Emerging Bioart and Biodesign

Bio Art & Design Award

Bioart and Design Awards: Life Sciences and Creativity Connected

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Bio Art & Design Award

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Introduction

by William Myers

Over the past decade the fields of bioart and biodesign have flourished, as evidenced by numerous works, from material prototypes and constructed architecture, to elaborate art installations and imaginative science-fiction-like speculations presented in multimedia. Educators have been a part of this emergence, including university leaders and museum curators who have initiated exhibitions and courses at the graduate and undergraduate levels to propel the movement still further. Another source of fuel has been the stream of festivals, publications, and awards that have illuminated some of the most promising approaches to working with the life sciences in the making of art and design. Among the latter has been the seminal Bio Art & Design Award in the Netherlands and its accompanying annual exhibition; this compilation here of images, texts, videos, and interviews catalogues its first decade. This award began in 2010 and has since anointed and funded 30 winning projects of up-and-coming young creative people.

The collection of work by the winners helps us see how the way we work with biology and how we describe and exhibit it *tend to mirror our societal values and goals*. Or, sometimes the works embody some of the conflicts or value-shifts in the zeitgeist about the development and meaning of biotechnologies. What we have seen since 2010 is a kind of evolution in how the non-human is regarded. In short, the approach of humans towards biology is quickly moving away from domestication and exploitation towards collaboration and mutual benefit between homo sapiens and other species.

This book's presentation of profiles, images, references, and advice is meant to be *a bridge, an inspiration and a welcome sign!* This field is growing fast and it is for everyone from high school students, to university attendees, professors, and professionals in the many fields of design and creative making. Broad participation in experiments, the act of learning about and trying to apply new research, and understanding new tools of making and designing are all urgently needed. To help illustrate how projects have come to fruition, there are many videos linked throughout the chapters.

There are many ways to enter the field, or to be welcomed to the concepts and underlying science that makes it possible, as the profiles in this volume will describe. There are also great stories available about how people found themselves making biodesign and bioart, that can be found published by the Biodesign Magazine, such as the story of teacher Corine Takara and her journey to becoming a designer starting in Hawaii. In addition, there are resources such as the book Biodesign (2018) which offers a chapter about 'Getting Started' including FAQs, Creating Artscience Collaborations (2019) by Claudia Schnugg, BioBuilder by Natalie Kuldell et all, (2015), Bioart (2015), and the many exhibitions and programs of the Science Gallery International.

These are just some of the resources available, many of them free, at least to preview. In addition, there is a growing number of labs faculty and university programs open to collaboration and dedicated to helping to develop these fields.

Re-occurring Topics in Bioart and Biodesign

Often patterns appear in how fields develop, propelled by technological advances as well as the evolution in aesthetic sensibilities and value systems. For bioart and design, those patterns materialize across a few broad topics such as fluidity. This is a phenomenon of change that can be observed in different scales such as digital platforms, fields of study, and identities. This also reflects developments at learning institutions (such as universities and museums) moving themselves towards cross-disciplinarity. Separately, fluidity in human identities, be they national, sexual, or otherwise intersectional, are becoming better understood as **moving across multiple dimensions** over time. This may be underappreciated in terms of what a large shift this represents, across just one or so generations.

Another topic addressed in much art and design with, for, or about biology is interconnectivity, specifically the degree to which it **manifests at different scales and how it is resisted or embraced**. Interconnectivity is arguably the most important phenomena of the 21st century, as reflected in the cultural and political impacts of social media, the climate crisis, the globalization of trade and finance and the covid-19 pandemic. Similarly, at the micro-scale, interconnectivity expresses itself in the emergent understandings of the human microbiome and epigenetics as networked systems of which we are a part. Interconnected systems are more important than ever and yet our understanding of them, and how emergent behaviors and forces are developing (some invisible) are as powerful as never before. [1]

Another recurrent topic, at least in the context of the Bio Art & Design Awards, is water and its many ecosystems, especially natural bodies of water like the North Sea. As many of the projects profiled in this volume were developed by citizens of the Netherlands, a nation in which approximately 26% of the land exists below sea level, water is a prominent consideration if not a dominate theme or context that inform them.

These topics can be identified as manifesting in categories of projects, which is how this volume has been organized; these are materials, food, bodies, motion, and society. The first, materials, includes

[1] Benjamin H. Bratton, 'The Stack: On Software and Sovereignty.' MIT Press, 2016.

projects that present prototypes of unexpected aesthetics and functions, using living materials, or grown matter that has been treated, colored, or cultivated in new ways. In the category of food, we see projects that support a recognition that the design of food systems in our contemporary world are frequently dysfunction, unknown or invisible. They are also a convergence point on matters of public health, changing climate, and genetic modification and its implications.

The category of bodies includes many projects exploring how the body may be different in the future, as in modified with technology, as well as how the body can be understood differently, as a more complex system of many interwoven species. The category of motion, in contrast, is populated with work that embraces movement as an aesthetic element. This is in tune with how biology not only moves with its own agency, but is a system in motion, always fluctuating at different scales, from osmosis across cell walls, to the unsteady march of evolution across millennia. Finally, the category of society features works that address the way dominant power structures are often characterized by dysfunction leading to problematic relationships between and among species.

Additional elements and perspectives:

A notable tendency in the life sciences which is occurring across many fields, is the move towards the digital. More specifically, the collecting, processing, and the subsequent reliance on data to advance research. The quantitative dimension of biological study becomes ever more prominent, while we may lose sight of lasting qualitative impacts. As this relates to design and art is captured well by a quote from Christopher Alexander in 1964, about the perils of reductionism, in his contributed to a conference on “Architecture and the Computer”:

> “The effort to state a problem in such a way that a computer can be used to solve it will distort your view of the problem. It will allow you to consider only those aspects of the problem which can be encoded – and in many cases these are the most trivial and the least relevant aspects.” [2]

There are similar risks with biology. For instance, with popular understanding of DNA as a blueprint or software code that builds all the wetware that is our bodies and brains, are misleadingly simplified in their linearity. We are more akin to

[2] Christopher Alexander, ‘A Much Asked Question about Computers and Design.’ Architecture and the Computer, First Boston Architectural Conference, 1964.

dynamic ecosystems in motion linked not only with the microscopic metropolis of non-human life that lives in and on our bodies but also with the experiences of generations past via epigenetic markers and the consequences of our environment on our telomeres, the end caps of our chromosomes that slowly change over time as our bodies reach the end of regenerative cell division.

