

Sat, 31/10/2015-Sun, 28/02/2016

Exo-Evolution

ZKM_ Atrium 8+9, ground floor + first floor Press conference: Thu, October 29, 2015, 11.00 am

The exhibition *Exo-Evolution* shows the interconnection between art and science and the artistic application of new technology. With more than 100 displays as well as the modules *Allah's Automata* and *The Future Is Here*, it opens up new perspectives on our background and our future.

Over the millennia, man has produced a tool culture that has expanded the boundaries of perception, ability to act and the world He has outsourced the functions of his body: the hand to the hammer, speech to writing, the memory to clay tablets, books and digital storage media, etc. Technology allows man to step out of evolution and frees him from the authority of nature. With his tools and exteriorised artificial organs, he is creating a man-made exo-evolution, which has introduced the age of the Anthropocene. The exhibition Exo-Evolution displays this new reality, which is characterised by incisive findings of space research, molecular biology, neurology, genetics and quantum informatics. It shows us visions and solutions to problems of the 21st century, e.g. the elimination of oxygen from CO_2 as a reaction to the climate crisis or innovative organisms that have adapted and optimised in view of severe environmental pollution.

Processes of evolution are directed by man

Due to the technological and industrial revolution, man has once again become the one set free from creation. This process, man's exit from natural evolution, is described by the term "exo-evolution". From exo-biology to exo-skeletons to exo-pregnancies, the contours of a new world are emerging in ever more so-phisticated fashion, a new world that is deeply technological in character. Even life itself, the procreation of life, is externalised and manufactured technologically by man.

One of the most fundamental features of biological systems in connection with evolution is the natural and random emergence of diversity within the framework of cell division. In the installation *Retooling Evolution: Nature at Work*, which has been created in **cooperation with the Karlsruhe Institute of Technology (KIT), Heurisko company and the ZKM | Karlsruhe**, this process – the breeding of microorganisms – is mechanised. The machine used for

this is able to select from a pool of microorganisms that come into existence through natural diversification those that, as food, can metabolise not just sugar, but also other carbon sources. This takes place by means of a controlled, conti-

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nuous thinning of the microorganisms, due to which, in time, the variants of the organism that can use the food offered most successfully prevail. In this scientific experiment, which is continued after the end of the exhibition at the KIT, how natural evolution can be directed by man is followed in real-time.

At the threshold of a new material and tool culture

In addition to directed processes of evolution, new material technology will also radically change our life. Using artificial tissue, biological defects are 'repaired''. Spines and nerve corsets – so-called exo-skeletons – attached to the outside of the body will help physically disabled people to move. From the automotive industry and the aviation and aerospace industry to the packaging industry, medical and dental engineering and bioprinting – the 3D print process in particular offers fundamental advantages for creating prototypes, workpieces and spare parts in various production spheres.

In the exhibition, the **3D-printed** *exo-skeleton Wilmington Robotic Exoskeleton (WREX)*, which was developed by Nemours Children's Health System in cooperation with the Alfred I. du Pont Hospital for Children in Wilmington (USA), is displayed. The machine aids movement of the upper limbs, while passive elements such as springs are used to counterbalance the effects of gravity. The WREX enables children who suffer from neuromuscular diseases to carry out everyday tasks that they otherwise can perform only with external assistance.

Technological innovation and human needs

The interdisciplinary design research project at the **Design Research Lab** (**DRLab**) of Berlin's University of the Arts (UdK) developed the mobile Lorm glove displayed in the exhibition. This is a mobile communication and translation device for deaf-blind people. The glove translates the Lorm alphabet – a form of communication of people who are both visually and audibly impaired, based on hand contact – into text and vice versa. Pressure sensors on the palm of the glove allow users to use the Lorm alphabet on their own hand and thus to compose messages in text form. A Bluetooth connection transfers the information onto a handheld device and automatically forwards it to the recipient as a text message. If the wearer of a mobile *Lorm glove* receives a text message, this, in turn, is forwarded to the glove. Small vibration motors on the surface of the glove then produce feedback patterns that allow the wearer to understand the incoming message.

