

Founded in 2000 in Paris, FR
Naziha Mestaoui, *1975 in Brussels, BE
Yacine Aït Kaci, *1973 in Paris

35

Mixed-media installation

Echo & Narcisse is an installation depicting global statistics in real time on a noticeable, almost palpable scale. Abstract figures such as world population, deaths, births, energy, pollution, consumption, expenditure, are all broken down to fill the pool with their waves. The installation consists of a basin, in which particles representing different units are reflected in real time.

When visitors approach the pool, they notice their reflection obscured by the particles and waves. In this way, two scales – micro and macro – are combined in a metaphorical space. Looking in the mirror, visitors will see an echo of the world, and find themselves surrounded by a constellation of data which reflects the ever-changing events and phenomena happening around the world. The pool breathes to the rhythm of these statistics and a tide displays the changes in these figures to the millisecond, creating an environment in which different physical and temporal scales become visible.

www.electronicshadow.com

Peter Fend / Ocean Earth

*Submarine for Conversion of
Plastics and Biomass, 2015*

Peter Fend *1950, lives and works
wherever a job requires it
Ocean Earth – Organization, active
in New York and New Zealand

36

Mixed-media installation

Peter Fend is a founding member of the organization Ocean Earth, a group of activists promoting a sustainable and climate-friendly power supply since the 1980s. In *Submarine for Conversion of Plastic and Biomass*, Fend presents his concept for the recovery of methane and hydrogen by converting Russian nuclear submarines and using them to harvest plastic refuse and brown algae from the ocean, for energy generation. In his installation, aside from examining the technical and financial feasibility, Fend analyzes prepared, detailed maps and satellite images – pinpointing potential operation areas for his submarine fleet and evaluation the commercial exploitation of the generated resources. By tapping the oceans as a source of renewable energies, Fend aims to reduce the political dependence on exhaustible raw materials. In this context, Fend sees protection of the environment as a crucial geopolitical factor – and an opportunity to use sophisticated military technology to solve the ecological crises of our planet.

www.inquest.us

Thomas Feuerstein

POEM., 2010

37

*1968 in Innsbruck, AT, lives
and works in Vienna, AT

Installation, glass, steel,
technical equipment

The installation *POEM.* combines Stanley Miller and Harold Urey's so-called primordial soup experiment of 1953 with a process produced by black smokers on the deep-sea bed. In a presumed primordial atmosphere of methane, ammonia, hydrogen and carbon monoxide, water steam circulates under anaerobic conditions. The introduction of electrical energy transforms inorganic molecules into such organic compounds as urea and amino acids. Parallel to this, the reaction column simulating the chemical processes of a black smoker produces ethanol, i.e. alcohol. The chemical cocktail drips into bottles assembled in a bar cabinet. The water required by these processes is gathered from the visitors' breath, exhaled as they speak, through condensation on the cooled metal of a microphone. The condensed water is purified, sterilized and continuously fed into the processes: The more people talk about art, the more art is produced – in the form of ice, water, amino acids and alcohol – and the more of it that is drunk, the more talkative the people become. Questions about the evolution of life are thus placed in an expanded context, through "molecular sculptures": the alcoholic beverages in the bar cabinet. Chemical evolution becomes linked – not without irony – with linguistic and cultural evolution.

www.thomasfeuerstein.net

Courtesy of Galerie Elisabeth & Klaus Thoman, Innsbruck
Technical implementation: Thomas Seppe, Department of
Radiotherapy and Radiooncology, Medical University of Innsbruck /
Software: Daniel Heki, Peter Chiochetti

Verena Friedrich

Cellular Performance, 2011–2012

38

*1981 in Hanau, DE, lives
and works in Cologne, DE

Installation, cutted
plot, 1-channel video,
color, sound, 4:41 min.

For a few decades, we have been able to observe a certain trend regarding body and skin care: A new product group has established itself, so-called "cosmeceuticals" – hybrid products between cosmetics and medicine – offering promises of medical, quasi-medical benefits. The language used to advertise these products relies on scientific and technical phrases, while connecting up with biotechnological fantasies.

Cellular Performance taps into this terminology, applying it directly to the biological material it refers to. For her installation, the artist Verena Friedrich manipulated skin cells in the lab, causing them to form letters and words "re-incarnating" the restorative promises of the cosmeceutical industry. Over a period of months, selected skin cell lines were cultivated and, over the course of numerous experiments, induced to grow into predetermined microstructures. The ephemeral results are directly recorded through live cell imaging and time-lapse microscopy. From time to time, the cells form readable terms, which then soon dissolve.

www.heavythinking.org

Developed at: SymbioticA – Centre of Excellence in Biological Arts,
University of Western Australia, Perth, AU / Laboratory of Stem Cell
Bioengineering, EPF Lausanne, CH; in collaboration with Adrian Ranga
/ Funded by: Kunststiftung NRW [Art Foundation of North Rhine-West-
phalia] / Saxon State Ministry of Science and Art / Academy of Media
Arts Cologne / Goethe Institute, Sydney, AU / Fremantle Arts Centre
and City of Fremantle, AU / SuSoS AG, Dübendorf, CH / Special thanks
to Hackteria

Klaus Fritze

**ARKADIEN 2.0. Laboratorium
zur züchterischen Optimierung
von Bäumen, 2015**

39

*1959 in Cologne, DE, lives and works in Cologne and Brühl, DE.

Mixed-media installation, laboratory furniture and equipment, growth process (in vitro trees, breeding poplars), moodboards, 1-channel video

Klaus Fritze's laboratory is a research station, open to the public, where cytological plant-breeding experiments and a plantation of wild and cultivated forms of poplars in petri dishes, jars, and pots are on display.

From a historical-cultural perspective, poplars have been assigned a place in Arcadia, the idealized location of a world conceived by artists and intellectuals. Meanwhile, though, the trees' rapid growth and efficient conversion of solar energy and CO₂ into biomass have also made poplars real trees of hope. In so-called short rotation plantations, they are planted to produce fast-wood biomass in short harvest cycles, with a minimum of agronomic effort.

Both natural evolution and breeding have produced many species of poplar with special growth traits. The challenge for laboratories is to develop new poplar breeds combining the maximum number of good traits from the various species. By accelerating natural evolution, nature is being adapted to the growing demands of our civilization and technology.

www.klaus-fritze.de

Poplar research scientists: Dr. Renate Lührs, Prof. Dr. M. Fladung, Dr. Nadia Efreмова
Courtesy of the artists, Galerie Brigitte Schenk, Cologne / Thanks to: Phytowelt – Green Technologies GmbH, Cologne

Future Visions, 2015

40

Interactive video installation

What will the world of tomorrow look like? Which technical equipment will we use to master the challenges of the future? What today still sounds like science fiction could have become part of our daily lives tomorrow. 3-D printing, digital interconnectedness, augmented reality, and re-growing organs: Science and industry are working feverishly, developing the technologies that will sustainably change our lives in the near future. *Future Visions* offers a selection of videos presenting these technologies and their applications. The majority of the videos are corporate concept studies distributed via the Internet, as advertising; thus shaping our notion of the world of tomorrow in no small way.

In the exhibition you can see videos of the following institutions and enterprises (among others): Baylor College of Medicine, Corning, Deutsche Post DHL Group, ETH Zürich, Google, Hyperloop Tech, Mercedes-Benz, Microsoft, Nemroff Pictures, This Place, Duke University (Durham, NC, US), Siemens, Carl Zeiss AG

FZI Research Center for Information Technology & H2T The Humanoid Robotics Systems - High Performance Humanoid Technologies Lab (H2T) at the Institute for Anthropomatics and Robotics, at the Karlsruhe Institute of Technology (KIT)

41a: LAURON III, 1999–2005

41b: *Made in Südwest: Schlaue Maschinen – Roboterforschung am KIT*, 2015

41

41a: Legged robot
41b: 1-channel video, color, sound, 29:44 min.

LAURON III is a biologically inspired hexapod legged robot, designed for use as a flexible sensor carrier for inspection tasks in difficult, unknown terrain. This legged robot is equipped with three joints per leg, foot sensors, a position sensor, and a moveable camera head. With this prototype, FZI scientists have been able to explore multi-leg walking-movement solutions for mobile robot systems, studying ways to improve their autonomy.

The FZI research center at the Karlsruhe Institute of Technology is a non-profit organization for information technology. One of its main tasks is the conveying of the latest scientific findings in information technology to enterprises and public organizations.

The video *Made in Südwest: Schlaue Maschinen – Roboterforschung am KIT* [Made in Southwest: Smart Machines – Robotic Research at KIT] gives an insight into research and development in the field of humanoid robot technologies and systems at the High Performance Humanoid Technologie Lab (H2T) at the Institute for Anthropomatics and Robotics. Since 1998, they have expanded the range of specializations and abilities of their robot ARMAR. The aim was to enable the robot to act in an ordinary household, supporting humans in the performance of their everyday work.

41b: © SWR3, Courtesy of KIT

Eyal Gever

#Laugh, 2015/2016

42

*1970 in Tel Aviv, IL, lives and works in Tel Aviv

Interactive mixed-media installation

Eyal Gever has worked for more than 18 years with digital 3-D simulation technologies. A visionary of the high-tech industry, Gever has founded several IT startups and holds numerous patents for 3-D computer animation and multimedia technology. Gever's presentation at *Exo-Evolution* is the premiere of his NASA collaboration, *#Laugh*. For this project, the 3-D spectrogram of a human laugh, selected by the artist in a global 90-day social media campaign, will be printed out by a 3-D printer operating in weightlessness on board the International Space Station (ISS). The universal message of human laughter will thus be the first 3-D-printed work of art created in space. Exhibition visitors are cordially invited to contribute their laughs to the project.

www.eyalgever.com

Supported by:

Alexandra Daisy Ginsberg

*Designing for the Sixth
Extinction, 2013–2015*

43

*1982 in London, GB, lives
and works in London

Lightbox, framed prints, slug
models, timeline diagram

Whilst conservationists are struggling to protect existing “natural” species and reverse the effects of the Anthropocene, scientists in the field of synthetic biology are busy designing new organisms for the “benefit of humanity.” *Designing for the Sixth Extinction* investigates synthetic biology’s potential impact on biodiversity and conservation. Could we tolerate “rewilding” – the conservation movement that lets nature take control – while also using synthetic biology to enhance nature further? Letting synthetic biodiversity loose in order to conserve the “nature” we idealize would disrupt existing conventions. The designed, functional species are ecological props that fill the void left by extinct mammals, or offer novel protection against foreign species, diseases, and pollution. Constructed using an expanded DNA code that produces non-biodegradable proteins, these “living machines” are resistant to wild predators that have not yet evolved to digest them. They form their own enclosed ecosystems, the outcome of decades of political negotiation around biosafety and release. Corporate-designed organisms used to preserve or revive disappearing ecosystems would demand a relaxed attitude towards biological control, risk and ownership. The taxonomic status of life forms that are technologically isolated, with no purpose except to save others, is also uncertain. Are they even alive? If nature is totally industrialized for the benefit of society – which for some is the logical endpoint of synthetic biology – will nature still exist for us to save?

www.daisyginsberg.com

Commissioned by Science Gallery, Dublin

Supported by: Stedelijk Museum, Amsterdam, and ZKM | Karlsruhe

Alexandra Daisy Ginsberg, Sascha Pohflepp
and Andrew Stellitano

Seasons of the Void, 2013

Alexandra Daisy Ginsberg *1982 in
London, GB, lives and works in London
Sascha Pohflepp *1978 in Cologne, DE,
lives and works in Berlin, DE
Andrew Stellitano *1986 in Cambridge,
GB, lives and works in London

44

Mixed-media installation

If humans went on a long-term mission to Mars, would they take with them all the provisions needed, or would they cultivate the food needed to sustain themselves along the way? *Seasons of the Void* reacts to proposals by NASA and others to use synthetic biology as a means of producing food in space by designing organisms able to perform electrosynthesis rather than photosynthesis.

Electricity flows through a dark tank connected to the solar panels of the spaceship. Inside, two symbiotic cultures of modified yeast are feeding on it, forming spherical fruit-like shapes in microgravity – a radical departure from how most life on Earth converts energy. Cut open, a harvested fruit reveals a structure that resembles the growth rings of a tree. It represents a record of the 377 days of the journey and the diminishing power of the Sun. The magnetic field within the tank, distorted by spikes in the solar weather, shows a brief moment in the shadow of Venus that momentarily halted the growth and caused small streaks in the fruit, left by cosmic rays.

www.daisyginsberg.com
www.pohflepp.net
www.astarism.co.uk

Niklas Goldbach

The World, 2012

45

*1973 in Witten, DE, lives
and works in Berlin, DE

1-channel video, color, silent, 13:00 min.

The World (2012, 13:00 min., looped) was produced on the artificial island landscape The World Islands, off the coast of Dubai. In long, evenly paced takes, with a minimum of movement, the video was shot on thirteen of the islands. Its formal composition directly references romanticism. The scale of nature is contrasted with the insignificant role of the human being – the human silhouette is placed within an impressive landscape. The exaggerated representation of the artificially constructed islands, however, ironically highlights the absurdity of the relation between humankind and nature. The uninhabited islands, which from an aerial perspective resemble a map of the world, are sinking, section by section, into the sea, through erosion. The protagonist looks on, nearly motionless, waiting impatiently for the collapse of this failed, absurd construction project.

www.niklasgoldbach.de

Text from: Silke Wittig, "KünstlerInnen der Ausstellung" [Artists of the Exhibition], in: *Give Us The Future – Stipendiatinnen und Stipendiaten des Arbeitsstipendiums Bildende Kunst des Berliner Senats 2013* [Recipients of the 2013 Fine Arts Scholarship of the Berlin Senate], exhib. cat., Neuer Berliner Kunstverein N.B.K., König, Cologne, 2014, pp. 49–108.

Andy Gracie

Deep Data Prototype_2, 2012

46

*1967 in London, GB, lives and
works in Barcelona, ES

Mixed-media installation

Deep Data Prototype_2 forms the second stage of the Deep Data research project carried out by British artist Andy Gracie, in which cultures of organisms common to space bioscience are manipulated, reconfigured and reinterpreted according to deep space conditions, using data collected by deep space probes and planetary orbiters. The project as a whole simulates a DIY astrobiological laboratory, connecting distant data streams with real-time organic processes.

Gracie uses photomorphogenic mutants of the plant *Arabidopsis thaliana* and exposes them to varying light frequencies, allowing us to witness the effects on the early stages of seed development. These light frequencies are taken from readings of light conditions on, around, and between other planets in our solar system, alongside those envisioned by science-fiction conceptions of the same places. The facts of science are placed alongside the fantasies and imaginings of the human psyche.