Another force that has a similar impact on the journey of the life sciences is the economic reality of its potential benefits which are often chased without consideration of their impacts. The engineering approach to biology invites numerous blind spots. How these deficiencies manifest is well captured in this snippet of conversation between Drew Endy and Donna Haraway:

"Some people are opposed to bio-synthesizing a few of the molecules found in this bean by engineering brewers' yeast, while other people think "What's the big deal? I'll just run this in a fermenter and I'll get the same chemicals." I never understood the two voices in opposition. This is a riff on your talking about the care of each other: Previously, I only saw the landscape as defined by the molecule, or the molecule and the money, and not as a richer, entangled landscape with multidimensional meaning to it." [3]

Vanilla beans are the foundation of livelihoods and ecologies that do not typically figure into the consideration of those working in the lab. Herein lies a risk, as with the race to develop artificial intelligence, of unintended consequences that, once they appear, cannot be undone.

The trajectories of the life sciences, as well as that of art and design, are uncertain yet destined to be more intertwined. The Bio Art & Design Award has been unique in anticipating this reality while the community they have fostered has played an influential role in shaping the practices of biodesign and bioart. As with other fields, as they advance they will encompass some of the values and priorities of their time. In light of the climate crisis and necessity to achieve greater social justice, programs such as the Bio Art & Design Award have taken helpful steps towards reflecting our collective responsibility to foment change. As the award continues, and as both experts and curious new tinkerers enter the field, we can hope the application and implication of their efforts proliferate and divide as a colony of microorganisms, steeped in agar.

[3] Conversation transcript, by Drew Endy and Donna Haraway. Published October 3, 2019. See 'Tools for Other Species Futures' and other sections, published under 'Other Biological Futures', in the Journal of Design and Science (Issue 4), MIT. Edited by Dr. Alexandra Daisy Ginsberg and Natsai Audrey Chieza.

Impact of the award: summary of an evaluation study

by Naomi Lagerweij

The Bio Art & Design Award was the first bioart and design competition in the Netherlands that matched artists and designers with scientific researchers, and exhibited the results of their collaboration. Every year artists and designers were invited to submit brief proposals for one of twelve research areas, to work with corresponding researchers. After a selection process and matchmaking event, artists/designers and scientists worked together to develop a full proposal. Out of a maximum of twelve propositions, three were chosen as winners and awarded 25.000 euros to realize each project. The results were exhibited in an annual exhibition, initially at Naturalis in Leiden, and then at MU Hybrid Arthouse in Eindhoven.

But what has been the impact of the award on participating artists, designers, researchers and their work? How has this work touched society?

Findings from the 2017 impact study *An evaluation of the impact of the Bio Art & Design Award* reveal that the award has significantly advanced the careers of the winning artists and designers, the majority of individuals surveyed (86%) reported this to be the case. For the winning scientific researchers, the main impact of the award was that it expanded the scope of their research through new ways of thinking, research questions, skills, and knowledge.

Whether they received a prize or not, the majority of participating designers/artists reported that the award enabled them to develop new tools, technologies and methods (100% of winners, 86% of non-winners). Of these, collaboration skills were most often mentioned as improved, reflecting the core of the award. In fact, the Bio Art & Design Award has been particularly effective in offering participants opportunities to continue their collaboration or start new ones (71% of winning artists/designers, 67% of winning researchers, 57% of non-winning artists/designers, 75% of non-winning researchers). This seems due, at least in part, to the expanding and strengthening effect the award has had on participants' networks. By increasing participants' general visibility both within and outside of their field of work, and building stronger networks within scientific and art/design communities, the award has had significant knock-on effects. For example, many of the winning artists/designers were also, and continue to be, invited to exhibit their projects elsewhere after the award (78%). In addition, winning researchers reported that winning the award helped them to secure subsequent funding for their work (17%).

In more general terms, the award has generated more attention for the fields of bioart and design, and had a positive impact on societal debate. The majority of winners reported that their projects were covered by the media (64% of artists and designers, 58% of researchers), and of the other experts surveyed many (81%) listed 'promoting media attention for the bioart and design scene in the Netherlands' as the awards biggest contribution to the bioart and design fields. The importance of the award for science communication has been especially lauded by researchers, with many reporting that it has **increased their levels of motivation to undertake public engagement activities** (63%). Although this study was not designed to measure how the awareness of bioart and design garnered by the award has gone on to impact wider society, it is clear that by offering designated funding, time, and connections the Bio Art & Design Award has facilitated innovative and inspiring projects that have advanced these emerging fields. As a signal of that emergence, it is most encouraging to find that the award spawned a new generation of bioartists and designers year on year: from just 12 applicants in 2010 to 50 for its final 2020 edition.

Illustrated chronology of winning projects, tracing the rise of bioart and biodesign activitys

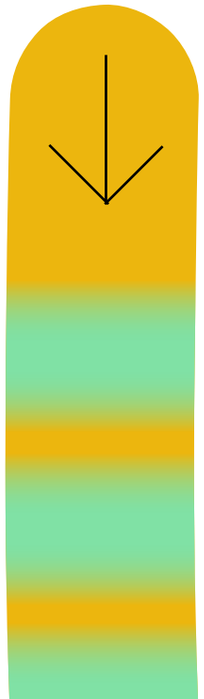
PROJECTS

EXHIBITIONS

BOOKS

COURSES, FESTIVALS, COMPETITIONS

ORGANIZATIONS & MILESTONES



2010

ORGANIZATIONS & MILESTONES

Start Bio Art & Design Award

PROJECTS

Jalila Essaïdi – Bulletproof Skin: 2.6g 329m/s

PROJECTS

Maurizio Montalti – System Synthetics

PROJECTS

Matthijs Munnik – Microscopic Opera

COURSES, FESTIVALS, COMPETITIONS

Ars Electronica – (yearly - started 1979)

ORGANIZATIONS & MILESTONES

Suzanne Lee – Biocouture jacket

ORGANIZATIONS & MILESTONES

Mycoplasma laboratorium or 'Synthia', the first truly synthetic organism created

ORGANIZATIONS & MILESTONES

Biology and the Built Environment (BioBE) Center founded at University of Oregon

PROJECTS

Tiddo Bakker – In Vena Verbum

PROJECTS

Center for Genomic Gastronomy – Eat Less, Live More – and Pray for Beans

PROJECTS

Susana Cámara Leret & Mike Thompson – Aqua Vita

ORGANIZATIONS & MILESTONES

BioArt Laboratories founded in Eindhoven by Jalila Essaïdi

ORGANIZATIONS & MILESTONES

“Trust Me, I’m an Artist” project, led by Anna Dumitriu in collaboration with Bobbie Farsides (2011 – 2017)