3D print process in architecture and art

3D print is now also used ever more frequently in architecture and art. A constantly developing algorithmic infrastructure allows architect and designer **Alisa Andrasek** to work in her laboratory with information that is linked to various forms of materialisation. XenoCells is based on an algorithm that simulates biological cell growth (morphogenesis). In such processes, the cells can differentiate in location in order to react to nutrients and inhibitors. The result is a world of design in which seemingly familiar objects and architectural units are penet-

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rated by an unseen complexity.

With her self-constructed CNC machine *Capacity for (urban eden, human error)*, **Allison Kudla** prints bio-architectural constructs using algae and seeds. She uses a 4-axle positioning table controlled by a computer built specially for this purpose. When the seeds are put into the growth medium – a transparent gel – the algae continue to grow and the seeds germinate. The models produced by algorithms, which are drawn by the system, are based on the Eden growth model. They feed on mathematical depictions of urban and cellular growth and thus link the concepts of "city" and "organism".

Scientification of art: Renaissance 2.0

From the microscope to computer tomography – the techniques of perception in science have developed. The new media transfer the techniques of instrument-based perception, from photography to computers, into the realm of art. A scientification of art, such as in the historical art period of the Renaissance, is evident: a Renaissance 2.0. After artists and scientists share a certain intersection of tools, artists' studios occasionally look like science laboratories – and vice versa. On this basis, new research methods and perspectives are emerging, such as art-based research and art & science labs.

La Biomista – this is the name not just of the new studio of Belgian artist **Koen Vanmechelen** in Genk, but also the installation displayed at the ZKM. Vanmechelen is convinced that together, scientific facts and the creativity of art can reveal the changeability of nature and of human life. La Biomista is more than just a temple of bioculture and a multiplier for active and living art as well as philosophical ideas. Besides its function as an intellectual breeding ground and the headquarters of his Open University of Diversity in Detroit and Havana, La Biomista also serves as a breeding station for the artist's chicken crossbreeds.

Nurit Bar-Shai's *Objectivity [tentative]* also sounds out the intersections between art, science and technology. Scientific methods and artistic exploration are combined in order to visualise the messages of microorganisms as patterns of extraordinary beauty. The work was inspired by the research into the social life of bacteria by Eshel Ben Jacobs at the University of Tel Aviv. He explored the complex communication systems of "smart" microorganisms, which are known for their amazingly well developed social behaviour reflected in the formation of colonies with highly complex architectural structures.

Anthropocene thesis

Around us there will be less and less nature and more and more technology. The Anthropocene age, a geological epoch shaped by humans, has begun. For the exhibition *Exo-Evolution*, multidisciplinary designer **Yesenia Thibault-Picazo** has produced an installation that consists exclusively of materials collected locally, in Karlsruhe. As part of her consideration, Thibault-Picazo ponders the future of geology and explores speculative narratives. She produces minerals

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created by people of the future using anthropogenic materials. The fossils created by her – which she calls "material tales" – are an exaggerated preview of what earthly materials could become in the distant future if our civilisation does not fundamentally rethink its raw material consumption.

The project Anthropocene Observatory – #4 The Dark Abyss of Time acts as an observatory connecting numerous documentary practices and discourses that retraces the formation of the Anthropocene thesis at different levels: from practices in the shaping of landscapes and territories to those that formed political institutions and governments in the past and that form them today. The Anthropocene Observatory documents these practices in a series of short films, interviews and documentary material. The aim of the project is to present as accurately as possible the development of the thesis of the Anthropocene in its many flows of influence. The Anthropocene Observatory has existed since the start of 2013 and so far has presented its works and archives in four episodes at the House of the Cultures of the World in Berlin and at the BAK (basis voor actuele kunst) in Utrecht.