The seeds used in this experiment are the NW67 long hypocotyl variety, a naturally occurring photomorphogenic mutation whose initial growth is affected by the extent to which the wavelength of light it receives is shifted towards the red or the blue ends of the visible spectrum. As the plant seedlings grow, the resulting organic micro-sculptures allow us to reflect on the possibilities of life under non-terrestrial conditions, and the extensions of our perceptual boundaries that these distant sensor platforms offer.

www.hostprods.net

Originally commissioned for *Sin Origen, Sin Semilla*, Universidad Nacional Autónoma de México, Mexico City

Tue Greenfort

VIS VITALIS, 2014

47

*1973 in Holbæk, DK, lives and works in Denmark and Berlin, DE

Mixed-media installation

In his works, Tue Greenfort thematizes social phenomena, in particular the relationship between humans and the environment.

Over the course of the last decade, Greenfort collected newspaper clippings related in various manner to the environment. Mounted on metal foil, the articles offer a panorama of numerous major environmental crises of our era; crises largely attributable to our accumulation of material goods, which are, in turn, a result of economic and political needs that lead to collective pursuit of constant growth. Greenfort's sculptures induce a critical investigation of the changing character of nature, conceiving an expanded version of ecology, including the environment, social relations, and human subjectivity.

The *UREA* crystal fountains and the *UREA* microscopic photo series represent different studies of urea crystallizations.

The compound urea easily crystallizes when dissolved in a saturated solution together with Polyvinyl alcohol, a water-soluble synthetic polymer. The crystallization processes is visually observable by the human eye. Greenfort presents works dealing with Urea, which was the first compound ever to be artificially synthesized, in 1828 by the German chemist Friedrich Wöhler. This discovery, that compounds could be produced from inorganic materials, signaled a revolution in organic chemistry and refuted the long held belief in Vitalism – the belief that living things contain and are governed by a “vital energy” that is distinct from physical or chemical forces. Today Urea is used in everything from beauty products to cloud seeding. It is however, its use as fertilizer for agriculture where it is found most extensively.

www.tuegreenfort.net

Courtesy of Galerie König, Berlin

History of Others (Laura Gustafsson and Terike Haapoja)

The Museum of the History of Cattle, 2013

Laura Gustafsson *1983 in Helsinki, FI, lives and works in Helsinki
Terike Haapoja *1974 in Helsinki, FI, lives and works in New York, NY, US

48

Mixed-media installation

The History of Others is an art and research project by visual artist Terike Haapoja and writer Laura Gustafsson. The focus of the project is an exploration into the lives and experiences of non-human animals and an investigation of their history. The project materializes in exhibitions, publications, performances, interventions, and seminars on the topic. It is structured as a continuous process, working towards a large-scale, encyclopedic installation exhibition, *The Museum of the History of Others*.

The Museum of the History of Cattle, first exhibited in Helsinki in 2013, is the first part of the ongoing project. The large-scale installation exhibits world history as seen through the eyes of cattle, one of the most important species for the development of human culture. The exhibit is divided into three parts. "Time Before History" includes the history of cattle before their domestication by humans. This is followed by "Time of History," which for many, if not all, cattle begins about 10,000 years ago, when bovine culture became intertwined with that of humans. "Time of History" ended one hundred years ago, when human industrial society made it impossible for cattle to pass on their heritage to later generations. During the ahistorical period, cattle were cut off from awareness of their own culture in many parts of the bovine world.

www.historyofothers.org

Terike Haapoja

Succession, 2008

49

*1974 in Helsinki, FI, lives and works in New York, NY, US

1-channel video, color, sound, 4:00 min.

We perceive ourselves as autonomous individuals. However, billions of others live in and on our bodies: microbes and parasites, which can cause diseases on the one hand, but which are also essential for our well-being. The interactions between ourselves as host organisms and these micro-communities remain mysterious, as less than one percent of the population living on and with our bodies has been identified.

The video shows a recording of the growth of bacteria on a canvas that was pressed onto the artist's face. The portrait becomes visible as colonies of bacteria, individually invisible to the naked eye, form. The size of the original cultivation was 20 × 30 centimeters. The nine-day process has been edited to create a four-minute loop.

www.terikehaapoja.net

Stephen Hawking

50a: *How Intel Keeps Stephen Hawking Talking*, 2014
50b: *How Stephen Hawking Communicates?*, 2010

50

*1942 in Oxford, GB, lives and works in Great Britain

50a: 1-channel video, color, sound, 1:59 min.
 50b: 1-channel video, color, sound, 1:36 min.

In 1963, the British physicist Stephen Hawking received the diagnosis amyotrophic lateral sclerosis (ALS), a degenerative disease of the motor neuron system that would, from 1968, chain him to a wheelchair. Since losing his ability to speak, for all verbal communication, Hawking has had to rely on a speech computer, which he first controlled with a switch in his hand and then, from 2008, with a single movement of his cheek muscle or eyes. With this technology, Hawking is able to speak, at a rate of up to fifteen words per minute; as well as write books, edit documents, and surf the Internet. From 2012, the US hardware company Intel developed a new software for Hawking, enabling him to accelerate his input of commands to the speech computer. The Assistive Context-Aware Toolkit (ACAT), which converts facial muscle movements into keyboard input, has since been released by Intel under an open source license. This grants many people with disablement improved access to communication.

50a: Courtesy of Intel® Coporation

Ivan Henriques

***Symbiotic Machine*, 2014**

*1978 in Rio de Janeiro, BR, lives and works in The Hague, NL

Mixed-media installation

51

Developed in collaboration with scientists from the VU University Amsterdam, Symbiotic Machine is a prototype for an autonomous biomachine which harvests energy from photosynthetic organisms; this energy activates the machine, which then starts moving to collect more photosynthetic organisms. By gradually acting as a living organism, this biosolar mechanism creates a symbiotic system with the environment in which it is located, detecting, collecting, carrying, and processing other organisms, and amplifying the energy obtained from them using a floating mobile robotic structure.

The machine works most optimally in habitats such as ponds, canals, rivers, and the sea, places full of the micro-organisms and algae which are a potential source of nourishment. Cleaning the water of harmful algae, the Symbiotic Machine also benefits the ecosystem, thus offering a concrete example of that which is speculated upon by the other artworks in the exhibition.

www.ivanhenriques.com

In cooperation with: Biophysics Lab, VU University Amsterdam, NL
 Mechanical Engineering Lab, CEFET-RJ, BR / Michel van Overbeek, physicist, Roosendaal, NL
 Yvo van Oos, 3D Lab, Royal Academy of Art, The Hague, NL



Camille Henrot

Grosse Fatigue, 2013

52

*1978 in Paris, FR, lives and works in New York, NY, US

1-channel video, color, sound, 13:00 min.

With *Grosse Fatigue*, Camille Henrot challenges herself to tell the story of the universe's creation. The backbone of *Grosse Fatigue* is a long poem delivered in the style of spoken word, a form of expression embraced in the 1970s by the New York musicians The Last Poets. It mixes scientific history with creation stories from religious (Hindu, Buddhist, Jewish, Christian, Islamic, etc.), hermetic (kabbalah, freemasonry, etc.), and oral (Dogon, Inuit, Navajo, etc.) traditions in a joyous syncretism. Against the visual background of this impassioned oration, Henrot performs what she calls an "intuitive unfolding of knowledge" through a series of shots which unveil the treasures hidden away in the prestigious collections of the Smithsonian Institution in Washington, D.C.

www.camillehenrot.fr

Courtesy of the artist, Silex Film, and Galerie Kamel Mennour, Paris, FR

Lynn Hershman Leeson

53a: Infinity Engine – Hybrid Room, 2013–2014

53b: Infinity Engine – Screening Room, 2013–2014

53

*1941 in Cleveland, OH, US, lives and works in San Francisco, CA, and New York, NY, US

53a: Wall paper, 1-channel video, color, silent, 10:00 min.
53b: 1-channel video, color, sound

In her work *Infinity Engine*, Lynn Hershman Leeson explores the rising influence of genetic engineering on human life. The multimedia installation was developed in cooperation with biologist Josiah Zayner and references scientific gene-engineering labs. Photographs and films about the latest achievements in molecular and cell biology, bioprinted organs, and genetically modified organisms form the basis the artist uses to question how far human intervention in DNA is ethically acceptable, and what social and political impact it may have. In this context, Hershman Leeson also returns to the theme of identity, which features frequently in her work. Against the background of bioprint technologies, facial recognition software, and DNA programming, she discusses such questions as how identities can be safeguarded in an age of genetic engineering. Thus with *Infinity Engine*, Hershman Leeson continues the fictional narratives of her films *Conceiving Ada* (1996) and *Teknolust* (2002), further developing them into an innovative artistic work based on real, highly topical scientific findings and technologies and, in the process, bringing together art and science.

www.lynnhershman.com

In cooperation with Josiah Zayner
Courtesy of ZKM | Center for Art and Media Karlsruhe

Bart Hess

Digital Artifacts, 2014

54

*1984 in Geldrop, NL, lives and works in Eindhoven, NL

1-channel video, color, silent, 1:14 min.

With *Digital Artifacts*, which was presented as a series of performances during the 2013 Architecture Triennale in Lisbon, Bart Hess foreshadows a future of cyborg couture, in which glitches play across our skin and transform our bodies. Today, our bodies are endlessly photographed, monitored, and laser-scanned down to the last millimeter. Anchored in this context of surveillance, facial recognition, avatars, and virtual ghosts, Hess imagines a near future in which digital static, distortions, and glitches become a new form of ornament. In his video, a model is dipped into a puddle of hot liquid wax resting in the center of a water tank. Underwater, her body is transformed into an architectural sculpture that is slowly revealed when she is lifted out of the water. The body of the model is encased in a sodden, ready-made prosthetic. It is a physical glitch, a manifestation of corrupt data in motion, a digital artifact.

www.barthess.nl

In collaboration with POSTmatter

Chris Jordan

Midway: Message from the Gyre, since 2009

55

*1963 in San Francisco, CA, USA, lives and works in Seattle, WA, US

1-channel video, color, sound, 3:55 min.,
3 framed photographs, 76 × 63 cm

Photographer, filmmaker, and environmental activist Chris Jordan uses his photo series *Midway: Message from the Gyre* to show the consequences of mass consumption and uncontrolled industrial growth. The small island archipelago of Midway, halfway between California and Japan, lies at least 3,000 km from any continent. As this nearly uninhabited group of islands is located in the middle of the "Gyre," one of five large circular ocean currents, remains and marks of civilization and its impact on the environment are very visible. On Midway, the detritus of human mass consumption surfaces in an astonishing place: inside the stomachs of thousands of dead baby albatross. A huge amount of plastic floats in the vortex of Gyre, mainly in small particles. Situated beside a highly polluted area of the Pacific Ocean, the Midway Island is a fatal nesting place for albatross. The albatross collect everything that looks to them like food, eating it or feeding it to their chicks, and on this diet of human rubbish the albatross die due to starvation, choking, or poisoning. Not a single piece of plastic was shifted, added, or moved in Jordan's photographs.

www.chrisjordan.com

Manfred P. Kage Science Art

56a: *Buthyl-Benzoesäure, Lichtmikroskopie*, 2006, Photography
 56b: *Aescin, Lichtmikroskopie*, 1973, Photography
 56c: *Dimethylnaphtalin, Lichtmikroskopie*, 2010, Photography
 56d: *Ovum Oleum Liquid Crystal, Lichtmikroskopie*, 2003, Photography
 56e: *Videokompilation I*, 1975–2003, with excerpts from: Salvador Dalí, *Hommage à la haute Mongolie*, 1975, 1-channel video, color, sound, 24 min.
 56f: *Videokompilation II*, 2005–2015, Video, color, sound, 15 min. Archive material and publications concerning the term Science Art, 1958–2008, Photographies, Books, Magazines
 Multibeam interference microscope after Horn, Ernst Leitz GmbH, before 1970, Object

*1935 in Delitzsch, DE, lives and works in Lauterstein, DE

Since the 1950s, Manfred P. Kage has applied himself to artistic and professional microphotography, using state-of-the-art technology to explore pictorial worlds invisible to the naked eye. To portray microorganisms or crystalline surfaces, he developed novel methods, putting his own personal aesthetic imprint on his photography. For this work, a product of the interaction between science and art, around 1969, he coined the term “science art”; which he later extended to “video science art”, to describe his filmic work. In 1974, after his active artistic involvement in the ZERO movement, Kage created the special effects for Salvador Dalí’s film *Hommage à la haute Mongolie*. Produced by German public broadcaster WDR, the film simulates a flight across a fantastic landscape using the surface of a ballpoint pen barrel. His works were presented in numerous exhibitions worldwide; and, in 2012, his lifework was honored with the Cultural Prize by the Deutsche Gesellschaft für Photographie [German Photographic Association]. To this day, Manfred P. Kage continues to produce new developments in the realm of microphotography and microvideo.

www.kage-mikrofotografie.de

Courtesy of the Institut für wissenschaftliche Fotografie, Manfred P. and Christina Kage

56

Wanuri Kahiu

Pumzi, 2009

*1980 in Nairobi, KE, lives and works in Nairobi

1-channel HD video, color, sound, 21:00 min.

57

Pumzi, which means “breath” in Swahili, is a short science fiction movie by the Kenyan film director Wanuri Kahiu. The film is set in East Africa thirty-five years after World War III, also known as the Water War, which caused ecological devastation on a large scale. The land has become uninhabitable and humans must live indoors in specially sealed compounds.

However, Asha, a curator at a virtual natural history museum, reasons that there must still be life on Earth. She receives soil that is not toxic and contains a lot of water. The seed she plants in that soil begins to grow. In order to find out where the soil comes from, Asha asks for permission to go outside, but her request is immediately denied by the Council. Nevertheless, she finds a way out and uses all her energy to plant the seed in nature. The post-apocalyptic short film is based on a dystopian idea: What if humanity were cut off from nature, living in a highly technologized world without access to natural resources?

www.pumzithefilm.com

Produced by: Simon Hansen, Hannah Slazeczek (Inspired Minority Pictures)
 Support by: Focus Features, Goethe Institut, KCDF

Felix Kemner

58a: *Sauerstoffproduktionsanlage*, 1970
 58b: *Sauerstoffproduktionsanlage, Moos-
 tafel, Moosfuge, Moostheater*, 1970–1983
 58c: *Buch Moooses*, 1969
 58d: *Sauerstoffhemisphäre Frankfurter
 Paulskirche*, 1978
 58e: *Cosmoss – Sauerstoffhemisphäre*, 1969
 58f: *Moosorgan*, 1971
 58g: *Moosgewand*, 1983

58

58a: Photo canvas
 58b: 1-channel video converted
 from Super 8 film, color, silent,
 sound, 42:26 min.
 58c: Object, moss, sound
 58d: Photo canvas
 58e: Object, Plexiglas, moss
 58f: Wall object, moss
 58g: Photo canvas

*1933 in Bad Godesberg, DE, lives and
 works in Cologne, DE, and Las Palmas, ES

Since the 1960s, Felix Kemner has been working with the organic material moss – focusing attention on the endangerment of the atmosphere through air pollution. In an engaged dialog with the budding environmental movement, he created, under the title *Cosmoss*, a number of objects, in which a moss landscape is surrounded by a acrylic glass hemisphere. Among the works highlighting the oxygen-producing and thus atmosphere-cleansing feature of moss, are such wall objects as *Moosorgan*; and such public-space actions as the *Sauerstoffproduktionsanlage*, first installed in Koblenz and later in downtown Cologne, for which Kemner planted a section of sidewalk with moss. Influenced by the object art and happenings of the Fluxus movement, Kemner also produced what he calls the “first living book in the world,” *Buch Moooses*: two book covers enclosing a magnetic tape and a moss field.