ORGANIZATIONS & MILESTONES

Synthetic Aesthetics program launched — run by Stanford University and University of Edinburgh

ORGANIZATIONS & MILESTONES

BioBuilder foundation founded at MIT

ORGANIZATIONS & MILESTONES

Lamp Half Alive by Joris Laarman

ORGANIZATIONS & MILESTONES

SymbioticA recognised as a Research Centre within The University of Western Australia

2011

ILLUSTRATED CHRONOLOGY OF WINNING PROJECTS

2012

PROJECTS

Charlotte Jarvis – Ergo Sum

PROJECTS

Haseeb Ahmed – Fish Bone Chapel

PROJECTS

Laura Cinti & Howard Boland – Living Mirror

BOOKS

Biodesign: Nature + Science + Creativity by William Myers first published

ORGANIZATIONS & MILESTONES

Post Natural History project by Vincent Fournier (founded 2012)

ORGANIZATIONS & MILESTONES

First 'Bio-Robot' created at University of Illinois

ORGANIZATIONS & MILESTONES

New logo Bio Art & Design Award

Bio Art & Design Award

ORGANIZATIONS & MILESTONES

BioTehna and Rampa labs founded in Ljubljana

ORGANIZATIONS & MILESTONES

CRISPR-Cas9 harnessed for genome editing

ORGANIZATIONS & MILESTONES

BioPen developed at Australian Research Council Centre of Excellence for Electromaterials, allowing the bioprinting of cells

ORGANIZATIONS & MILESTONES

First 3D printed bionic ear prosthesis at Princeton University

EXHIBITIONS

Yes Naturally: How Art Saves the World at Kunstmuseum den Haag (Mar – Aug 2013)

EXHIBITIONS

Biodesign: On the Cross Pollination of Nature, Science, and Creativity at Het Nieuwe Instituut (Sept 2013 – Jan 2014)

EXHIBITIONS

CUT/PASTE/GROW at Observatory / Proteus Gowanus (Mar – May 2013)

BOOKS

Art + Science Now by Stephen Wilson first published

BOOKS

Speculative Everything: Design, Fiction, and Social Dreaming by Anthony Dunne and Fiona Raby first published

ORGANIZATIONS & MILESTONES

Silk Pavilion by Neri Oxman

ORGANIZATIONS & MILESTONES

Mycelium Chair by Eric Klarenbeek – the first 3D printed chair made from mycelium

2013

ILLUSTRATED CHRONOLOGY OF WINNING PROJECTS

2014

PROJECTS

Studio PSK – The Economics of Evolution: The Perfect Pigeon

PROJECTS

Špela Petrič – Naval Gazing

PROJECTS

Julia Kaisinger & Katharina Unger – Fungi Mutarium (Growing Food From Toxic Waste)

ORGANIZATIONS & MILESTONES

The Pelling Lab designs human ears by injecting human cells into pieces of sterilized apple

COURSES, FESTIVALS, COMPETITIONS

Biofabricate, New York (yearly – started in 2014)

BOOKS

The Greening of the Galaxy by Suzanne Anker first published

BOOKS

Synthetic Aesthetics: Investigating Synthetic Biology's Designs on Nature by Alexandra Daisy Ginsberg, Jane Calvert, Pablo Schyfter, Alistair Elfick, and Drew Endy first published

ORGANIZATIONS & MILESTONES

Hy-Fi by David Benjamin the first construction made of mycelium bricks

EXHIBITIONS

Matter of Life at MU Hybrid Art House

PROJECTS

Emma Dorothy Conley – MSA: Microbiome Security Agency

PROJECTS

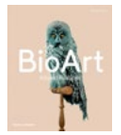
Isaac Monté – The Art of Deception

PROJECTS

Agi Haines – Drones with Desires

BOOKS

Bio Art: Altered Realities by William Myers published



BOOKS

BioBuilder by by Natalie Kuldell, Rachel Bernstein, Karen Ingram, and Kathryn M. Hart published

COURSES, FESTIVALS, COMPETITIONS

Biomimicry Global Design Challenge (yearly – started 2015)

COURSES, FESTIVALS, COMPETITIONS

Biodesign Challenge (yearly – started 2015)

ORGANIZATIONS & MILESTONES

BlueCity founded in Rotterdam

BOOKS

Material Alchemy by Jenny Lee first published

EXHIBITIONS

Body of Matter at MU Hybrid Art House

2015

ILLUSTRATED CHRONOLOGY OF WINNING PROJECTS

2016

PROJECTS

Lilian van Daal & Roos Meerman – Dynamorphosis, the beauty of inner mechanisms

PROJECTS

Pei-Ying Lin – Tame is to Tame

PROJECTS

Cecilia Jonsson – Haem

COURSES, FESTIVALS, COMPETITIONS

Bio Inspired Innovation masters at Utrecht University (Yearly – started 2016)

EXHIBITIONS

Fluid Matter at MU Hybrid Art House

PROJECTS

Jiwon Woo – Mother's Hand Taste (Son-mat)

PROJECTS

Xandra van der Eijk – Seasynthesis

PROJECTS

Guo Cheng – A Felicitous Neo-Past

ORGANIZATIONS & MILESTONES

The Odin, founded by the bio-hacker Josiah Zayner, first markets CRISPR/Cas9 Gene Editing kit to the public

ORGANIZATIONS & MILESTONES

Science Gallery Detroit opens

ORGANIZATIONS & MILESTONES

'spun', silken fibres by Bolt Threads

ORGANIZATIONS & MILESTONES

Zoa, animal-free, liquid leather by Modern Meadow

EXHIBITIONS

Life Time at MU Hybrid Art House

2017

2018

PROJECTS

Baum & Leahy – Microbiocene: Ancient ooze to future myths

PROJECTS

Ani Liu – No regrets for what you haven't been, Be the ghost you want to see in the machine

PROJECTS

Chen Yiyun – Horizontal Living

COURSES, FESTIVALS, COMPETITIONS

World's first genetically modified babies born, twin girls (known as Lulu and Nana) who had been made resistant to HIV

COURSES, FESTIVALS, COMPETITIONS

Science Gallery London opens

EXHIBITIONS

ReShape at MU Hybrid Art House

PROJECTS

Jonathan Ho – Sex Shells: Gender fluidity in the modern age

PROJECTS

Emma van der Leest – Fungkee | Fungal Supercoatings

PROJECTS

Michael Sedbon – CMD: Experiments in Bio-Algorithmic-Politics

EXHIBITIONS

La Fabrique du Vivant at Centre Pompidou (Feb – Apr 2019)