Novel biological life forms

While conservationists are fighting to preserve the existing "natural" species and to reverse the effects of the Anthropocene, synthetic biology is developing new organisms for the "good of humankind". In view of the increasing amount of plastic ending up in the seas and inspired by the discovery of new types of microorganisms that settle on the surface of plastic in the sea and form new eco-systems, in her installation artist and neuroscientist

Pinar Yoldas has created a series of speculative organisms that have adapted to their environment and developed special properties. With her imaginary novel life forms, the artist counters the disquieting man-made threat from waste in our seas with a hopeful, utopian design and with her "species of plenty" she shows us a positive perspective of a fauna that will change in the near future.

Opportunities for synthetic biology?

Designing for the Sixth Extinction by **Alexandra Daisy Ginsberg** investigates the potential effects of such a course of action on biodiversity and species preservation. Could "rewilding" – the alignment of species preservation in which nature assumes control – really exist while, at the same time, we cause nature to improve using synthetic biology? As ecological surrogates, the designed functional species fill the gaps left by mammal species that have died out. As they have been designed from an expanded DNA code that produces non-biodegradable proteins, one thus creates living machines. As such, they are more resistant to wild predators, which have not yet developed to the extent that they are able to digest the new species. They thus form their own closed eco-system.

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New robot eco-system

Our new reality – not least since the automation of production in industry – is also characterised by robots. To mark the opening of the exhibition, the participatory robot performance Inferno, by **Louis-Philippe Demers and Bill Vorn**, is being shown in the ZKM media theatre. Visitors slip into "robot shells" themselves. What makes this performance special is that the machines involved in it are attached to the bodies of members of the audience – who are positively engrossed by the presentation – who thus become performers and have – without exception – an immersive and participatory experience: they no longer have control over their exo-skeleton.

In addition to the participatory performance, in the exhibition the ZKM displays the walking robot LAURON of the Institute of Anthropomatics and Robotics of the Karlsruhe Institute of Technology (KIT). LAURON III is a biologically inspired, six-legged walking robot that can be used as a flexible sensor carrier for inspection tasks in difficult, unknown terrain. The walking robot is equipped with three joints per leg, foot sensors, a position sensor and a mobile camera head. With this prototype, research was done into how multi-leg walking movements can be implemented with mobile robot systems and how their autonomy can be increased.

Visions for the problems of the 21st century

In addition to machines that lead their own life, the exhibition Exo-Evolution also presents visions and solutions for the ecological problems of the 21st century. Together with his team at the University of Toronto, material scientist and nanotechnology pioneer **Geoffrey Ozin** searches for an opportunity for sustainable energy generation and storage that tackles the problems of climate change. Inspired by photosynthesis, in the solar refinery synthetic fuels are produced through recovery of carbon dioxide from the air and the utilisation of solar energy. These fuels have the potential – with regard to their storability, distribution and processing – to fill the shoes of fossil energy carriers, without emitting new CO_2 into the atmosphere in the process. Thus the visionary approach adopts the earth's natural carbon cycle as its role model.

The future of food production

Food prices will rise in future because production capacities cannot keep pace with global population growth. Therefore, the food industry is searching for alternatives to traditional food production in the field of synthetic biology and biotechnology. **Maja Smrekar's** project *Hu.M.C.C. – Human Molecular Colonization Capacity –* deals with the biotechnological approaches of the food industry. A yoghurt is produced that contains the product of an enzyme of the artist and is offered for public consumption.

Deep Data Prototype _2 forms the second phase of the deep-data research project of British artist **Andy Gracie**, in which cultures of organisms, as used in space bioscience, are manipulated, reconfigured and reinterpreted under cosmic

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conditions. Here, data is used that was collected by space probes and planetary satellites. The project as a whole simulates an astrobiological laboratory for DIYers and connects data flows whose origin lies in remote areas with organic processes in real-time.