Thanks to: Bazon Brock

Allison Kudla

Capacity for (urban eden, human error), 2009

59

*1980 in Mesa, AZ, US, lives
 and works in Seattle, WA, US

Custom-built CNC machine, algae, seeds

Capacity for (urban eden, human error) uses a custom-built, computer-controlled, four-axis positioning table to “print” bioarchitectural constructions out of algae and seeds. Suspended in a clear gel growth medium, the algae continues to grow and the seeds to sprout. The algorithmically generated patterns drawn by the system are based on the Eden growth model, and use mathematical representations of both urban and cellular growth, thereby connecting the concept of the city with the concept of the organism. The Eden growth model drawn by the printer is a surface fractal that has been used to describe bacterial growth. As stated by Philip Ball in *The Self-Made Tapestry: Pattern Formation in Nature* (2001): “Watching a bacterial colony grow is like watching a city expand into urban sprawl, except that it happens in days rather than decades.” This association has also been made by applied mathematicians and urban designers. For instance, in his essay “Connecting the Fractal City” (2004), Nikos A. Salingaros writes: “Living cities have intrinsically fractal properties, in common with all living systems.”

www.allisonx.com

Nandita Kumar

60a: *eLEmeNT: EaRTh*, 2014

60b: *pOLymORpHic hUMansCApE*, 2013

60

*1981 born in Pamplemousses, MU, lives and works in Bombay, IN, and Auckland, NZ

60a: Glass bottle, wood, acrylic sheets, wire, solar cells, battery, sensors, copper, silver soldering, PCB board components

60b: Glass bottle, copper, acrylic, PCB components, Raspberry Pi, sensor, LCD

Nandita Kumar's works take the form of interactive biospheres which demonstrate the organic integration of nature and technology. Inspired by biomimicry, both dioramas imagine a future in which nature and technology are in sync. *eLEmeNT: EaRTh* uses functional and non-functional transparent PCB boards to produce sounds of the Earth which respond to light and movement. When touched, it produces man-made sounds which represent our carbon imprint on the diorama of the Earth. The eco-system contained within the bottle is primarily powered by a tree constructed of solar cells.

pOLymORpHic hUMansCApE uses video to examine two days in diametrically opposite urban landscapes. Inside the bottle, nature-based time-lapse video footage plays until it is disrupted by movement, representing the impact of unplanned urbanization. The installation aims to spark a dialogue on the issue of sustainable human ecology.

www.nanditakumar.com

Ebru Kurbak and Irene Posch

The Knitted Radio, 2014

61

Ebru Kurbak, *1977 in Izmir, TR, lives and works in Vienna, AT
Irene Posch, *1983 in Graz, AT, lives and works in Vienna, AT

Knitted sweater, framed objects, printed knitting instructions, radio

The Knitted Radio demonstrates how to knit a sweater that is also an FM radio transmitter. At the centerpiece of the exhibition is a tactile, functional, and electronic object knitted from ordinary wool and common conductive materials. The accompanying knitting instructions, to be published in a knitting magazine, enable the electronic object to be reproduced by others. This piece is part of a larger investigation into the use of traditional textile crafting techniques to create electronic components and devices from scratch. The work is inspired by the events of the 2013 protests in Taksim Square in Istanbul. *The Knitted Radio* is conceived to allow its wearer to access electronic space by sending invisible radio waves. It makes multiple voices in a public space possible, providing a local area for communication in environments where other means of communication are heavily controlled or restricted. In *The Knitted Radio*, knitting as an established craft in Anatolian female culture is creatively used as a way of organizing conductive, non-conductive, and resistive yarns in desired forms and structures in order to make the functional electronic components of a simple FM radio transmitter.

www.ebrukurbak.net
www.ireneposch.net

Realized at Eyebeam Art & Technology Center New York, with the support of Bundeskanzleramt Österreich and Land Steiermark.

Christian Lölkes and Adrian Vielsack
touch → reality, 2014/2015

Christian Lölkes, *1990 in White Plains, NY, US, lives and works in Karlsruhe, DE
 Adrian Vielsack, *1990 in Herne, DE, lives and works in Berglen and Karlsruhe, DE

62

Interactive installation, with app and 3-D printer

In today's digitized and interconnected world, the use of the Internet as a form of transcending limits, between separate dimensions, has become a matter of daily routine: actions – such as shopping – take place in the virtual realm, but their results – the delivery of the purchased products – occur briefly thereafter in the “real world.” In the digital world, while Internet users and cybernauts act untied to any geographic location, their actions do affect local reality.

This principle is addressed in the 3-D printer-based installation *touch → reality*, where technology and art find themselves in close proximity: An app (or website) enables users, independent of place or time, to send creative input, in a variety of forms to *touch → reality*. The entered data is combined with other metadata, which the users cannot control, into a probabilistic algorithm, and then processed. The artists transpose this process to a data cloud, from which the data streams, now changed by the algorithm, are sent to a 3-D printer installed in the ZKM exhibition space. Here, for the duration of the exhibition *Exo-Evolution*, a sculpture is printed daily; the one- and two-dimensional information sent by the users to the installation is transformed, with the aid of human beings, technology, and machine, and using the appropriate material, into three-dimensional objects.

www.touch-reality.com

Andy Lomas

Cellular Forms, 2014

63

*1967 in Welwyn Garden City, GB,
 lives and works in London, GB

2-channel HD video,
 color, sound

Inspired by the work of Alan Turing, Ernst Haeckel, and D'Arcy Wentworth Thompson, Andy Lomas uses a simplified biological model of morphogenesis to explore the generation of complex three-dimensional structures. Each form starts as a small initial ball of cells, which is incrementally developed over time, adding iterative layers of complexity to the structure. The aim is to allow forms to emerge from the interactions between individual cells, exploring generic similarities between many different shapes in nature, rather than to emulate any particular organism. The process reveals universal archetypal forms which can emerge from growth-like processes, instead of resorting to top-down externally engineered design.

www.andylomas.com

Audio: Max Cooper

Wolfgang Mally

Barnard211Ey5-ZKM, 2015

64

*1952 in Magdeburg, DE, lives and works in San Francisco Javier, ES

DNS transit gels, 1-channel video, silent, 11:47 min.

Since the 1970s, Wolfgang Mally has been interested in the spaces of possibility between the natural and the artificial. The interdependent, processual, fluctuating web, where the non-impossible, the unexpected can become a co-actor, in the broadest sense, is the actual “substance” from which Mally develops his work. The project *Barnard211Ey5-ZKM* is artist Wolfgang Mally’s reference to the molecular cloud Barnard 211 and the molecules in the human body. The DNA was extracted from the hair of a variety of people whom Mally met during his daily train ride between an exhibition space and the University of Münster. In the laboratory of the Institute for Physiology at the University of Münster, the DNA was loaded, marked and injected into tiny cavities, whose form simulates human bodies, in agarose. By means of electrophoresis, the DNA was caused to move through the agarose gel’s matrix. The video shows these transits and is an element from a larger installation comprehensively treating this process.

www.mally-art.de

Courtesy of the Ursula Walbröl Gallery, Düsseldorf

Daria Martin

Soft Materials, 2004

65

*1973, San Francisco, CA, US, lives and works in London, GB

16 mm film, color, sound, 10:30 min.

Soft Materials was shot in the Artificial Intelligence Lab at the University of Zurich where scientists are researching “embodied artificial intelligence.” In this cutting-edge area of artificial intelligence, robots are made which learn to function through experiencing their physical bodies, rather than being programmed from the “head down” by a computer “brain.”

Soft Materials introduces two performers to these robots, a man and a woman. These performers are trained in bodily awareness, and are acutely sensitive to the nuances of movement, primed to mimic the robots in a game of copying. These performers shed skins of soft fabric, moving their joints in a mechanical manner, and approaching the robots in the nude as if they were sentient beings. Creating intimate relationships in turns tender, funny, and eerie, they bend flexible human fantasy around tough materials.

www.dariamartin.com

Courtesy the artist and Maureen Paley, London

***Mechanismus von Antikythera,*
second century BC**

66

Documentary by Philippe Nicolet;
1-channel video, color, sound, 13:17
min., quotations by Marcus Tullius
Cicero, and Titus Livius

In 1900, in a shipwreck off the Greek island Antikythera, divers discovered a complex astronomic analog computer, which enabled its operator to correlate the solar and lunar calendars with each other; as well as predict lunar phases, and lunar and solar eclipses; and to synchronize the established Olympiad calendar with these astronomic phenomena. The front face of the apparatus shows a Greek and an Egyptian calendar, as well as the positions of the moon and the five then known planets. The rear face shows a 19-year calendar and a calendar of the Olympic Games. This functionality of the mechanism, which scientific examination has dated to the second century BC, not only prefigured Roman scientific findings but also represents the foundation of today's computer-based technology.

Reconstruction: Museumslandschaft Hessen Kassel, Cabinet of Astronomy and Physics, Kassel
Documentation: Direction: Philippe Nicolet / Images and editing: Julien Cuendet / Production:
NvP3D.com / Thanks to: Hublot and Hellenic Ministry of Culture and Tourism

Mediated Matter Group

Silk Pavilion, 2013

67

1-channel video, color, sound,
6:18 min., 2 photographs

The *Silk Pavilion* explores the relationship between digital and biological fabrication on a product-based and an architectural scale. Inspired by the silkworm's ability to generate a three-dimensional cocoon from a single multi-property silk thread (one kilometer in length), an algorithm which works to assign a single continuous thread across patches with various degrees of density. The overall density variation was determined by the silkworm itself, deployed as a biological "printer". A swarm of 6,500 silkworms was positioned at the bottom rim of the scaffold, spinning flat non-woven silk patches as they locally reinforced the gaps between deposited silk fibers. Following their pupal stage the silkworms were removed. The resulting moths can produce up to roughly 1.5 million eggs, allowing for the potential construction of up to 250 additional pavilions.

Mediated Matter Group, founded and directed by architect and designer Neri Oxman, explores how digital design and fabrication technologies mediate between matter and environment to radically transform the design and construction of objects, buildings, and systems. The goal is to enhance the relationship between built and natural environments by employing design principles inspired by nature, and by implementing them in the invention of novel digital design technologies.

www.matter.media.mit.edu

Research and design by the Mediated Matter Group at the MIT Media Lab in collaboration with Prof. Fiorenzo Omenetto (TUFTS University) and Dr. James Weaver (WYSS Institute, Harvard University). Mediated Matter researchers include Markus Kayser, Jared Laucks, Carlos David Gonzalez Uribe, Jorge Duro-Royo, and Neri Oxman (Director).

Agnes Meyer-Brandis

**42 – The Large
METEOR T-R-A-P
(Terrestrial-Rerouting-
Array-Pad), 2014**

68

*1973 in Aachen, DE, lives
and works in Berlin, DE

1-channel video, color,
sound, 4:02 min.

42 – The Large Meteor T-R-A-P investigates the possibilities of calculating and steering a meteor safely down to Earth.

On October 7, 2008 the first meteor ever to be predicted impacted in Sudan exactly on time. Many scientists are working on Near-Earth Object (NEO) studies, examples of which include NASA's "NEO Survey and Deflection Study" and the NEOShield project. Such studies seek technologies and strategies to protect the Earth from asteroids and large meteor impacts. Slow-push technologies and concepts such as the gravity tractor, the mass driver, and the space tug will be explored, as well as technologies for impulsive deflection with nuclear explosive contact.

42 is a new approach in the attempt to control meteors and their possible landing on our home planet. The technology is installed outside the city of Marrakesh, Morocco. A network of spiral antennae extending deep below the earth's surface creates a magnetic hole in the earth's atmosphere. Passing meteors attracted to the antennae are caught and slowed down before (hopefully) descending into the magnetic hole.

www.blubblubb.net

Thanks to: Samya Abid, Paper Blattmacher,
Jens Brand, Enric Duch, Natasha Hoare,
Hicham Khalidi, Simon, Mamadou and the
large Antennae Team
Commissioned by the Marrakesh Biennale
2014 and supported by IFA

Yann Mingard

DEPOSIT, 2009–2013

69

*1973 in Pompaples, CH, lives
and works in Colombier, CH

7 photographs

DEPOSIT is a photographic project about hidden places, the strong belief in technology, fear of the future, and the presumption that storing and archiving genetic, biological, and human data will make the future world a safer place. In his project, Swiss photographer Yann Mingard challenges the trust that we place in technology. Between 2009 and 2013, Mingard visited twenty-one places where human, vegetable, animal, cultural, and digital data is collected and stored, such as the Belgian Laboratory of Tropical Crop Improvement, the Swiss National Stud Farm, and a bull sperm bank in France. He photographed the architecture of these depositories, the landscape, and the archived objects, capturing the paradoxical quality of these places. The exhibition provides an insight into this extensive photographic project.

www.yannmingard.ch

Courtesy of Robert Morat Gallery, Hamburg

Dave Murray-Rust and
Rocio von Jungenfeld

Lichtsuchende, 2014

70

Dave Murray-Rust, *1976 in Stirling, GB, lives
and works in Edinburgh, GB
Rocio von Jungenfeld, *1982 in Marbella, ES,
lives and works in Edinburgh, GB

Interactive kinetic installation

Lichtsuchende is an interactive installation, presenting a society of biologically-inspired robotic creatures who exchange light as a source of energy and as a means of communication. The robotic creatures are reminiscent of sunflowers, turning their heads to face the sun in order to absorb its light. However, they simultaneously generate light in order to engage with others. Each creature is relatively small, but when a group of *Lichtsuchende* is brought together in an installation, they form an expanding photo-kinetic social environment in which visitors can become immersed. Based on simple cybernetics combined with human and animal psychology (Maslow's Hierarchy of Needs), the *Lichtsuchende* sleep and dance with each other or with visitors, while constantly seeking light sources with which to play and communicate. Visitors are invited to engage with the installation by using torches.

www.mo-seph.com
www.rociojungenfeld.eu

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land's Alt-w Fund and the University of Edinburgh
Design-Informatics programme

MVRDV & The Why Factory in collaboration with MOON Kyungwon & JEON Joonho (News from Nowhere)

I-City, 2012

MVRDV was founded in Rotterdam in 1993
MOON Kyungwon *1969 in Seoul, KR &
JEON Joonho *1969 in Bosen, KR
Live and work in Seoul

1-channel film, color,
sound, 8:25 min.