EXHIBITIONS

Nature at Cooper Hewitt Smithsonian Design Museum and Cube Design Museum (May 2019 – Jan 2020)

EXHIBITIONS

Biobasecamp and Growing Pavilion at Dutch Design Week

ORGANIZATIONS & MILESTONES

STUDIOTOPIA – Art meets Science in the Anthropocene (2019 – 2022)

ORGANIZATIONS & MILESTONES

Science Gallery Bangalore opens

ORGANIZATIONS & MILESTONES

Science Gallery Rotterdam opens

BOOKS

La Fabrique du vivant by Collectif published

BOOKS

Nature: Collaborations in Design edited by Caitlin Condell, Andrea Lipps, Matilda McQuaid, Gene Bertrand, Hans Gubbels published

BOOKS

Art's Work in the Age of Biotechnology: Shaping Our Genetic Futures by Hannah Star Rogers and William Myers published

EXHIBITIONS

Polarities at MU Hybrid Art House

2019

ILLUSTRATED CHRONOLOGY OF WINNING PROJECTS

2020

PROJECTS

Nadine Botha – The Orders of the Undead

PROJECTS

Sissel Marie Tonn – Becoming a Sentinel Species

PROJECTS

Dasha Tsapenko – Productive Fur

EXHIBITIONS

Broken Nature at The Museum of Modern Art (Nov 2020 – Aug 2021)

EXHIBITIONS

Design by Nature at Museum de Fundatie (July – Oct 2021)

EXHIBITIONS

Neri Oxman, Material Ecology at MoMA (May – Oct 2020)

ORGANIZATIONS & MILESTONES

Ecology Futures program at The Master Institute of Visual Cultures (MIVC), St. Joost School of Art & Design (launched in 2020)

ORGANIZATIONS & MILESTONES

Science Gallery Melbourne opens

EXHIBITIONS

Evolutionaries at MU Hybrid Art House

ORGANIZATIONS & MILESTONES

New logo Bio Art & Design Award introduced in 2021

Bio Art & Design Award

ILLUSTRATED CHRONOLOGY OF WINNING PROJECTS

CHAPTER 1

Materials

The work of bioartists and designers is often characterized by unusual materials or media, as compared with more traditional creative practices. Most notably, the work is sometimes living, changing, decaying, growing, or otherwise in an unstable state. Like with performance or other sorts of ephemeral creations, there is not a fixed moment of completeness or status, but rather elements in motion. As such, the work of new bioartists and designers owe a debt to artists like Hans Haacke who made work out of processes found in nature such as condensation. Haacke also prototyped approaches to critiquing larger systems in their work, for instance by making a performance out of a sociological study and survey, to highlight problematic relationships in the art world between museums and private companies.

Material work in bioart and design is frequently a critique (direct or subtle) of the systems of extraction and exploitation that are the current global standard. Here works perform that "there *is* another way" aside from relying on fossil fuels and the old, accepted ways of making or giving form. Many of the works in this section seek new materials with novel properties, often as a means to critique and offer an alternative to such systems. Designer Maurizio Montalti does just that in the work *System Synthetics*, an example of designing with decay and decomposition, rather than from cradle-to-grave as has been the dominant approach in design thinking.

Dasha Tspenko is another designer who also takes the need to transition from finite resources to cyclical systems as the starting point for the work *Productive Fur*, which moves from extraction to cultivation, and offers the possibility that we might soon be able to breed new garments, instead of manufacturing them.

The notion of building value over the life of a material, rather than degradation can be traced back to indigenous approaches. Take, as an example the root bridges of Meghalaya in the northeastern state of present day India: infrastructure that has been 'grown' from the roots of rubber trees over centuries by the local Khasi peoples. A natural solution to mobility issues that arise in the area from fluctuation in river levels, the bridges are a form of bioengineering that 'coaxes' structures from the natural growth of the *Ficus elastic*, a variety of rubber tree. Given enough time, care, and repetition sturdy, ever-evolving suspended walkways are created that have the potential to withstand hundreds of years of use. The root bridges demonstrate what is possible in the realm of living materials, when the hand of the human agent works with and in collaboration with natural processes.

Materiality is key to any art and design process, as contact with the material builds the artist or the designer's intuition. Hands on work translates most directly into testing various media and methods for

making; thus, it is through innumerable splinters and computer crashes that the coder and wood-worker learns to craft. There is no other way. Embodied knowledge and sensorial experience in turn becomes wisdom that the designer or artist might wield to establish a new culture of use by understanding that which exists. But what are the implications when the material in question is living? And where do the boundaries lie between use, misuse, or even exploitation? Laura Cinti and Howard Boland explore these questions in the work *Living Mirror*, for which the duo inserted living organisms and natural phenomena into the art historical tradition of portraiture. In so doing they explore the possibilities, but also the ethics of using life as artists' material.

In contrast, materials are also a layer of the world that we do not often take into consideration, just as with design, where everything around us is usually designed, either well or not. Materials are likewise ubiquitous, and behind them lay decisions and tradeoffs made by somebody or some organization. Recognizing this is a first step, just as we are now more aware of single-use-plastic. One of the most common, but perhaps unexpected, materials artists and designers in this section have identified to work with, is the human body. In their work *Dynamorphosis, the beauty of inner mechanisms*, Lilian van Daal and Roos Meerman utilize the form generating mechanisms of the body to create installations that illuminate the often-overlooked beauty to be found in the functionality and efficiency of the human body.

By rendering the body as material, such works reposition designers as biological actors, and point to the materiality of the human brain as perhaps that most important and malleable of all materials. As we absorb new ideas, form different connections between concepts and adjust our priorities, as you are doing subtly, even as you read this sentence, the material of the brain, the 86 billion neurons it consists of, make new and different types of physical connections. Our experiences sculpt us in small ways, and we can be mindful of how those changes can in turn revolutionize how we use materials; be it the transformation of global production systems, looking to ancient practices, or simply using less. What works in this section have in common is a more cognizant understanding of material processes, and that it is ultimately ideas that shape the world in which we live.

Navigate to the artist

DASHA TSAPENKO

Fur_tillize, 2020

Mixed media installation, including five prototype coats and material samples at different growth phases

Developed in collaboration with Prof. Han Wösten, Department of Biology, Utrecht University.