Virtual evening meal

In Project *Nourished*, **Jinsoo An** attempts to enrich the way we consume food by isolating various smell and taste components and by imitating its smell, taste and texture profile. Thanks to a virtual-reality headset with various sensors, the simulation of an evening meal allows the participants to consume a genuine feast. In the process, the headset monitors the movements of the users and allows them to perceive objects.

Participating artists: ::vtol: 1024 architecture · Yuri Ancarani · Jinsoo An Alisa Andrasek · Alisa Andrasek & Jose Sanchez · Suzanne Anker · Anthropocene Observatory Artificial Nature (Haru Ji & Graham Wakefield) · Lise Autogena & Joshua Portway · Nurit Bar-Shai · Sonja Bäumel · Sonja Bäumel & Manuel Selg · Ursula Biemann & Paulo Tavares · Howard Boland & Laura Cinti (C-LAB) · Ecke Bonk / typosophes sans frontiers · Adam W. Brown & Robert Root-Bernstein · Oron Catts & Ionat Zurr & Corrie Van Sice · Center for Post-Natural History · Jürgen Claus · Sam Conran · Hermann Cuntz · Hermann Cuntz & Marvin Weigand · Theresa Dankovich · Robert Darroll · Caitilin de Bérigny Frederik de Wilde Thierry Delatour Louis-Philippe Demers & Bill Vorn Heather Dewey-Hagborg · Kitsou Dubois Anna Dumitriu · eco-LogicStudio · Electronic Shadow (Naziha Mestaoui & Yacine Ait Kaci) · Peter Fend / Ocean Earth · Thomas Feuerstein · Verena Friedrich · Klaus Fritze · FZI Forschungszentrum Informatik · Eyal Gever · Alexandra Daisy Ginsberg · Alexandra Daisy Ginsberg & Sascha Pohflopp · Niklas Goldbach · Andy Gracie · Tue Greenfort · Terike Haapoja · Terike Haapoja & Laura Gustafsson · Zaha Hadid Architects · Stephen Hawking · Ivan Henriques · Camille Henrot · Lynn Hershman Leeson · Bart Hess · Heurisko Gesellschaft für Biologische Technologien GmbH & Karlsruhe Institute of Technology · Chris Jordan · Manfred Kage Wanuri Kahiu · Felix Kemner · KIT | Institute of Meteorology and Climate Research · Allison Kudla · Nandita Kumar · Ebru Kurbak & Irene Posch · Christian Lölkes & Adrian Vielsack · Andy Lomas · Wolfgang Mally · Daria Martin · Mediated Matter Group | MIT Media Lab · Agnes Meyer-Brandis · Yann Mingard · MVRDV & The Why Factory (in cooperation with MOON Kyungwon & JEON Joonho) · Dave Murray-Rust & Rocio von Jungenfeld · Michael Najjar · Geraldine Ondrizek · Lucy & Jorge Orta · Neri Oxman · Geoffrey Ozin · Tariq Rahman · Reynold Reynolds Byron Rich · Adam G. Riess robotlab · Hermann J. Roth · Scenocosme (Grégory Lasserre & Anaïs met den Ancxt) · HA Schult · SEAD (Space Ecologies Art and Design) · Conrad Shawcross · Semiconductor · Maja Smrekar · Studio Swine · Luisa Székely · Yesenia Thibault-Picazo · Luca Trevisani · Troika · UdK | Design Research Lab · Andrei Ujica · Koen Vanmechelen · Paul Vanouse · Aline Veillat · Pinar Yoldas · Martin Walde · Peter Weibel, · Daniel Widrig · Where Dogs Run

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In accompaniment of the exhibition, two modules are displayed:

Module I

The Future Is Here

Curator Ljiljana Fruk and co-curator Bernd Lintermann

We are living in the age of astonishing technological advancement. However, despite the immense flow of information and its, in principle, ease of access, numerous discoveries are still discussed mainly in the lecture theatres of cosmopolitan metropolises and in academic articles - thus remaining inaccessible and incomprehensible to the wider public. This must change, for to advance all our knowledge further and thus to find solutions to urgent problems, global actions are required. In order to tap into the available creativity more comprehensively, knowledge must be shared and non-experts too should be invited to step onto the path of continuous discoveries. This is already being put into practice rudimentarily: biological do-it-yourself laboratories are being set up and the public is being encouraged to fold proteins or map their brain via the internet. The Future Is Here is an artistic project with a heavily scientific background and at the same time a scientific project that explores the possibilities of artistic means with which scientific developments bordering on science fiction are illustrated and made comprehensible. Inspired by the most recent scientific advancements such as the mapping of dark matter and the synthesising of exotic carbon materials, the project invites observers to become part of the installations and to expand their knowledge horizon. In the process, the project does not resort to traditional teaching methods; rather, the philosophy of the project is that science, technology and art as well as senses and feelings ought to be used to deal with highly modern topics such as dark matter, nanotechnology, DNA synthesis and controlled evolution.

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Module II

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

Curator Siegfried Zielinski in collaboration with Eckhard Fürlus and Daniel Irrgang

"In the Name of Allah, the Most Gracious, the Most Merciful" – with these words, Seyyed Hossein Nasr opens his publication Islamic Science: An Illustrated Study (2000), published in Lahore, Pakistan, the former scientific centre in the east of the Islamic empire. Almost every major natural-philosophical tract from the Golden Age of Arab-Islamic sciences dating approximately to the period from c. 800 to 1200 AD, is introduced, interrupted and ended with similar

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words of praise for the Muslim God. Not just in the Christian ideology but also in the Islamic ideology, God is the established all-mover and all-enabler. Allah uses the talented mathematician to express the proportions and relations of his creation. Gifted engineers are a means by which he creates functioning and harmonious alternative worlds from mechanics and energy that, in turn, are to praise him as the creator of all things. The artefacts are likely to be useful to those subordinated in faith but also in themselves. Between the 8th and 13th centuries AD, the Muslim culture generated the first Renaissance on the Arabian Peninsula, in North Africa, in Asia Minor and in south-western parts of Europe.

Beginning with the House of Wisdom, which – according to the model of the Persian Academy of Gondishapur – was jointly constructed in Baghdad by Christians, Jews and Muslims, an elaborated culture of translation, adaptation and development of ancient ideas emerged under Islamic hegemony. The texts of Greek or Indian mathematicians and natural philosophers were processed, as were the tracts of Roman, Alexandrian, Persian or Byzantine engineers, geometricians and astronomers. Allah's Automata shows a special microuniverse within the immense wealth of mathematical, natural-philosophical and physical knowledge of this early renaissance. Elaborated knowledge of mechanics, kinetics, lifting and moving, hydraulics and hydrostatics, as well as pneumatics comes together in the artificial self-movers.

The wastefully and highly decoratively highlighted world of Muslim automata was outstandingly suitable for demonstrating the avant-garde status of Baghdad or Cordoba. The cultural technique required to construct them was no esoteric secret knowledge, but rather was recorded in numerous manuscripts often having the character of open manuals. It is an extremely modern world articulated in these manuscripts. They are evidence of a markedly experimental culture in the centre of which are concepts and topoi that, in Europe, are commonly associated only with the Early Modern Age: the organisation of different movements by means of mechanical controls, the initiation and permanent establishment of mechanical forces for moving physical material and above all the idea of the programming of flows of movement and the control thereof by means of program carriers (hardware).

Particularly with a view to an archaeology of the media and the arts, a minimal canon of masterful manuscripts has developed in the history of the sciences that the ZKM is exhibiting under one roof for the first time. However, Allah's Automata is not a spectacle, but rather a sophisticated, intimate play. In four departments open towards each other, the protagonists of this microarchaeology, the manuscripts on the divine machines, show themselves from some of their best sides.

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