71

I-City is one of the chapters of MOON Kyungwon & JEON Joonho's ongoing project *NEWS FROM NOWHERE*, a collaboration between the Korean artist duo and the architect groups MVRDV & The Why Factory.

MVRDV presents a video documentary about "We-City" – a city made of safe bubbles. An "I-City" is an eco-friendly bubble unit, a self-sufficient entity that provides food, energy and the environment required for survival. Existing as individual units or grouping together to form a community based on their needs, the unification and separation of the I-Cities comes to determine the We-City – the community of the future.

The video echoes MOON Kyungwon & JEON Joonho's artistic research, suggesting an alternative scenario for a post-apocalyptic future. At the same time, it draws inspiration from the architectural landscape of East Asian cities and the exponential population growth they are facing, providing hybrid architectures as well as new housing models and shapes as possible means of shaping a better future.

www.mrvdv.nl
www.thewhyfactory.com
www.newsfromnowhere.kr

Michael Najjar

72a: golden eye II, 2012

72b: muse, 2014

72c: orbital debris 2020, 2013

72d: serious anomaly, 2015

72e: spacewalk, 2013

72f: vision statements, since 2012

72

72a–d: 4 pigment prints, Diasec, aluminum frame
72e: 1-channel video, color, sound, 3:31 min.
72f: Note paper, hand signed

*1966 in Landau, DE, lives and works in Berlin, DE

The photographs and videos in Michael Najjar's *outer space* project deal with the latest developments in space flight and its influence on future life on earth and in low earth orbit. His photographs seek to accentuate the cultural dimension of these technological developments and to channel them into an artistic process. In pursuit of this, Najjar enrolled in the training program at the Russian Cosmonaut Training Centre called Starcity. The selection of photographs from this work series show one of the golden mirror segments of the James Webb Space Telescope (*golden eye II*), scheduled to be transported into space in 2018, to replace the renowned Hubble Space Telescope; and (in *orbital debris_2020*) a model of the Russian module of the International Space Station (ISS) located twelve meters under water in a gigantic hydrolab, used to train extra vehicular activity, as well as the Multi Unit Spectroscopic Explorer (MUSE), an innovative spectrograph for observing very remote objects. *Serious anomaly* thematizes the crash of the manned space glider VSS Enterprise in autumn 2014, which was scheduled to offer commercial space travel for private tourists in 2015. *vision statements* is a collection of statements by scientists and astronauts whom the artist asked to share their visions of the future and further space exploration.

www.michaelnajjar.com

72b,c,e: Sammlung Wemhöner

Geraldine Ondrizek

**73a: Case Study 22
Chromosomes X & Y, 2011
73b: Cellular, 2008–2009**

73

*1963, lives and works in Portland, OR, US

73a: Installation, 24 printed, stitched and painted panels of synthetic silk, Plexiglas, metal

73b: 1-channel video, color, sound, 12:00 min.

In Case Study 22 Chromosomes X & Y, Geraldine Ondrizek explores the artistic representation of genetic information: Starting with 24 synthetic silk panels printed with a graphic representation of the human genome, Ondrizek used traditional silk painting to dye them, then applied hand-stitching. Geraldine Ondrizek uses the needlework to mark known and detectable features localized on the chromosomes, such as eye or hair color, which are contained in our genetic material and define each person as a unique human being. The film *Cellular* depicts the early development of a spider embryo, and is accompanied by the sound of cells growing and dying. At first, one hears the sound of a healthy cell dividing, which is somewhat melodic. However, the sound changes after a few minutes and loses its rhythm, becoming irritatingly scratchy, like a rusty hinge. This is the sound of an unhealthy cancerous cell, dying.

It was recently found that cells with cancer or other diseases give off low and strained-sounding frequencies, while healthy cells produce a pleasant sound. The physical structure of metastatic cancer cells is softer than that of healthy cells, which explains their distinctive vibrations.

For the video, 200 hours of still images were made with digital cameras mounted on stereomicroscopes and consolidated into a film. In the final film, ten segments of development terminating just prior to full gestation are overlapped, thereby creating an infinite loop of potential.

73a: Portland Art Museum, provided by the Ford Family Foundation

Lucy and Jorge Orta

**Orta Water – Zille Fluvial Intervention Unit,
2008/2015**

Lucy Orta, *1966 in Sutton Coldfield, GB, lives and works in Paris

Jorge Orta, *1953 in Rosario, AR, lives and works in Paris

Installation, Austrian *zille* (a flat-bottomed boat), steel, water bottles

74

Water – the essential resource for life on this planet – is one of Lucy and Jorge Orta's central topics. For years, their projects have highlighted the scarcity of water and the threat to our drinking water supply posed by a high degree of pollution – while pointing out various possibilities of purification and fair distribution of this natural resource. The *Zille Fluvial Intervention Unit* is part of the *Orta Water* series of sculptures and installations representing inexpensive devices for water purification and bottling, each designed for processing polluted water from the very environment of the particular exhibition site; so that it may then be distributed, in a pure state, to the exhibition visitors. *Zille Fluvial Intervention Unit* thus functions as a huge water bar, where drinking water bottles from around the globe are displayed, while inviting critical questions regarding the increasing privatization and commercialization of clean water.

Geoffrey Ozin

Closing the Carbon Cycle, 2015

75

*1943 in London, GB, lives and works in Toronto, CA

Mixed-media installation with 3-D model, graphics, 1-channel video, color, sound, 33:00 min.

Materials scientist and nanotechnology pioneer Geoffrey Ozin and his University of Toronto team are seeking solutions for sustainable energy production and storage, to address the problems of global climate change.

Inspired by photosynthesis, their “solar refinery” is designed to use solar energy and recapture atmospheric carbon dioxide to produce synthetic fuels. These offer the potential, with regard to storability, distribution and processability, of supplanting fossil fuels, without emitting new CO₂ into the atmosphere. In this sense, this visionary approach is modeled on the earth’s natural carbon cycle.

Media artist and exhibition designer Matthias Gommel has examined Ozin’s research work about nanotechnological catalyzers and the vision of a closed carbon cycle, and created a visual rendition in the form of a documentary installation: 3-D model, video and wall graphics visualize and contextualize Ozin’s research.

Artistic implementation: Matthias Gommel /
video: Matthias Gommel and Martina Rotzal

***Retooling Evolution:
Nature at Work, 2015***

76

Mixed-media installation

One of the fundamental evolutionary principles of biological systems is the natural and random creation of diversity through cell division. Here, the plurality is generated that is of key significance to the adaptive and resistive powers of life. Furthermore, in this manner, organisms can evolve that cope better in a human-defined environment – human beings, in their breeding of livestock and plants, have been exploiting these processes for thousands of years.

The installation on display, a collaboration between KIT, ZKM | Karlsruhe and the private company Heurisko, brings current scientific activity into the museum space, making the process of cultivating microorganisms visible to exhibition visitors. The displayed machine, provided by Heurisko, is able to select, from a pool generated through natural diversification, those microorganisms which are able to metabolize not only sugar, as food, but also other carbon compounds. This is achieved through controlled, continuous selection of the involved microorganisms – over a period of time, those variants of the organism prevail that can most successfully utilize the provided nutrients.

This experiment follows, in real time, human-controlled evolution designed to optimize an organism for a technical application: creating the ability, for example, to eliminate problematic chemicals from the environment.

www.zkm.de/globale/exo-evolution/retooling-evolution

A collaboration between the Heurisko Gesellschaft für Biologische Technologien mbH the Institute for Biological Interfaces I of the Karlsruhe Institute of Technology, and ZKM | Karlsruhe
KIT scientific team: Dr. Kersten Rabe, Manfred Maier
Heurisko team: Philippe Marlière, Simon Trancart, Matthias Bild
Scientific advisors: Prof. Dr. Christof Niemeyer, Dr. Ljiljana Fruk



Reynold Reynolds

Secret Machine, 2009

77

*1966 in Central, AK, US, lives
and works in Amsterdam, NL

2-channel video installation converted from
16mm film and digital stills, color, sound,
7:00 min.

Reynold Reynolds, who studied physics and photography, combines the fields of science and arts, both of which use the method of measuring.

In *Secret Machine* a woman is subjected to a series of increasingly restrictive pseudoscientific measurement procedures. Increasingly bizarre, and verging on the occult, these procedures begin with a restaging of photographer Eadweard Muybridge's late nineteenth-century motion studies, and culminate in her autopsy, as witnessed by the viewer. The methods of measurement and their constituent apparatuses are themselves recorded on camera, which itself becomes another measurement tool. In turn, different filming techniques are compared to the body's motion, transforming the human organism into a species of apparatus. *Secret Machine* is the second work in the *Secrets Trilogy*, a cycle exploring the imperceptible conditions framing life. It is preceded by *Secret Life* (2008) and followed by *Six Easy Pieces* (2010).

www.artstudioreynolds.com

Byron Rich

Protista Imperialis v2.1, 2012–2015

78

*1984 in Calgary, CA, US, lives
and works in Meadville, PA, US

Interactive mixed-media installation
with living algae

Protista Imperialis is an interactive work that uses an elaborate technological apparatus to maintain or destroy itself depending on the interface between the viewer and the art via custom facial recognition software.

The piece offers the viewer a moral conundrum. By maintaining close proximity to the work and an active engagement of it, the viewer is able to sustain the life of the bio-sculpture. Once the viewer disengages from the piece, the apparatus reverts to a state in which the sculpture decays. This is achieved by utilizing facial recognition signals for the activation of a series of high frequency tones when the viewer displays apathy through non-engagement or becomes removed from the viewing area. The effectiveness of this form of algal mitigation is debatable, and as of yet not necessarily scientifically proven forcing this work onto the border of fiction and reality; a place where we can ponder technology's ability to save us from ourselves or not. The digital interface between viewer and microcosmic biosphere echoes anecdotal concerns collected from participants about a growing gap between human beings and their biological foundations, as a result of an increasingly digitized sense of identity and human connection. *Protista Imperialis* is designed in hopes of initiating dialogue and reflection on how the digitization of interactions and identities affects relationships between individuals and a vastly interconnected biosphere.

www.byronrich.com

Adam G. Riess

*Dark Energy and the Future
of the Universe, 2014*

79

*1969 in Washington, D.C., US

1-channel video, color,
sound, 18:45 min.

In a lecture initiated by Peter Weibel for the twenty-fifth anniversary of ZKM, US astronomer and Nobel laureate Adam G. Riess presented his research into the expansion of the universe. Born in 1969, the astronomer and John Hopkins University professor was part of the High-Z Supernova Search Team. The team was one of two groups whose observations of stellar explosions, so-called supernovas, led to the finding, in the late 1990s, that the universe is expanding – contrary to previously accepted theory – at a steadily accelerating rate. The cause of the accelerating expansion is currently believed to be an unexplored energy form, making up some 70% of the universe, called dark energy. In this video message, Riess offers not only easily graspable insight into his research and the use of supernovas as cosmological distance gauges. Based on the question of the fate of the universe, he also introduces various scenarios, describing dark energy and possible alternative futures of the universe.

robotlab (Matthias Gommel,
Martina Haitz, and Jan Zappe)

the big picture, 2014

Matthias Gommel, *1970 in Leonberg, DE
Martina Haitz, *1970 in Karlsruhe, DE,
lives and works in Karlsruhe
Jan Zappe, *1969 in Siegen, DE, lives
and works in Berlin, DE, and Karlsruhe
/ Founded in 2000 in Karlsruhe, DE, af-
filiated with the ZKM | Center for Art
and Media Karlsruhe

80

Robot installation

In a process taking months, an industry robot draws a Martian landscape – with but a single line. *the big picture* is a creative process, surpassing the possibilities of human creativity. In the installation the robot is given the role of a landscape draftsman – *the big picture* thus refers to traditional art forms based on human perception. This drawn landscape has never been beheld by a human eye, though – only by a Mars robot. Through algorithmic operations, the robot artist converts visual data from that robot into a single uninterrupted path, consisting of more than 900 million movements. The line, stretching for hundreds of kilometers on the surface of the drawing, forms an abstract structure that gradually approximates a photorealistic image. The original photograph on which the drawing is based is from the MastCam of NASA's Curiosity Mars rover. The shot was taken in the afternoon, local Mars time, on the 528th Mars day (sol) of the mission (January 30, 2014).

www.robotlab.de

Software development: Nikolaus Völzow
With support from: KUKA Roboter GmbH, DE /
Metsäboard, FI / Festo, DE / Lamy, DE

Hermann J. Roth

Das Gedächtnis des Wassers, 2012

81

*1929 in Eisenberg/Pfalz, DE, lives and works in Karlsruhe, DE

11 Plexiglas sheets with acrylic paint, stepped base

In its solid state of aggregation – ice – a water molecule is spatially fixed, and forms 4 hydrogen bonds, the highest possible number. The result is a regular crystalline lattice. When the ice melts, these bonds break. The solid crystal becomes a fluctuating network, containing variously sized rings of bonded molecules.

The image in *Das Gedächtnis des Wassers* [The Memory of Water] is a three-dimensional section of such a multi-molecular assembly of water molecules. In physical chemistry, these groups of molecules are known as water clusters. They are caused by the dipolar nature of the water molecule, with separate concentrations of positive and negative electric charge. The form of these clusters is altered by the influence of positive and negative ions. The clusters contain energetic information and are of brief duration.

Hermann J. Roth is emeritus professor of medicinal and pharmaceutical chemistry and former director of the pharmaceutical institutes of the Universities of Bonn and Tübingen. Alongside his scientific work, since 1972, he has also dealt artistically with symmetry and chirality (“handedness”) in chemical substances, focusing on the visualization of molecular aesthetics.

www.h-roth-kunst.com

Scenocosme (Grégory Lasserre and Anaïs met den Ancxt)

Matières sensibles, 2013

82

Grégory Lasserre, *1976 in Annecy, FR, lives and works in the Rhône-Alpes region, FR
Anaïs met den Ancxt, *1981 in Vénissieux, FR, lives and works in the Rhône-Alpes region

Sound sculpture on wood, interactive marquetry, bio-hacking

Matières sensibles [Sensitive matters] is an interactive sculpture made of a thin ash wood veneer sheet. This sheet has distinct sonorous touch zones that follow the natural veins of the wood. The human body’s electrostatic energy acts as the trigger for the sculpture. An invisible design concept allows the artists to define a musical score, spread over different areas of the wood. This process of bio-hacking, invented by the artists, is called “interactive marquetry.”