Dasha Tsapenko fuses knowledge and techniques from disciplines including architecture and social design to create works about spaces and bodies, and their relationship on various scales, from mushroom roots to the fast fashion industry. Her practice has advanced along a journey, beginning with training in architecture at the Academy of Fine Arts and Architecture in Kyiv, Ukraine, and continuing through to the Design Academy in Eindhoven, where she earned a master's in Social Design. Her graduation project for that degree is demonstrative of the direction of her thinking and what would emerge as her winning project for the Bio Art & Design Awards in 2020. The work *dress_de_code* from 2017 staged a re-enactment of the daily private routine of dressing, but with alternative types of objects and body motions. It works as a revelation of how influential the design of a space and routines can be on an act we hardly consider, but is linked to how we think and behave as it serves as the transition point between private space and social context.

Parts of the approach behind *dress_de_code* inform Tsapenko's winning project *Fur_tilize*. In short, what is seen again is a focus on bodies and all the communication that can be read by how we cover them. Yet *Fur_tilize* takes this several steps further by examining the means of production, presenting an alternative, and then interrogating the entire system of value generation in fashion by performing an inverse of it. To achieve this Tsapenko,

Fur_tillize, 2020
Photo: Hanneke Wetzer

Fur_tillize, 2020
Photo: Hanneke Wetzer

in collaboration with the microbiologist Han Wösten, created a multi-step plan of cultivation of living organisms on coats of woven hemp, cut into shapes resembling a kimono. The resulting clothing is regarded as “new” in this first stable stage; the “second hand” materialization occurs once populated by a layer of fungi *Schizophyllum commune*, then a “third hand” layer is created by selectively fertilizing areas on the coat to create fruiting bodies of the same mushroom; once those are harvested, the resulting material can be seeded with a variety of legumes to make a “fourth hand”, which enables still other cultivation, and so on. Each “hand” refers critically to how in contemporary fast fashion cycles, garments are made neither with the robust quality allowing multi-person or generational use or even the intention that a piece of clothing could remain desirable for longer than a season.

The installation of the work presented three stages of growth on prototype garments hanging in space, along with numerous samples at different “hand” stages and experiments with different species of plants, contained in vitrines. The instability or fluidity of each item presented is part of its beauty, to make ever-more clear that all our systems could be but are not circular in terms of materials and energy. They could better resemble the seasons found in nature, ever returning and renewing; but of course, what most clothing design today leaves us with is waste and decay. A linear production line from extraction to landfill is the norm and has been for ages. Yet, it is helpful to consider that there was a centuries-long era when Europeans couldn’t envision an end to monarchy; of course things eventually changed and the rights of the individual became enshrined. More recently, the philosopher Mark Fisher pointed out that his contemporaries like Fredric Jameson and Slavoj Žižek, despair that "it is easier to imagine an end to the world than an end to capitalism.” *Fur_tilize* is a work that offers a novel vocabulary, words and ideas communicated with objects, processes, and beauty that might make the beginning of imagining a new world order possible, well beyond reforming wasteful cycles of fashion.

The process in the laboratory for Wösten and Tsapenko was marked by iteration, hands-on processes, and mutual esteem. Aspects of the work proved especially challenging such as crafting vessels to a size that could be sterilized in an autoclave, to enable the growth of more samples and for further tests. In a moment of clarity for the designer, she understood after many failed attempts at a stage of production, that her role was “to facilitate the fungi” rather than “grow” it, which would imply control that was not experienced. In a sign of potential for fungi in general, despite the kind of

[2] Mark., Fisher (1 January 2010). Capitalist realism: is there no alternative?. Zero Books. ISBN 9781846943171. OCLC 699737863.

Fur_tillize, 2020
Photo: Hanneke Wetzer

challenges the designer faced, at one of the laboratory session with Wösten a topic of numerous meanings and practical areas of investigation was raised: the sex of fungi. As Wösten and other specialists describe it, there are fungi with “thousands of sexes,” all distinct and with the potential to create yet unstudied phenomena. It seems these evolved properties make fungi a rich medium for both expressive gestures about society, such as about symbiosis, sex, and ecological circularity, as well as for making new materials with novel properties for design.

The Bio Art & Design Award has supported Tsapenko’s subsequent work and facilitated new opportunities. She continues working as a guest researcher at Wösten’s lab at Utrecht University, works as a lecturer at ArtEZ in Arnhem, and is studying potential circularities in energy and materials for the fashion industry at Wageningen University. *Fur_tilize* and images of its installation have been written about in international media, and the work has subsequently been shown, in part as part of the program Grain Loves Rain, a Galway 2020, European Capital of Culture Project.

Discover more about the artist and this project

VIEW THE VIDEO →

EMMA VAN DER LEEST & ANETA SCHAAP-OZIEMLAK

Fungkee | Fungal Supercoatings, 2019

Mixed media installation, including material samples, lab equipment, prototype products, and documentation of research

In collaboration with Prof. Paul Verweij & Prof. Sybren De Hoo, Center of Expertise in Mycology, Radboudumc & Canisius Wilhelmina Ziekenhuis Nijmegen.

Schaap-Oziemlak and Van der Leest are a biologist and designer team that subscribe to the view that the biosphere is awash in resources that are undiscovered and unappreciated. They both have a rigor in research and richness in imagination that was combined in their Bio Art & Design Award-winning project *Fungkee | Fungal Supercoatings*, a project working towards making bacterial cellulose, a potential alternative to textiles, more stable and resistant to water, utilizing a fungus toxic to humans. The effort to perfect this application for broad adoption remains underway. The work is an example of an earnest attempt to change the design process by switching from traditional manufacturing to biofabrication, and make better use of all the promising scientific research that has yet to see application as a technology.

Van der Leest discovered, while completing a degree at the Willem de Kooning Academy in Rotterdam, an opportunity that influenced her future work: an internship at the BioCouture Design Consultancy in 2014, a pioneering studio-lab in London at which she learned about biofabrication from one of the field's most visionary pioneers, Suzanne Lee. Van der Leest's early projects evince more than an interest in natural systems, but of the complexities and contradictions in people's behaviors, such as in the *Liturgical Raw Food Ritual* (2013) that observes how conscious consumers of raw food often follow a lifestyle relying on systems

Fungkee | Fungal Supercoatings (2019)
Photo: courtesy of artist

of modern processing. In general, Van der Leest's projects, from being a co-founder of BlueCity Lab, Rotterdam, to working as a rigorous biodesigner, are propelled by entrepreneurship and tenacity tuned to a bright vision of the future.

Aneta Schaap-Oziemlak studied in numerous settings, adapting and achieving professional fluency inside laboratories and firms of many kinds in places as varied as Warsaw, Rotterdam, and Leuven. Her research has touched on many areas of the life sciences, from cancer and stem cells to antileukemic drugs. Her teaching is similarly varied, from a master class on patenting to guiding high school level students to an understanding of mitochondria. Schaap-Oziemlak's swiss-army-knife of skills and knowledge are well fitting for such an ambition as the project of Fungkee | Fungal Supercoatings.