The wood sculpture produces sounds when the spectator touches it. Sounds are used to stimulate haptic and gestural behavior. Thus, the design of the sculpture resembles an instrument, using touch to produce various kinds of sound.

Matières sensibles fosters a sensory and intimate relationship between the wood and the body of the viewer, able to remember and reproduce the specific sound induced by the touch of a particular viewer.

www.scenocosme.com

Awarded with the Human Interface Award, 2015

HA Schult

83a: *Biokinetic Laboratories*, 1972
 83b: Ulrich Herzog, *Pilze im Schloss*.
HA Schult läßt Farben wachsen, 1969

83

*1939 in Parchim, DE, lives
 and works in Cologne, DE

83a: Picture box
 83b: 1-channel video converted from
 16mm film, color, sound, 29:50 min.

Since the 1960s, action and object artist HA Schult's work has been characterized by provocative undertakings focusing attention on ecological problem areas, and human environmental pollution, in particular. To describe his work, in which he visualizes biological processes of change and decay, he has coined the term "bio-kinetics." In his bio-kinetic object cases and installations, Schult experiments with such living organisms as fungal or bacteria cultures that change color over the course of their development and decay. In 1969, he caused a stir at Leverkusen's Schloss Morsbroich Museum, with his exhibition *Biokineticische Situationen*, in which he decried the high degree of air pollution in "Chemical City" Leverkusen. In 1972, Harald Szeeman invited HA Schult to display his *Biokinetic Laboratories* at the legendary documenta 5 in Kassel. Wibke von Bonin's film which was produced by WDR, *Pilze im Schloss* documents HA Schult's first biokinetic exhibition in Leverkusen.

www.haschult.de

Courtesy of the HA Schult Museum, Cologne

SEAD (Space Ecologies Art and Design)

Biomodd [ZKM⁷], 2015

84

International collective,
 founded in 2009

Mixed-media installation, computers,
 plants, algae, sensors, pumps, lighting,
 various construction materials, and
 custom software

Biomodd, originally conceived of by Belgian biologist and artist Angelo Vermeulen, is a global series of art installations exploring new relationships between computers, biology, and people. In each *Biomodd* installation, e-waste is transformed into a functioning computer network with a living ecosystem inside. The heat generated by the computer electronics is used to create ideal growing conditions for plants and other organisms. Algae and aquaponics are used to cool computer processors so they can run faster. In later versions of the installation, sensors and robotics allow for more elaborate interactions between computers and biology. *Biomodd* is a community art project that is recreated in each new location where it takes root. Team members typically include artists, craftspeople, computer scientists, game designers, hackers, biologists, gardeners, and community organizers. The creation of the *Biomodd* [ZKM⁷] installation will take place in the form of an open workshop in the museum space during the first two weeks of the exhibition. *Biomodd* creates immersive art installations. It opens a science-fictional world in which biology and technology integrate into a fully functioning hybrid machine. Through the grass-roots approach and the collaboration of a culturally diverse team, *Biomodd* translates the imagination, vision, and artistry of a larger community. In this way the installation does not simply propose an aesthetic immersive experience but also a vision of a co-created future.

www.biomodd.net



Semiconductor (Ruth Jarman and Joe Gerhardt)

Do You Think Science..., 2006

85

Founded 1997

Ruth Jarman, *1973 in Great Britain

Joe Gerhardt, *1972 in Great Britain

Both live and work in Brighton, GB

1-channel video, color, sound, 12:15 min.

Do You Think Science... contributes a skeptical yet visionary perspective to the conceptual framework of the exhibition. By asking a group of space physicists from the NASA Space Sciences Laboratory unanswerable questions, Semiconductor reveals the hidden motivations driving scientists to the furthest limits of human knowledge. In an attempt to find meaning within the question, they open a Pandora's box of limitations within science itself, revealing their own philosophical confines. Issues of faith, medicine, and the laws of matter are raised in order to illustrate the infinitely complex universe we live in. And if, as one of the scientists suggests in the video, "[t]he purpose of knowledge is to display our ignorance, as the more you learn about something the more you learn that you don't know about that thing," then what we perceive here is the inner uncertainty and incommensurability of the universe, and at the same time the ultimate scientific belief that, nevertheless, the "universe makes sense."

www.semiconductorfilms.com

Made during an Arts Council England International Artists Fellowship Programme: Art and Space Science at the UC Berkeley Space Sciences Lab., University of California, US

In partnership with the Leonardo network and NASA.

Conrad Shawcross

The Blind Aesthetic, 2011

86

*1977 born in London, GB,
lives and works in London

Glass, steel, mechanical system, light

In his kinetic machine sculptures, Conrad Shawcross combines industrial aesthetic and epistemological inquiry. That is to say, Shawcross places technology at the service of aesthetics: One's initial impression of *The Blind Aesthetic* is a technical one, suggesting a productive purpose underlying the work, while it is actually to be read mainly from an aesthetic perspective. Shawcross uses robots to control light and the movement of his sculpture in such a way that the eye perceives regular curves, which he calls "three-dimensional algorithms." In mathematics, this form is known as a torus knot. Shawcross frequently bases his works on scientific references, whose complexity he transforms into sensual experience. Offering an aesthetic perception of scientific knowledge, Shawcross grants his viewers the opportunity to gain an individual understanding of universal theories.

www.conradshawcross.com

Courtesy of the artist and Victoria Miro, London

Maja Smrekar

Hu.M.C.C. – Human Molecular Colonization Capacity, 2012

87

*1978 in Ljubljana, SI, lives and works in Ljubljana

Interactive mixed-media installation

Food prices will rise in the future because production facilities lack the capacity to keep pace with the rate of global population growth. The food industry is exploring new possibilities and alternative means of future food production within the fields of synthetic biology and biotechnology. *Hu.M.C.C. – Human Molecular Colonization Capacity* dwells on the food industry's biotechnological production. It is represented as a highly designed yogurt package containing the product of the artist's enzyme, which is offered for the public to consume. The project can be seen as an experiment on social Darwinism, set within the realm of industrial food chain processes.

For the artist, the project is an interpretation of Marx's theory on the waste of productive forces. Marx established a connection between a rise in the accumulation of capital and a fall in the tendential rate of profit, a concept which is related to the exploitation of labor due to new waves of technological innovation. This concept is reflected in the project through the use of a genetically transformed microorganism producing lactic acid (one of the most widely used additives in the contemporary food industry), which has been synthetically designed using the artist's genetic code and the genetic code of a yeast cell.

www.mayayoghurt.net

The project has been executed in cooperation with Institute of Biochemistry, Medical Faculty, University of Ljubljana / Supported by Ministry of Culture of the Republic of Slovenia and Municipality of Ljubljana / Production: Kapelica Gallery, Ljubljana / Brand identity and web design: Atelje Balant / Coding: Oliver Marčetič / Lab infrastructure concept and design: Marko Žavbi, B. Lab. Biomed. / Design support: Andrej Strehovec, B. Arch. / Co-worker in the field of molecular biology: Dr. Metka Lenassi / Co-worker in the field of molecular gastronomy: Dr. Tilen Konte / Co-worker in the field of biotechnology: Dr. Špela Petrič / Courtesy: Kapelica Gallery, Ljubljana

Studio Swine (Azusa Murakami and Alexander Groves)

Sea Chair, 2012

88

Azusa Murakami, *1984 in Nagoya, JP,
lives and works in London, GB

Alexander Groves, *1983 in London,
lives and works in London

Plastic chair, 1-channel video,
color, sound, 3:21 min.

Huge amounts of plastic drift about in the planet's oceans. Similar to the "Great Pacific garbage patch," discovered in 1997, research scientists have also found vast surfaces of plastic refuse in the Atlantic – concentrated by surface currents, it has formed a gigantic carpet many times the size of Germany. As many as 200,000 particles of plastic per square kilometer, most of them less than a centimeter in diameter, float in these patches on the marine surface. Wave activity and UV light disintegrates the plastic into ever smaller particles, which are then consumed by various ocean dwellers instead of their usual food. Through the food chain, the discarded plastic, along with the incorporated toxic chemicals, is finally consumed by humans.

The *Sea Chair* by the London design studio is manufactured completely from discarded plastic gathered from our oceans, with the help of fishermen, and processed at sea.

www.studioswine.com

Luisa Székely

Luisa, die mit den Augen redet, 2015

89

*2006 in Filderstadt, DE, lives in Karlsruhe, DE

1-channel video, color, sound, 11:40 min.

Born severely physically disabled and speech-impaired, Luisa Székely has no way of expressing herself verbally. But her cognitive development is age-appropriate – she understands everything and learns well. So she was able to learn, with help, how to use electronic aids. Luisa communicates with the aid of a computer, a so-called talker, which she controls with her eyes. An infrared camera connected to the computer detects the movement of Luisa's eyes. The communication software that Luisa uses and edits to suit her own needs is based on sentences or words stored behind screen icons. Once these are activated, the words are spoken by the computer. This feature has three application options: entire sentences whose validity is either permanent or for longer duration, and which can be retrieved as a whole unit, e.g., "My name is Luisa"; single words, from which Luisa can form individual sentences herself, including a full range of grammatical options; and a computer keyboard, allowing Luisa to write out words not available in the software's existing vocabulary, for example: "ZKM."

Luisa uses her talker constantly, from rising time till evening: at home, at school, outdoors and on the go. Over a period of four years, she has acquired and continually improved the use and operation of this communication form.

The video *Luisa, die mit den Augen redet* [Luisa, Who Talks with Her Eyes] was produced by Gábor Székely. It can be located via title search on the online platform YouTube.

Yesenia Thibault-Picazo

Craft in the Anthropocene – The Cabinet of Anthropogenic Specimens, 2013–2015

90

*1987 in Villecresnes, FR, lives and works in London, GB

Mixed-media installation

For the *Exo-Evolution* exhibition, multidisciplinary designer Yesenia Thibault-Picazo produced an installation presenting a *Cabinet of Anthropogenic Specimens* made with site-specific material samples collected in Karlsruhe. The work builds upon her *Craft in the Anthropocene* project, initiated in 2013, which questions and incites debate on the recent theory of the Anthropocene. The term refers to the present geological era in which humankind has become a global geophysical force, intertwined with the most powerful forces of nature.

In response to this shift, Thibault-Picazo investigates the future of geology and explores speculative narratives. She produces future human-made minerals with anthropogenic materials. Her manufactured fossils, which she calls "material tales," offer an extreme projection of what terrestrial minerals could become in a world in the distant future if our civilization doesn't change its ideas of resource consumption.

Inspired by a technology used in laboratories called geo-mimicry, which engineers synthetic minerals and reproduces geological processes on a small scale, Thibault-Picazo works in a low-tech frame. She uses her workshop as a laboratory in which she places anthropogenic materials under extreme conditions.

Craft in the Anthropocene is a tale intended to raise awareness about the current shift in the relationship between human and nature. As a designer, Thibault-Picazo strives to provide a tangible experience of the abstract and complex notions of the Anthropocene and of deep time.

Luca Trevisani

91a: *Glaucocamaleo*, 201391b: *As though repetition can legitimize the act (I, II, III)*, 2014/2015

91

*1979 in Verona, IT, lives and works in Berlin, DE

91a: 1-channel video, color, sound, 75:00 min.

91b: Dried plants, solar cooker, copper sulphate crystals

Glaucocamaleo is a film about water: about its nature, mysteries, and its scientific and aesthetic properties. Water acts as proof that nothing is stable. The narrator of the film is Kary Mullis, who won the 1993 Nobel Prize in Chemistry, and has become a recognizably eccentric figure among the scientific community, constantly questioning hierarchies, values, and conventions, and combining his passion for science with his love of surfing. In *Glaucocamaleo*, scientific experiments generate sculptural processes and the lab becomes the platform upon which unexpected shapes can be produced and new forms can be created.

Three sculptures from the series *As though repetition can legitimize the act* allow the chemical reactions shown in the film to be represented in material form in the exhibition space.

As James Ballard's *The Crystal World* (1966) recounts, the original forms become imprisoned within these shiny gems; plants and animals are deprived of their temporal dimension and transformed into sculptural elements, which are the first stage in a constantly changing multiform series, just like the natural and chemical processes they reflect.

www.lucatrevisani.eu

Glaucocamaleo: Director of photography: Vassili Spyropoulos / Scenography: Carlo Trevisani and Luca Trevisani / Editing: Angelo Teardo e Luca Trevisani / Music: Dracula Lewis, Esperanza, Massimo Carozzi, Luca Trevisani / Voiceover: Kary Mullis / Executive producer: Luca Trevisani / Associate producer: Davide Giannella / Produced by: Luca Trevisani, Davide Ferazza – Withstand Film, Luca Legnani – 9.99 Films, Sasha Gandolfi Vannini – Spazio, Marco Gandolfi Vannini – Spazio, Marco Ballerini – Spazio, Museo Marino Marini
91a+b: Courtesy: Gallery Mehdi Chouakri, Berlin

Troika (Eva Rucki, Conny Freyer, and Sebastian Noel)

Dark Matter, 2014

92

Eva Rucki, *1976 in Emmerich, DE
Conny Freyer, *1976 in Frankenberg, DE
Sebastien Noel, *1977 in Montbéliard, FR
all live and work in London, GB

Installation, wood, aluminium, black flock

Dark Matter is a sculpture in which different forms may coexist. The viewer first sees a perfect circle, then a hexagon, followed by a perfect square. One can never see all of the three "states" at once while at the same time being challenged to accept the seemingly impossible.

The work questions a purely mechanistic worldview in which all material form is reduced to simple geometric entities that fit the rational mind's natural geometry. With *Dark Matter*, Troika continues to explore the dynamics of perception and reality, space and object, asking why we know what we know and whether this knowledge is certain, all the while asking what dictates how we determine knowledge in the first place.

Dark Matter interprets a monocular, disembodied, objective vision of the world. It questions whether everything can be understood completely in terms of the processes from which it was composed, and suggests that a single model or view alone can never form an accurate image of the whole, unless the whole is viewed through the lens of the particular.

www.troika.uk.com

Andrei Ujica

Out of the Present, 1995

93

*1951 in Timișoara, RO, lives and works in Karlsruhe, DE, and Bucharest, RO

1-channel video converted from 35 mm film, color, sound, 96:00 min.

Out of the Present is a non-fiction cult film of the 1990s. Celebrated around the globe, the montage film, based mainly on documentary video material from a space mission, uses a diary form to depict the story of Soviet cosmonaut Sergei Krikaljow. After reaching the MIR space station in May of 1991, Krikaljow is forced to stay there for ten months – twice as long as planned. During his sojourn in space, the August putsch takes place in Moscow, leading to the disintegration of the Soviet Union. Upon Krikaljo's return, in March 1992, his homeland is called Russia.

Film critics have compared *Out of the Present* with such masterpieces as Stanley Kubrick's *2001: Space Odyssey* and Andrei Tarkowski's *Solaris*, and this is not entirely without concrete bearing: In acknowledgement of his cinematography for *Solaris*, Wadim Jussow was offered the opportunity of becoming the first cameraman in film history assigned to shoot the first purely cinematographic footage in outer space. He was charged with the preparation and coordination of the two sequences making up the prolog and epilog of *Out of the Present*, for the shooting of which a 35 mm camera was sent up to the MIR space station.

With funding from: Film Foundation of North Rhine-Westphalia, Federal Ministry of the Interior, DE / With support from: RKK Energia, Energia Deutschland GmbH / Sponsored by: Daimler-Benz Aerospace

Featuring the cosmonauts: Sergei Krikaljow, Anatoli Artsebarski, Aleksandr Volkov / Cinematographer (35 mm): Wadim Jussow / Editors: Ralf Henninger, Heidi Leihbecher / Music: Lazonby, Mory Kanté, Johann Strauß, Jean-Luc Ponty, and others / Paintings and drawings: Mikhail Romadin / Producer: Elke Peters / Production company: Bremer Institut Film / Fernsehen / Coproduced by: WDR, la sept/arte, RTBF, St. Petersburg Documentary Film Studios, Harun Farocki Filmproduktion / Distributor: Les Films de Camélia

Koen Vanmechelen

La Biomista – Cosmopolitan Chicken Project, 2015

94

*1965 in Sint-Truiden, BE, lives and works in Genk, BE

Mixed-media installation

Koen Vanmechelen believes that hard scientific data and artistic creativity can work together to reveal the vicissitudes of nature and of human life. *La Biomista* [Mixed life] is Vanmechelen's new studio, situated in the multicultural city of Genk and home to Vanmechelen's first Open University of Diversity and the four foundations and subprojects of his *Cosmopolitan Chicken Project*. He started this multidisciplinary, artistic/scientific project in late 1990. More than a mere biocultural temple, *La Biomista* aims to be a disseminator of active and living art and philosophical ideas. In addition to serving as an intellectual breeding ground and as the headquarters for his other Open Universities of Diversity in Detroit and Havana, *La Biomista* also serves as a breeding station for the artist's chicken crossbreeds. Last but not least, *La Biomista* is also a laboratory and a library of biocultural diversity.

www.koenvanmechelen.be

Paul Vanouse

Ocular Revision, 2010

*1967 in Minneapolis, MN,
US, lives and works in Buffalo,
NY, US

2-channel video installation,
scientific apparatuses

95

Biology is a discipline which was greatly influenced by the ocular frenzy of the Modern period. The visual information it produced was based around the lens, which, like the eye that it aided, was fundamentally circular. Conversely, the DNA image typically belongs to a different regime of late twentieth century screen-based information: the grid and the database. While the nineteenth century marks the age of biology, the late twentieth century marks the "post-biological" age, as DNA is increasingly understood as a code rather than as a material substance. *Ocular Revision* reflects upon this epistemic shift in the life sciences, using an alternate device for imaging DNA.

In the installation, Vanouse seeks to create DNA patterns resembling hemispheric images, thus using DNA as a medium to generate maps of the earth's continents, by selectively processing DNA from common laboratory organisms and inserting this DNA into the custom gel.

www.paulvanouse.com

Aline Veillat

Pas de deux en vert et contre, 2009–2012

*1967 in St Denis, Réunion, FR,
lives in works in Basel, CH

Mixed-media installation, plants,
latex, clods of earth, metal, elec-
tronics

96

Pas de deux en vert et contre presents living vegetal organisms hybridized with technology, which enables the plants to move autonomously according to their needs and desires. Like nomads, they follow their own logic to wander falteringly about our world. Aline Veillat combines intelligent behavioral algorithms with domestic robots. Thus the plants move slowly, hesitantly, and unpredictably, with many periods of immobility. Naturally, they like daylight and water, but they prefer quiet places, recognize other plants, moving towards and away from them, and require some time to relax and stay still.

Pas de deux en vert et contre offers an eye-opening, unusual perspective: trying to imagine the world as it could be, but also as it was. A world with plants capable of moving at a speed perceptible by humans, at a faster pace than that of the simple change of seasons or of the gradual transformations caused by climate change.

www.alineveillat.com

In cooperation with: Swiss Federal Institute of Technology, Autonomous System Lab (ASL), ETH Zurich, CH / Tegoro Solutions ag, Basel, CH / Fulguro Design, Lausanne, CH / Plants physiologist: Dr. Sebastian Leuzinger, Robotics specialist: Prof. Roland Siegwart, and his lab: Stefan Bertschi, Dr. Xavier Perrin, Dr. Gilles Caprari, Thomas de Candia, Dr. Francis Collias, Dr. Stéphane Magnétat, Janine Stocker, Fadri Furrer / New-media specialist: Christian Rohner / Designers: Yves Fidalgo and Cédric Decroux
The installation at ZKM is supported by: schweizer kulturstiftung

prohelvetia

Martin Walde

Hallucigenia #1 SHAI, 2009
Hallucigenia #2 AHIS, 2009
Hallucigenia #3 IRAH, 2009

97

*1957 in Innsbruck, AT, lives and works in Vienna, AT

Plasma glass, various
noble gasses

Using new material technology to expand the concept of sculpture, Martin Walde's work comprehensively alters our notion of matter and space – by exploring both the connection between material and sculpture, and the relation of sensory organs to sensory perception. The *Hallucigenia* sculptures consist of thin-walled blown-glass bodies filled with various gasses, which are then made to fluoresce, using high-frequency technology. In these sculptures, Walde combines art, technology, nature, and science: Their form is inspired by Precambrian invertebrates, whose fossilized remains were found in Canada in 1911. In 1977, British paleontologist Simon Conway Morris named this extinct species *Hallucigenia*, a reference to the organism's bizarre exterior.

www.martinwalde.at

ZKM | Center for Art
and Media Karlsruhe

Peter Weibel

Exo-Evolution, 2015

98

*1944 in Odessa, UA, lives
and works in Karlsruhe, DE,
and Vienna, AT

Felt-pen drawing on wall

In the diagram he drew on the wall for the exhibition of Tetsuo Kondo+Transsolar's work *Cloudscapes*, Peter Weibel used the example of a cloud presented within the closed museum space to illustrate the relationship between evolution and exo-evolution. While clouds were only rendered in traditional art, the technological generation of microclimatic conditions makes it possible today to actually create them. Representation gets replaced by reality, nature can be artificially generated by humans. This means we are no longer surrounded by nature, we are surrounding nature. Thus becoming the dominating factor on earth, human beings usher in the Anthropocene epoch.

www.peter-weibel.at

**Where Dogs Run (Alexey Korzukhin, Olga Inozemtseva,
Natalia Grekhova, and Vladislav Bulatov)**

Faces of Smell, 2012

99

Founded in 2000 in Yekaterinburg, RU
Alexey Korzukhin, *1973 in Sverdlovsk, RU
Olga Inozemtseva, *1977 in Yalutorovsk, RU
Natalia Grekhova, *1976 in Kamensk-Uralsky, RU
Vladislav Bulatov, *1974 in Sverdlovsk, RU
All live and work in Yekaterinburg, RU

Mixed-media installation

Most people cannot reconstruct smells from memory. When we try to recall the smell of mint, we end up recalling how mint looks. However, there is a well-established and widely used method of recalling and recreating a visual image: the facial composite, whereby a previously seen face is reconstructed by comparing and selecting individual facial features.

Where Dogs Run uses the same method for fixing smells. They have created an array of gas analyzer sensors, which continuously examine the space and people within their operating range. The data the sensors gather results in a pattern that is unique to the place, people, and moments in time. This unique pattern is visualized in a facial composite: When a person approaches the analyzer, sniffing tubes “sniff” him. Gas analyzers process the information gathered by the tubes and pass it to a computer program that translates air composition data into data concerning the shape and position of facial features (the components of a facial composite). As a result, a person sees a face made from his or her smell which is conditional and in no way related to his actual physical appearance. If the same person were to approach the “nose” once again, his portrait would be slightly different, albeit still recognizable. This mechanism is yet another “memory crutch,” obviously deficient and ridiculous, and yet entirely in line with the requirements of total visualization that surround us today.

www.where-dogs-run.livejournal.com

Pinar Yoldas

Ecosystem of Excess, 2014

100

*1979 in Denizli, TR, lives and works in Durham, NC, US

Installation, diverse materials

In light of increasing amounts of plastic debris in the oceans, and inspired by the discovery of novel microorganisms colonizing the surface of ocean plastic debris and forming new ecosystems, artist and neuroscientist Pinar Yoldas created a number of speculative organisms for her installation – organisms that have adapted to their environment and developed special characteristics. It would seem the logical consequence of the environment conditions rapidly changing through human influence that future organisms would be able to perceive plastic (plasto-sensation), to digest plastic particles (plastivores), or remove pollutants from plastic (petronephros). The correlation between a creature’s pigmentation and its diet is demonstrated by means of the bright array of feather colors, other animals could use the plastic to form air-filled outer skeletons, so-called exoskeletons.

The novel forms of life imagined by the artist counter the disturbing human-made threat imposed by the debris in our oceans with a hopeful utopian design, offering us, with her “species of affluence,” a positive view of an imminently changing fauna.

www.pinaryoldas.info

Pinar Yoldas

Archipelago, 2015

101

Sculptures, diverse
materials

Over the past thirteen years, more than half of all Nobel Prizes in Chemistry have been awarded to scientists who are directly or indirectly studying proteins. We are witnessing a rise in the importance of proteins in science, understandable given their abundance in biological systems and their importance for the continuity of life. Proteins are at the center of the life of the cell. Their functions include catalyzing metabolic reactions, replicating DNA, responding to stimuli, and transporting molecules from one location to another. The project *Archipelago* simply expresses a fascination for these macromolecules. Considering their increasingly central role in the biological sciences, it is possible to predict that protein research alone will lead to significant developments in fields such as synthetic biology. The project is inspired by the crystal structures that these macromolecules form, and follows their crisp geometry. Highly organic structures lie within each crystal, mimicking the molecular dance of proteins. Overall, the installation creates a playful architectural space, encouraging the viewer to reflect on the growing importance of these macromolecules and on a future dominated by biology.

New Tools, New Materials: 3-D Print

102a: STRATASYS, Magic Arms, 2012

102b: Nemours: Children's Health System and Alfred I. duPont Hospital for Children, *Wilmington Robotic Exoskeleton*, 2010

102c: Zaha Hadid Architects, Chair, 2015

102d: Daniel Widrig, *Transhuman Male*, 2015

102e: Daniel Widrig, *Transhuman Female*, 2015

102f: Neri Oxman, *Zuhal. Saturn's Wonderer*, 2014

102g: Neri Oxman, *Qamar. Luna's Wonderer*, 2014

102h: Neri Oxman, *Mushtari. Jupiter's Wonderer*, 2014

102

102a: 1-channel video, color, sound, 3:56 min.

102b-g: 3-D printed objects

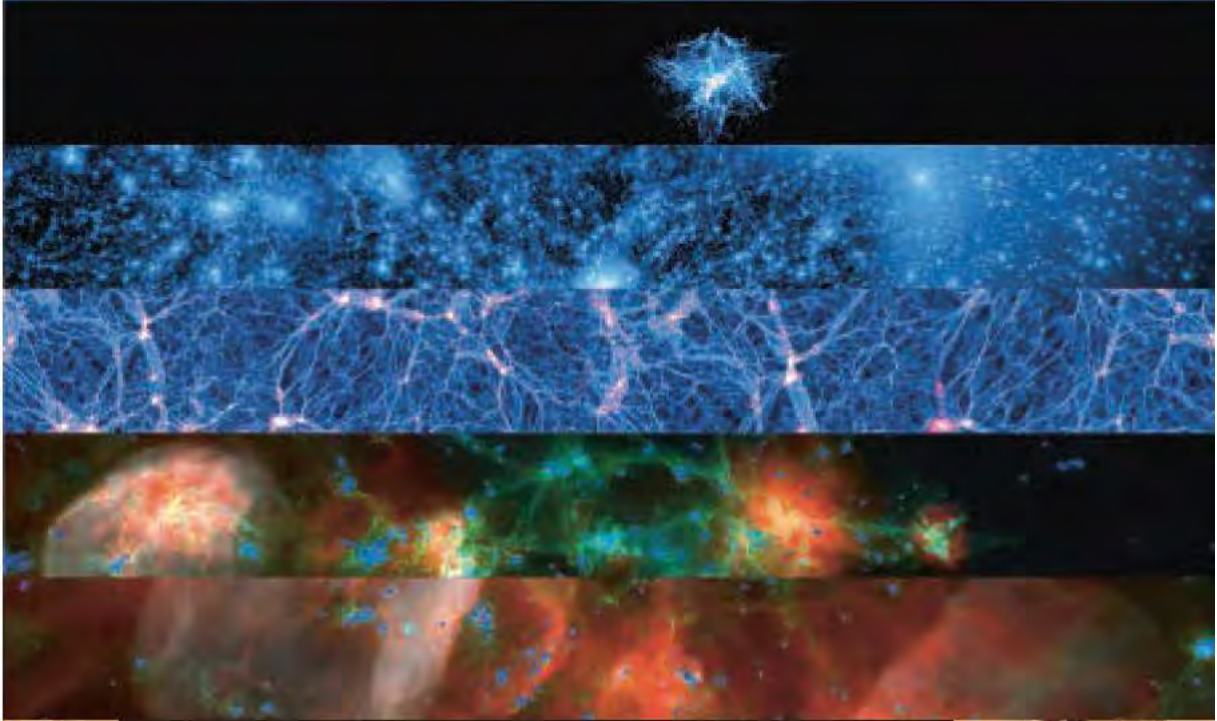
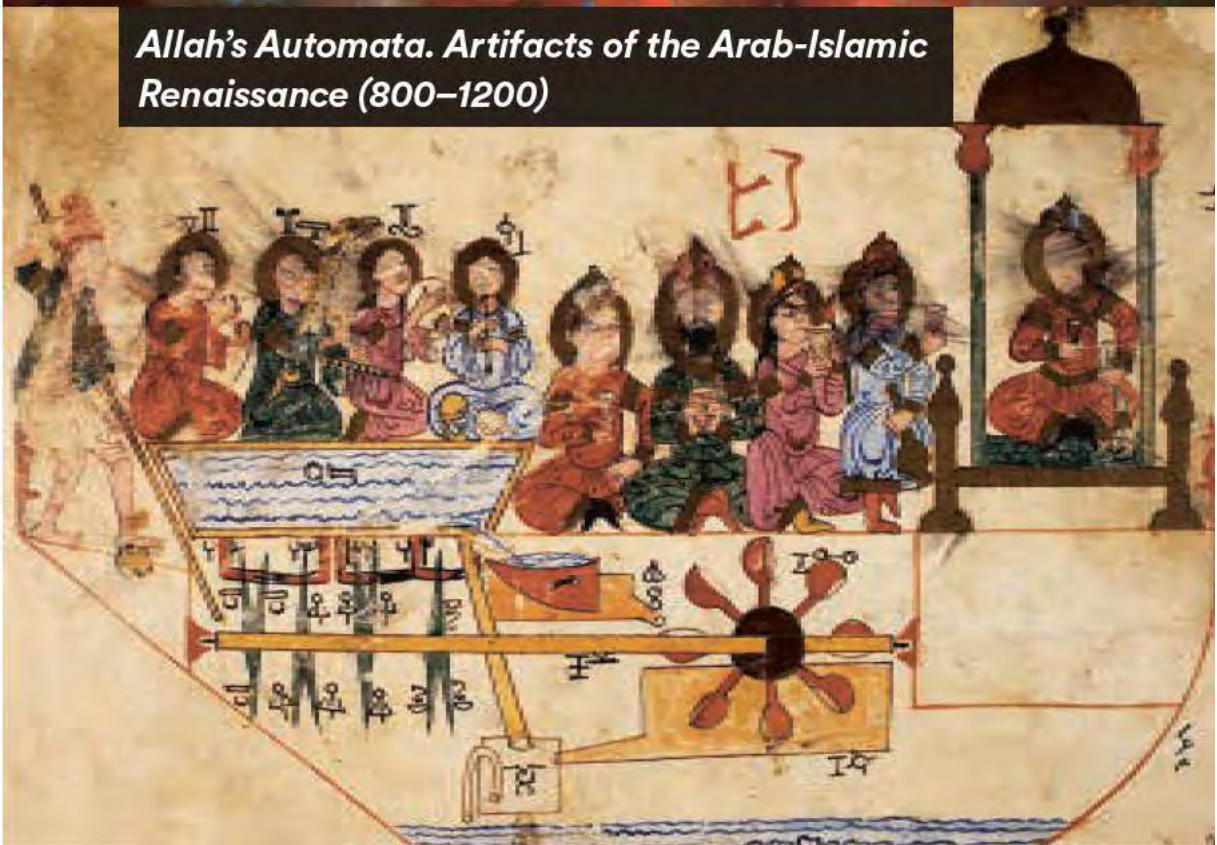
102h: 1-channel video, Farbe, Ton, 5:27 min.