The fungus selected for the winning project, *Hormopraphiella aspergillata*, was identified by the project's scientific partner, Prof. Paul Verweij, in 1997 as causing fatal lung infections in patients who have leukemia. Yet it also has other properties interesting for design. At different stages of the growth and reproduction processes of this particular fungus it produces compounds that can be usable as ink, hydrophobic coating, or to impart texture. The team investigated different ways to cultivate this fungus safely while coaxing them to create those compounds that could be used on microbial cellulose, so that it could have some of the same material properties as a textile. In order to communicate the concept in exhibition form, prototype products including a garment, along with lab equipment and a video documentary were shown together, as well as samples of extracted dye and the wax-like coating.

As is the case with many biodesign prototypes, this one will require further investigation, testing, and iteration of process before it may become a viable commercial product. The work, in its different stages, has had a life in exhibitions beyond the first at MU Hybrid Art House in Eindhoven, most notable being shown in the *Growing Pavilion* as part of Dutch Design Week in 2019, which has since traveled to various locations in the Netherlands. The award has opened doors for the biologist and designer, and accelerated their separate practices. In particular, for Van der Leest, the experience helped support her work founding the BlueCity Lab in Rotterdam, a space dedicated to aiding entrepreneurs who are pioneering biodesign approaches.

Discover more about the artist and this project

VIEW THE VIDEO →

INTERVIEW

Emma van der Leest

Biodesigner, Curator, and Founder of BlueCity Lab

Did you have memorable experiences in youth or early at university that gave you a strong motivation to work in biodesign?

I grew up in the Veluwe, surrounded by forests, sand drifts, and water, and was outside a lot, therefore nature was a central part of my childhood. For example, I built huts from wood scraps and tree trunks for fun. I always liked science, but the mathematical part was difficult for me, as I suffer from dyscalculia. Interestingly, my grandfather was a freemason and mathematician, but I did not inherit that gene. Rather, learning by doing was my motto, and I have an incredible curiosity about other forms of life. With a lot of effort, I passed my chemistry and biology exams with a little higher grade than my Dutch. For me, the best part was dissecting and identifying all the parts of a mussel under the microscope, which was all very educational and edifying until I got home and my parents served mussels for dinner.

Are there artists or designers who you would call inspirations? Relatedly, is there a single work that stands out to you as something to aspire to in your own practice?

My fascination with biodesign started with the exhibition *Micro Impact* at Boijmans van Beuningen Museum in Rotterdam, where I saw a jacket made by Suzanne Lee that utilized bacteria and yeast in a fermentation process.

The making process was closer to making beer than weaving fabric, and the fact that you can *grow* garments moved me. Like many product design students, I only thought of the material after finishing the design of a product. In contrast, thinking about the material before the design really fascinated me. In 2012, there were not many resources online about this topic, so I started a series of my own experiments at home. Still, Suzanne Lee is still my biggest inspiration!

In what ways has winning the Bio Art & Design Award influenced your creative practice?

When I won the Bio Art & Design Award I was really excited to start a new collaboration with a scientific institute. Having access to professional lab equipment and professors opened new doors for me. I still collaborate with professor Sybren de Hoog, who is officially retired, but we continue to join forces and take the project to another level. We will collaborate with professor Han Wösten from Utrecht University, and with a PhD student from China who will focus on developing local, Chinese, material waste streams in order to assist us to create a composite packaging material from fungi and bacteria. Besides this, the *Fungkee Supercoating* has been in multiple exhibitions in The Netherlands.

Can you describe your experiences of collaboration in your projects, such as with Paul Verweij?

Paul Verweij and Sybren de Hoog were both fantastic. Besides them I have also collaborated with two analysts from the laboratory, Hein van der Lee and Marlou Tehupeiory-Kooreman. Hein is a fungi expert, who participated in *Growcast*, a podcast I made for BlueCity in Rotterdam. I shared my design perspective on the field of biofabrication, and now they are really involved with it. They too see the value, and also experience that there is more than only a medical use for fungi.

Can you please name one or two things that surprised you (or continues to surprise you) about the process of collaborating with a scientific partner?

It’s not really surprising, but something to remember is that biology is slow. It is nothing like woodworking or ceramics. Biology is also a craft, but for which patience is required. Those who work with it need to learn and understand the growth process of organisms. Only by studying it in this way will you discover its immense possibilities. It is also important to remember that even though you work in a professional laboratory, things can still go wrong. Additionally, I learned that preserving cultures is a difficult task, as currently there is

no chemical-free alternative to formaldehyde that can be used to ‘freeze’ cells. I used this technology to keep beautiful growth patterns ‘alive’ for exhibitions.

If you were granted a million euros and 5 years to work on any biodesign project, what would it be?

First of all, that would be fantastic; at this time, I do everything by myself, so I would hire personnel and rent a workspace in BlueCity Lab in Rotterdam. With the right innovation and support you can transform the entire packaging and coating industry. I would also want to start a campaign to transform the harbor of Rotterdam into a bioplant, where the old fossil-fuel-based infrastructure is repurposed as a place to brew materials, fuels, and food. I have already spoken with the Dutch chemical and biotechnology company, DSM about the possibilities. To realize them would be my dream.

Can you explain your work leading the BlueCity Lab and how it has evolved in the last two years?

The idea for BlueCity Lab emerged during my graduation project, when my need for a biolab in the city of Rotterdam was big. At that time, I worked at the Waag Society in Amsterdam, and in the Molecular Cell biology lab at University College London. When I presented my graduation project at a conference, the idea for a local lab was picked up by the founders of RotterZwam and BlueCity. Soon there was a tiny budget to start a ‘lab’ in the old changing rooms. With this, some second-hand machinery and lab equipment from hospitals, and the help of a lot of volunteers we were able to launch the lab in January 2017. Later that year Nienke Binnendijk, now director of BlueCity Lab, became part of the team. In 2019, I won the Bio Art & Design Award, which was covered on national television (VPRO). I then became very busy, and decided to focus on developing my own practice. Leading a lab; from writing funding applications to machinery maintenance, organizing events to developing educational programs, was a bit too much alone. Now we have three fantastic new colleagues in the laboratory, workshop, and to manage the programs, and we completely redesigned the lab with the help of funds during the first Covid-19 lockdown in 2020. I am very pleased that we now have 15 ‘bioneers’ in the lab. It makes me happy that my dream came true, and that we lowered the threshold for anyone who wants to practice biotech and biodesign: from designers, to scientists and entrepreneurs.