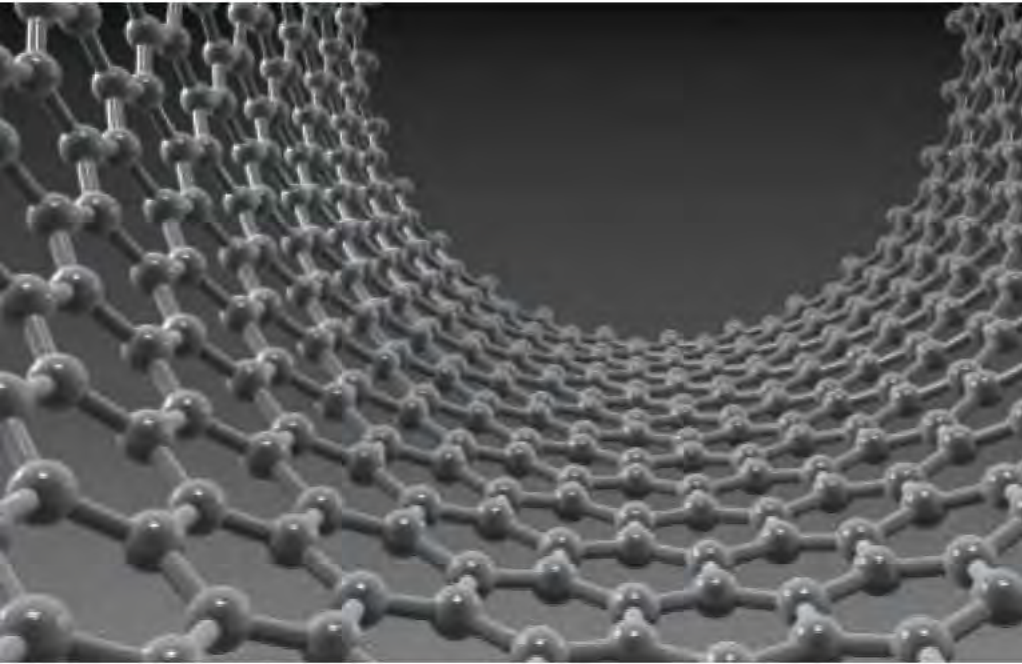
For a broad range of manufacturing applications – from the automobile, aerospace and packaging industries, to medical or dental technology, and bio-printing – the 3-D printing process offers new opportunities and basic advantages for the creation of prototypes, components, and replacement parts. In 3-D printing, three-dimensional components are built up by layering one or more liquid or solid materials (usually plastics, synthetic resins, ceramics or metals), in a computer-controlled process according to specified measurements and forms. 3-D printing is an additive printing method, enabling not only a sustainable fabrication process, it also supports the development and realization of complex forms that are either difficult or impossible to fabricate with existing machines. For this reason, the use of 3-D printing in architecture and art is increasing, as well. Additionally, the appearance of so-called fab labs and maker spaces is making such digital fabrication equipment as 3-D printers available to private individuals.

By overlapping high-resolution 3-D scans of male and female figures with intricate digital compositions, architect and designer **Daniel Widrig** has created abstract humanoid forms. **Neri Oxman's** 3-D printed wearable capillaries from the series *Wanderers* are infused with synthetically engineered microorganisms. The design *Qamar. Luna's Wonderer*, for example, functions as a wearable pneumatic surface for generating and storing oxygen, while *Zuhal. Saturn's Wonderer* is designed as a wearable vortex field, varying in size, density and organization to accommodate for local wind variation. The wearable *Mushtari. Jupiter's Wonderer* is designed as an organ system for consuming and digesting biomass, absorbing nutrients and expelling waste. The peristaltic movement of matter within 3-D-printed, translucent anatomical structures is designed to support the flow of cyanobacteria engineered to convert daylight into consumable sucrose.

The *Chair*, by **Zaha Hadid Architects**, is the result of ongoing research into the formal and structural potential of large-scale multi-material 3-D printing. The initial idea for the design was to create a relatively lightweight chair that would take advantage of its geometry, detailing and manufacture to highlight and improve its performance.

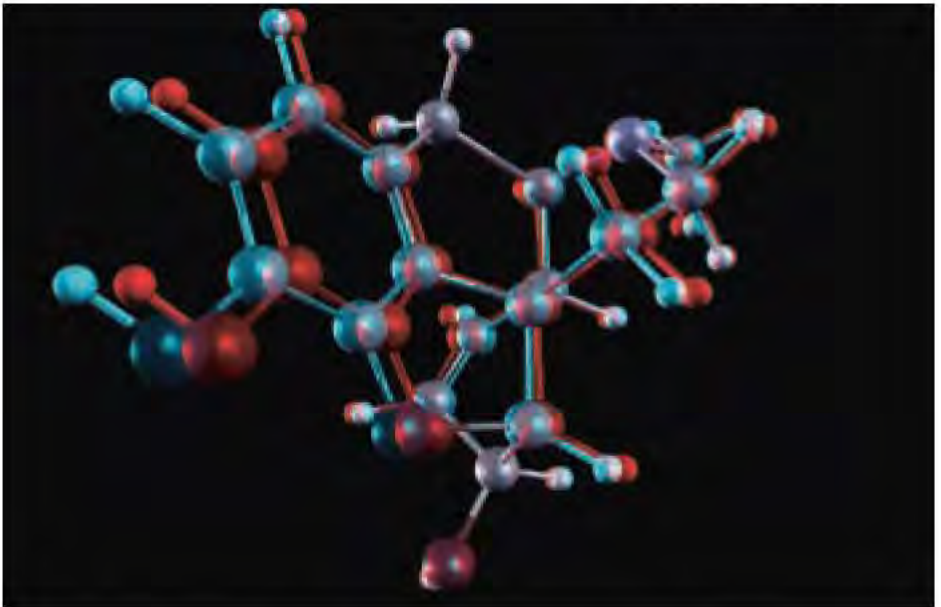
The *Wilmington Robotic Exoskeleton (WREX)* is a device for assisting upper-limb movement by means of such passive elements as springs, to counter the effect of gravity. The *WREX* can potentially help children with neuromuscular difficulties maintain their independence and self-esteem, as they perform routine tasks requiring manipulation.

The Future Is Here*Allah's Automata. Artifacts of the Arab-Islamic Renaissance (800–1200)*



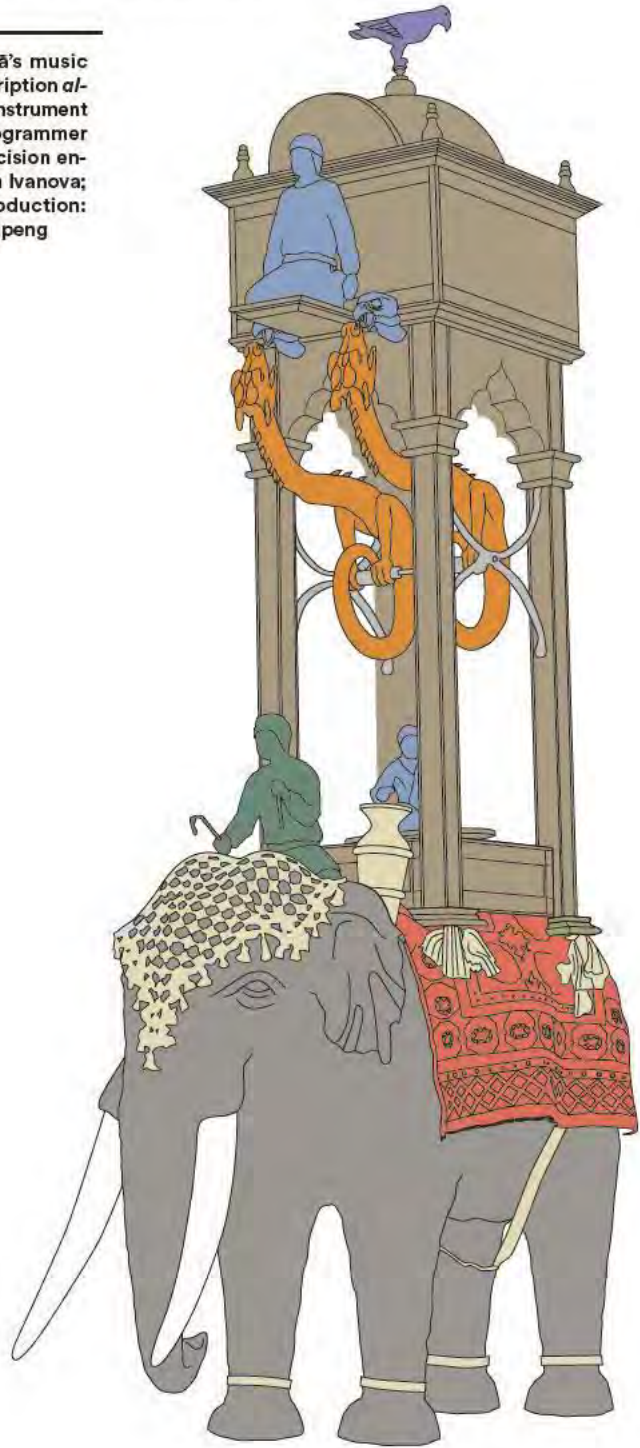
Ljiljana Fruk, Bernd Lintermann, Rüdiger Mach, grid structure of graphene from *Seeing the Invisible*, 2015

Ljiljana Fruk, Bernd Lintermann, molecule from *Molecules that Changed the World*, 2011



p. 69 top: Ljiljana Fruk, Bernd Lintermann, Rüdiger Mach, BANG/Matter/Dark Matter, 2015 / below: *Automaton for Carousals*, facsimile from *Ibn al-Razzâz al-Jazarî, Compendium on the Theory and Practice of the Mechanical Art / al-Jâmi^ç bayn al-^çilm wa-l-^çamal an-nâfi^ç fi şinâ^çat al-^çiyal*, Fuat Sezgin ed. Fuat Sezgin, Institute for the History of Arabic-Islamic Science, Goethe University Frankfurt, Frankfurt am Main, 2002, based on the manuscript from the Süleymanyie Library, Ayasofya 3606, pp. 12 m, photo: Harald Völkl

Reconstruction of the Banū Mūsā's music automaton according to their description *al-Āla allatī tuzammir bi-nafsihā* [The Instrument which Plays by Itself] (ca. 850), programmer and precision engineering: Liang Zhipeng and Petja Ivanova; animation: Olivia von Pilgrim; production: Stefanie Rau; illustration: Liang Zhipeng



Mondial Relations of Knowledge in the Year 1206. The elephant clock of al-Jazari
The phoenix represents a reference to Egypt, the hydraulic mechanism to Alexandria, the carpet to Persia; the hawks refer to Arabia, the dragon to China, elephant and jockey to India, the Registrar and the cause of the movement to Mesopotamia, mechanics and movement to Greece

The Future Is Here**Curator: Ljiljana Fruk****Co-Curator: Bernd Linterman**

Ljiljana Fruk, *1975 in Krapina, HR, lives and works in Karlsruhe, DE, and Cambridge, GB

Bernd Lintermann, *1967 in Düsseldorf, DE, lives and works in Karlsruhe

We live in an age of great technological progress. However, despite the immense flow and availability of information, many discoveries are still mainly discussed in lecture halls and scientific papers in cosmopolitan metropolises, remaining largely incomprehensible to the general public. But this needs to change, because gaining the knowledge needed to find solutions to pressing problems requires global action. To expand the creative pool of knowledge, it must be shared and non-experts must be invited to join the path to discovery.

Some measures have already been taken: Do-it-yourself biological labs are being set up, and the education of the public on protein folding and brain mapping is being enabled through Internet tools. *The Future Is Here* is both an art project heavily informed by science and a science project exploring the use of artistic tools in the illustration of scientific developments on the verge of science fiction. Inspired by recent scientific advances such as the mapping of dark matter and the synthesizing of exotic graphene material, it invites audiences to become a part of the installation and thus expand their scope. Rather than preaching or employing traditional teaching methods, its central philosophy is to use science, engineering, art, senses, and emotions to explore cutting-edge topics such as dark matter, nanotechnology, DNA synthesis, and directed evolution.