ISAAC MONTÉ

The Art of Deception, 2015

Series of 21 manipulated pig hearts in glass vessels

Developed in collaboration with Prof. Toby Kiers, Department of Ecological Science (DES) at VU University Amsterdam.

Isaac Monté's work focuses on the planet-wide degradation of our shared social and ecological conditions, amounting to a form of 'design activism.' His works can make powerful statements, while going beyond raising awareness by prompting interaction or challenging the viewers belief systems. *Filter Factory* (2013), an early project which involved Monté building birdhouses out of used cigarette filters, was not only a reaction against the huge amounts of toxic litter that cigarettes create, but a functional waste disposal machine designed to positively reinforce the good behavior of smokers who responsibly discard their cigarette ends. For every three hundred cigarette filters deposited, a door in the machine opens and offers a birdhouse to take away. Monté has continued to work with waste as a theme and a material since graduating from the Product Design program at Willem de Kooning Academie in Rotterdam in 2013, where he now teaches. Specifically, he is concerned with understanding, controlling, and manipulating unusual materials to arrive at solutions to some of the world's most pressing issues. His mediums include discarded trash, animal fur from roadkill, surplus food from supermarkets, as well as the less traditional waste stream of biological material.

As the winner of the Bio Art & Design Award in 2015, Monté worked with Evolutionary Biologist and Professor of Mutualistic Interactions at the VU Amsterdam, Toby Kiers, on research in the future

The Art of Deception (2015)
Photo: Monica Monté

of organ transplantation. *The Art of Deception* was the result of their collaboration, a work that used the technique of decellularization to transform pig hearts into a new material. Decellularization is the process by which all of the cell contents of an organ are washed away, leaving only the extracellular shell, the organ's 'skeleton'. These eerily white 'ghost organs', reminiscent of the formaldehyde preserved body parts commonly found in anatomy collections, are a blank canvas that can be repopulated with stem cells and transformed into something entirely different.

Whilst decellularization presents exciting opportunities for medical utilization, the discarded hearts Monté obtained were used as a blank canvas for a variety of aesthetic modifications. The work, which has been presented in several locations internationally, including Ars Electronica and Science Gallery Dublin, consists of twenty-one decellularized hearts, wrenched from their bodily context and suspended in individual glass vessels. The hearts have been visually transformed: tattooed, embroidered, shrunken, or otherwise modified almost beyond recognition. In doing so the work calls into question the very idea of improvement through science-assisted, aesthetic modification. The dead hearts can no longer function as the rhythmic, blood-pumping center

[2] Mark., Fisher (1 January 2010). Capitalist realism: is there no alternative?. Zero Books. ISBN 9781846943171. OCLC 699737863.

The Art of Deception (2015)
Photo: Monica Monté

of an animal, but rather are representations of how dramatically one might manipulate the body, and to what end. Monté states that the ultimate goal of the project is to explore how biological interventions can be used as "tools for the ultimate deception: the transformation of inner beauty, from grotesque to perfection".

In her scientific work, Kiers is interested in how organisms can manipulate themselves and their environments for their own benefit. *The Art of Deception* draws a parallel between humans and nature, as much like other animals, people use deception as a tool to increase their success. Yet Monté's mastery of biological material in the pursuit of pure aesthetics is a direct affront to contemporary notions of beauty and an absurdist gesture towards society's enduring pursuit for perfection. The work can also be connected to the historic domination of nature in the quest for scientific discovery. Specifically, the coincidence of Renaissance art with the rise of empirical science in the beginnings of the Scientific Revolution. A connection strengthened by the clear anatomical nature of the work which brings to mind the anatomical drawings of Andreas Vesalius in his *On the Fabric of the Human Body* (1543). This comparison comes full circle with the fact that the work reflects some of the research interests of the Kiers Lab: to explore the mechanisms of communication, including deception, within and across species.

As with some of Monté's other works, *The Art of Deception* illuminates what is scientifically possible while questioning what is ethically acceptable when combining technology, art, and science to render new uses for spent materials. By using pig hearts he asks: can biological materials such as organs provide fertile ground for creative expression about the emerging potential of both bodily modification? In doing so Monté adeptly re-draws the frontiers of where and how a designer can forge a practice while questioning, from an informed perspective the authority of science alone to redesign the human body.

Discover more about the artist and this project

VIEW THE VIDEO →

INTERVIEW

Isaac Monté

Artist

Given your long interest in waste streams, what are some that may be unusual but you think hold a lot of potential for artistic response or design usage?

For a few years I have been working with waste streams from agriculture, and thinking about cutting waste from vegetable farmers or the flower industry in the Netherlands. I have transformed the natural fibers in these cuttings into paper and containers, with the idea to use them as packaging material for fruit, vegetables, and flowers. Currently these products are packed in plastic and at the same time there is no real purpose for cutting waste. We are already witnessing bans on plastic and I believe this will become much bigger in the future. With this paper and containers made out of cutting waste I strive to offer an alternative.

Did you have memorable experiences in youth or early at university that gave you a strong motivation to work in your medium?

I grew up in the countryside and most of the time I was playing outside together with my sister. We explored our natural surroundings, building dams, catching frogs, harvesting beautiful leaves and flowers and so on. Nature was our playground and we were as scouts and pioneers, discovering the world; we were outside all year round and did not do things like play video games inside. I believe these experiences

influenced me a lot in my creative approach and the way I work in my studio. I am very experimental and like to try combining a hands-on approach with literature, or verbal narrative. Usually I do not know what to expect in advance and my work is a process of trial and error. If I try a hundred different things then I am lucky if just one of the iterations is successful.

Are there artists or designers who you would call inspirations? Relatedly, is there a single work that stands out to you as something to aspire to in your practice?

Growing up in a fashion workshop, I always dreamed of becoming a fashion designer. I even tried to enter the Antwerp Fashion Academy when I was 17. I look up to Iris van Herpen and the way she looks at the human body, and reinterprets fashion in how she uses unusual materials in the context of the body. Further, I have always admired Lucy McRae and Bart Hess who call themselves "body architects." In the work of these designers and how they describe themselves and their practice I see a love for the human body, the architecture of it and how an artist can manipulate the body and affect it with their creations. I also admire the way they explore new materials and break with the rules and strive for the unconventional.

In what ways has winning the Bio Art & Design Award influenced your creative practice?