Ljiljana Fruk, Bernd Lintermann, and Rüdiger Mach**104a: *BANG/Matter/Dark Matter*, 2015**

Rüdiger Mach, *1965 in Karlsruhe, DE, lives and works in Karlsruhe

104a: Panoramic projection

Only 5% of the universe consist of ordinary matter. All we know about the rest is that it is composed of 68% dark energy and 27% dark matter. Dark matter does not interact with ordinary matter or light, but has a gravitational effect on galaxies, meaning instruments can be used to indirectly visualize it. Scientists around the world are trying to decipher what dark matter is made of, but they still have no clear evidence. Telescopes and supercomputers have helped us visualize the possible beginning of our universe, to make maps of tangled dark matter, and to postulate theories. The installation *BANG/Matter/Dark Matter* re-creates visions of the known and unknown universe, presenting one of the possible truths on the matter of dark matter. It is a take on the universe, invisible dark matter, and time, combining scientific data with artistic vision to compress billions of years into a few minutes of visual material shown on a panoramic screen.

Ljiljana Fruk and Bernd Lintermann

104b: *Seeing the Invisible*, 2015

104c: *Quintessence*, 2015

104b: Mixed-media installation
104c: DNA machine

Invisibility is an underlying theme of this installation focused on nanotechnology: Through interactive actions and real laboratory samples of different nanostructures, *Seeing the Invisible* encourages the exploration of what was previously considered invisible, and can today be explored using powerful microscopes that allow an atomic level of visibility. Once we see and understand matter, can we also manipulate and change it? This question leads us to the *Quintessence* installation concerning DNA synthesis. DNA, a genetic code carrier and the essence of our genetic matter, can be synthesized by chemical means. We exhibit the instrument used to design short DNA sequences from four different building elements (A, T, G, C bases), and try to put it in the context of genes and DNA visualization. *Quintessence* explores the power of technology, but reminds us that our knowledge is still fragile and incomplete. Even if we can handle DNA, life's main software, we still do not have a functional computer; rather, we have only just begun to edit some of its programs. But our progress so far shows us that we are already living in the future, in which evolution and natural selection can be harnessed as tools.

Ljiljana Fruk and Bernd Lintermann

104d: *Molecules that Changed the World*, 2011

104d: Interactive 3-D installation

The interactive 3-D installation *Molecules that Changed the World* presents a selection of basic chemical molecules such as water and carbon dioxide as well as synthetic, more complex molecular structures which have an essential influence on our lives and have changed the course of civilization. The installation comprises of interactive stereoscopic 3-D projections of the molecular structures and provides background information on the origin and significance of selected molecules.

The Future Is Here

Concept: Ljiljana Fruk, Bernd Lintermann

Project management: Sabiha Keyif

Technical project management: Henrike Mall

Museum and exhibition technical services: Team ZKM

Registrars: Marianne Meister, Nina Fernandez

Graphics: Rüdiger Mach (MachIdee, Karlsruhe)

Thanks to: Cheng Chen, Dr. Klaus Dolag, Jan Gerigk, Prof. Dagmar Gerthsen, Manfred Hauffen, Dr. Yu Chieh Hung, Dania Kendziora, Stefan Kühn, Marko Miljevic, Dr. Erich Müller, Prof. Volker Springel, Ludwig Stöckl (TIDES SERVICE TECHNOLOGY), Lukas Stolzer, Volker Zibat

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Molecules that Changed the World

Thanks to: Ishtiaq Ahmed, Dennis Bauer, Bianca Geiseler, Dania Kendziora, Lukas Stolzer, Sinem Engin, Andre Petershans, and Marko Miljevic (KIT)

Graphics: Christina Zartmann

Technician: Manfred Hauffen

Project coordinator (2011): Sophie-Charlotte Thieroff

Allah's Automata. Artifacts of the Arab-Islamic Renaissance (800–1200)

105

Curated by Siegfried Zielinski in collaboration with Eckhard Fülus and Daniel Irrgang

“In the Name of Allah, the Most Gracious, the Most Merciful” – these are the opening words of Seyyed Hossein Nasr’s *Islamic Science: An Illustrated Study* (2000), published in Lahore (Pakistan), an early center of natural sciences in the eastern Islamic Empire. Similar words of praise of the Muslim God open, punctuate, and end nearly every major natural philosophical treatise from the Golden Age of Arab-Islamic natural sciences, lasting from approximately 800 to 1200 CE.

It is not only Christian theology – the Islamic view of Creation also envisions God as the self-contained universal mover and enabler. Allah uses the talented mathematician to express the proportions and relations of his creation. Talented engineers are His medium for the creation of functioning and harmonious alternative worlds, using mechanics and energy, which in turn are to praise him as the Creator of all things. But it is permitted that these artifacts be also useful to the subjugated faithful themselves.

Between the 8th and 13th century, the Muslim-influenced culture on the Arabian Peninsula, in North Africa, in Asia Minor, and in southwestern Europe, produced the first Renaissance. Evolving from the House of Wisdom, a Bagdad institution based on the model of the Persian academy of Gundeshapur and co-developed by Christians, Jews, and Muslims, there arose an Islam-dominated, elaborated culture of translation, transfer, adaptation, and elaboration of ancient ideas. The scholars worked on texts by Greek and Indian mathematicians and natural philosophers, as well as treatises by Roman, Alexandrian, Persian or Byzantine engineers, geometers, and astronomers.

Allah's Automata presents a special micro-universe within the vast wealth of mathematical, natural philosophical, and physical knowledge of this first renaissance. These artificial “self-acting devices” combine an elaborate knowledge of mechanics, kinetics, hoist and thrust physics, hydraulics, hydrostatics, and pneumatics. The lavish and highly decoratively staged world of Muslim automata was uncommonly suited as a demonstration of Baghdad’s or Córdoba’s avant-garde status. And the cultural techniques required to build them were not treated as esoteric, arcane knowledge, but were recorded in numerous manuscripts, many of which had the character of open manuals.

It is quite a modern world that is articulated in these manuscripts. They are evidence of a pronounced experimental culture, centered around concepts and topoi not generally known in Europe until the early modern era: the organization of different movements through mechanical controls, the initiation and sustainable establishment of mechanical forces to move physical material and, above all, the idea of the programmability of motion sequences and their control by means of a programming medium (hardware).

In the history of the natural sciences, particularly with regard to an archaeology of media and the arts, there has evolved a minimum canon of master manuscripts, which is now on display at ZKM | Karlsruhe – together for the first time under one roof. However, *Allah's Automata* is no spectacle, but restrained, intimate theater. In four openly interconnected departments, the protagonists of this micro-archaeology, the manuscripts for the divine machines, reveal some of their best sides.

Department 1

Written around 830 CE by the Banū Mūsā ibn Shākir, the *Kitāb al-ḥiyal* contains descriptions of one hundred hydraulic-pneumatic and mechanical models. Of the three extant nearly complete manuscript copies of the *Book of Ingenious Devices*, two are on display in this exhibition: the manuscript from the Vatican Apostolic Library in Rome, from the second half of the 13th century; as well as a divided manuscript, dated 1209 CE, from the oriental collection of the Staatsbibliothek Berlin [Berlin State Library] and the Gotha Research Library. In digitized form, the two halves of the manuscript can be viewed through as one work, virtually reunited for the first time.

Department 2

The media-archaeological jewel here is a treatise by the Banū Mūsā ibn Shākir that Arab science historians call *Kitāb al-urghānūn*. The manuscript from the mid 9th century describes, on a superficial level, a flutist, which closer examination reveals to be a programmable universal music instrument. For the first time, ZKM presents a complete German translation of the original text, which has survived only as a photographic negative in Beirut. In addition, we are showing the automaton in the form published by Maurice Collangettes and Louis Cheikho in the Jesuit magazine *al-Mashriq* (Beirut, 1906), as well as the first English translation by British music historian George Farmer (1931). The masterpiece in this department is the mechanical reconstruction of the playing automaton, along with an animation showing the functioning drive component.

Department 3

The *al-Jāmiʿ bayn al-ʿilm wa-ʾl-ʿamal an-nāfiʿ fī ṣināʿat al-ḥiyal*, which its author Ibn al-Razzāz al-Jazarī completed in the spring of 1206 CE, is the acknowledged gem of engineering art from the golden age of the Arab-Islamic arts of knowledge. In it, the Kurdish engineer displays the mechanical skill of his era, presenting an array of wonderful apparatuses, from complex hydraulic clockworks to musical drinking automata. Our display includes a reconstructed complete version of the manuscript and a hand-written copy from Leiden University Library (1562). The complete digitizations of the early master manuscripts from Istanbul's Topkapı Palace allow visitors to not only study al-Jazarī's extraordinary elegance and precision, but also compare the texts with later versions. Two of al-Jazarī's automata can be viewed in motion: the early 9th century water clock of Caliph Hārūn al-Raschīd, in an animation by Aachen scientist Ulrich Alertz; as well as the reconstruction of the legendary elephant clock from the Konya Science Center in Anatolia. Engineers and programmers from Bursa, the former capital of the Ottoman Empire, built the apparatus especially for this exhibition.

Department 4

Kitāb al-asrār fī natā'ij al-afkār [The Book of Secrets in the Result of Ideas] is one-of-a-kind. The treatise of the (presumably) Andalusian engineer Aḥmad ibn Khalaf al-Murādī was begun in the eleventh century and completed as a copy in 1266. This is the first public European presentation of the restored original manuscript from the Biblioteca Medicea Laurenziana in Florence. The reconstruction and simulation of a digital version was completed by the Milan group Leonardo3, and excerpts of their reconstruction work are presented in this exhibition.

Between the departments, we reconstruct the origins of Muslim automata from their tradition in Alexandria, Rome, and Byzantium, and offer a view beyond, to their elaboration in Europe. Among the authors of a genealogy of the inventions of the Arabs are: Hero of Alexandria, Ktesibios, and Polybios, Vitruv, Giambattista Della Porta, and Athanasius Kircher.

Allah's Automata. Artifacts of the Arab-Islamic Renaissance (800–1200)

Curated by Siegfried Zielinski in collaboration with Eckhard Furlus and Daniel Irrgang

Project management: Judith Bihr, Sarah Maske

Technical project management: Verena Bolz, Henrike Mall

Museum and exhibition technical services: Team ZKM

Logistics, registrar: Regina Linder, Marianne Meister, Nina Fernandez

Conservation team: Nahid Matin Pour, Jonathan Debik, Morgane Stricot, Katrin Abromeit, Bianca Faletti, Cornelia Weik

Exhibition architecture: Stadelmann Schmutz Wössner, Berlin / London

Exhibition graphics: 2xGoldstein+Fronczek, Clemens Jahn

Special thanks to: the lenders as well as Ö. Furkhan Banaz, Salim T S Al-Hassani, Ayhan Ayteş, Petja Ivanova, Delio V. Proverbio, Stefanie Rau, George Saliba, Imad Samir, Eckhard Neubauer, Leon Strauch, Liang Zhipeng, and the engineers and staff of the Science Museum in Bursa/TR.

Stadelmann Schmutz Wössner Architects

Creating Relationships – An Exhibition System for the GLOBALE

The exhibition architecture for the *Exo-Evolution* provides an open system that, unlike closed spaces, enables a non-hierarchical presentation of the exhibits, with maximum transparency. Wall modules featuring a light, wooden frame construction can be combined into module groups of various shapes and sizes, which are grouped around walk-in black boxes for screen projection, while also structuring the exhibition space. We can identify similar spatially ramified systems in different eras and cultures; they find expression in nature, science, and art – timber framework, space frame, stellar constellations or molecular formulas are here condensed into a homogenous exhibition structure, which uses simple means to establish both spatial continuity and relationships.

The module constellations accommodate a flexible exhibition arrangement and provide a fine structure for different interconnected theme areas. Depending on exhibition requirements, the exhibits can be hung either on the paneled wall system or directly on the wooden framework. Tables, pedestals, and showcases constructed in the same manner round out the system into a family of modules, providing a discreet background for the presented exhibits. The space between the modules is flowing and can be used in a variety of ways. Visitors can freely navigate, gaining an individual experience of the exhibition. The permeability of the modules, along with the superimposition of the presentation levels, provides for an interaction between the exhibits that allows visitors to experience their simultaneity. The transparent modular system reflects both the generous, open ZKM architecture, as well as the comprehensive, expanded concept of art in the context of the exhibitions interlinked within the GLOBALE.

www.ssw-architects.com



Exo-Evolution

Curated by Peter Weibel with Sabiha Keyif
and Philipp Ziegler

October 31, 2015 – February 28, 2015

Location: ZKM_Atrium 8+9, ground floor + first floor

The exhibition is part of GLOBALE,

June 21, 2015 – April 18, 2016

GLOBALE concept: Peter Weibel

GLOBALE project manager: Andrea Buddensieg

Exo-Evolution project manager: Sabiha Keyif

Curatorial assistant: Giulia Bini

Project team: Annika Etter, Maxie Götze, Daria Mille, with Marjoleine Leever, Stine Hollmann, Maren Pfeiffer

Translations: E→G: Christiansen & Plischke

G→E: Lonnie Legg

Copy editing: Sylee Gore, ZKM | Publications

Exhibition architecture: Stadelmann Schmutz Wössner, Berlin / London

Exhibition graphic design: 2xGoldstein+Fronczek

Logistics, registrar: Marianne Meister, Nina Fernandez

Technical project manager: Henrike Mall, Verena Bolz

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Travel coordinator: Silke Sutter

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Unless otherwise noted, all works are solely the property of the artists.

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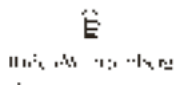
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Koen Vanmechelen, *La Biomista*
– *Cosmopolitan Chicken Project*,
2015

Luca Trevisani, *As though repetition can legitimize the act*, 2014/2015, photo: Sara Montali, Courtesy: Gallery Mehdi Chouaki, Berlin





Conrad Shawcross, *The Blind Aesthetic*, 2011, Courtesy of the artist and Victoria Miro, London

Ursula Biemann, Paulo Tavares, *Forest Law*, 2014



Yesenia Thibault-Picazo, *Craft in the Anthropocene – The Cabinet of Anthropogenic Specimens*, 2013–2015



Yann Mingard, *Plants 11* from *DEPOSIT*,
2010, Courtesy of Robert Morat Gallery,
Hamburg



Nandita Kumar, *eLEmeNT: EaRTh*, 2014

Agnes Meyer-Brandis, *42 – The Large Meteor T-R-A-P (Terrestrial-Rerouting-Array-Pad)*, 2014, photo: Agnes Meyer-Brandis, © VG Bild-Kunst, Bonn 2015





Adam W. Brown, Robert Root-Bernstein, *ReBioGeneSys*
– *Origins of Life*, 2015, photo: Adam W. Brown

History of Others (Laura Gustafsson, Terike Haapoja), *The Museum of the History of Cattle*, 2013, © Terike Haapoja, Noora Geagea





Camille Henrot, *Grosse Fatigue*, 2013, Courtesy of the artist, Silex Films, and Galerie Kamel Mennour, Paris, © VG Bild-Kunst, Bonn 2015



Chris Jordan, *Midway: Message from the Gyre*, since 2009