Winning the Bio Art & Design Award has changed my artistic practice completely. Before the development of *The Art of Deception* I was mainly focusing on material research, specifically the manipulation of materials with a strong link to sustainability. But due to the collaboration with Toby Kiers and this project, my long love for science and the human body was revived. In high school, I enjoyed the biology lessons a lot, but I was not an excellent pupil in the other sciences such as chemistry and mathematics. Studying sciences and reading about new developments makes much more sense to me now in the context of the work that I create. There is a bigger purpose. Because of the process with Toby I found out that I can combine art with my fascination for biology and the human body.

Can you describe how your experiences of collaboration were different in your projects, from Toby Kiers to your newer works like *Prosthetic X*?

In the collaboration for the Bio Art & Design Award project I was being challenged and pushed by Toby. I expected her to be enthusiastic about my ideas and to support me from a scientific point of view. But her strategy was to

push me further, because she knew I had more to give. We had a great interaction and because of our synergy the project developed into something beyond our own expectations.

For *Prosthetic X*, I am collaborating with In4Art, which is an organization which aims to increase the impact of art in society and the economy. They are the creators of the Art-Driven Innovation method for idea generation and a bottom-up approach to actively developing responsible innovations. Because of our collaboration we can join forces and network, which allows us to work with a team of researchers, creatives, programmers, and business developers. It brings my work and my artistic practice to a completely different level.

Can you please name one or two things that surprised you about the process of collaborating with a scientific partner?

It might be a daring thing to say, but they are not as boring as I thought they were. I believe I am not the only one who has this cliché idea about scientists being absorbed by their lab and working on incomprehensible subjects at the intangible micro-scale. But the opposite of all of that is actually more the reality. Interestingly, the scientific process is very much comparable to the process of an artist and it is very creative as well. Just as artists they go through a cycle of trial and error in order to realize their ideas or the hypothesis they are trying to prove. Scientists also have to come up with creative solutions to overcome the struggles in their way of working and to find the key to solve the scientific puzzle.

What do you think of the state of the bioart and biodesign fields in the Netherlands now? Are there other places that you think have become (or are becoming) prominent in supporting such content?

Apart from the designers, who are the driving force here in my opinion, you also see the development of quite some organizations and foundations supporting this kind of artistic research, think for example about BioArt Laboratories in Eindhoven and BlueCity in Rotterdam. Also, more galleries and museums are interested in showing this type of work, which is a great encouragement for the artists working in this field. I think, for example, about the Science Gallery Rotterdam which opened in 2019.

What new developments in the sciences are interesting to you now? Do you foresee future collaborations with a scientist?

The sciences are constantly under development and new findings happen on a daily basis. As an artist, it is very inspiring to follow these developments and speculate about the future.

Nowadays we are living in the biological revolution, which follows the digital revolution by Steve Jobs and the physics revolution by Einstein. Taking *The Art of Deception* as a starting point in combination with the work I am currently working on *Prosthetic X*, I am very much interested in how we can 3D print body parts, on the inside as well as the outside of the body and create super-humans. I believe in customized body parts which allow us to become better versions of ourselves.

I am also very much interested in the work of Marileen Dogterom, who won the Spinoza Award in 2018 to continue her research to create a completely artificial cell. I see great overlap between her philosophy and mine and the interest in humanizing artificial material. I would love to be part of such an interesting body of research and to share my artistic ideas and vision on the matter.

What is a dream project you would work on if granted a large budget and any scientific collaborators you wanted?

I am currently working on the translation of *Prosthetic X* into an easy to use intuitive wearable for the elderly, supporting their vitality and enabling them to stay healthy by measuring UV exposure, vitamin D intake, social interaction, and steps, while keeping their data private. It is a project that transcends the art project with which it all started. We should be aware of the fact that we are getting older and I want to contribute to how we can do this in a vital way. I have explored this artistically with *Prosthetic X* and I want to take steps to transform this from speculation to reality. This translation requires a lot of scientific research about geriatrics and healthy living in combination with technological development such as life logging and design.

LAURA CINTI & HOWARD BOLAND

Living Mirror, 2012

Interactive installation, including camera, bacteria, screens, and live video stream

Developed in collaboration with Bela Mulder & Prof. Tom Shimizu, FOM-Institute AMOLF.

The practices of Laura Cinti and Howard Boland have been combined since they began C-LAB in 2003. Prior to that time, Boland held positions in a variety of companies where he developed tools and methods for efforts such as digital archiving and the development of new online and VR experiences. This followed study of mathematics and software for the arts at the University of Oslo and University at Hertfordshire, respectively. He subsequently went on to earn a PhD at the University of Westminster, the study for which involved exhibiting genetically-modified organisms in a public setting for the first time in the United Kingdom. Cinti studied fine art, medial, and critical theory at the University of Hertfordshire, Goldsmiths, University of London, and then too went on to earn a PhD focusing on bioart, also at the University of London. Thus, they have been well equipped in terms of knowledge and experience to be working and building this emerging field.

An example of their work from 2011 that anticipated their direction was *Stress-O-Stat*, a living artwork that visually expresses the stress of bacteria. Using a gene circuit the artists developed by applying the tools of synthetic biology and linking the stress response to activate production of fluorescent protein. For its display, they utilized laboratory parts in such a way to suggest the aesthetics of a machine, which in turn became more life-like as the bacterial population grew and glowed; meanwhile the microorganisms themselves became more machine-like,

Living Mirror (2013)
Photo: Sas Schilten

having undergone human-directed redesign of their genetic material. Doubtless some of these processes and related learnings helped support their winning proposal for *Living Mirror*, for the Bio Art & Design Award in 2013, which was developed in full with researchers from FOM-Institute AMOLF.

Their winning project utilizes magnetotactic bacteria as a starting point; these have a sensitivity to magnetic fields and actually use the earth's geomagnetic field lines as a navigation aid. By introducing changing magnetic fields to these microorganisms, they rotate in concert causing light to scatter. When choreographed just so, using tiny electromagnetic coils, with multiple pulsating waves of bacteria affecting the light, pixelated images or patterns can be made. This setup is translated into a living mirror using a motion sensor, which tracks and records an audience member's face, then renders it into a low-resolution image. In turn, the values in the image are used to activate magnetic coils directing the microorganisms to produce that image. The artists consider the living biological mirror in liquid to draw on the idea of water as "our first interface predating today's screen-based digital technologies." They also see connections to the myth of Narcissus who fell in love with his own image in the water, and drowned trying to get closer to it, which they also believe to be akin to how problematic it can become when we try to extend our identities into the virtual, digital space.

Living Mirror (2013)
Photo: Sas Schilten

The species they worked with *Magnetospirillum gryphiswaldense*, which has specific requirements to flourish, such as a low level of oxygen. When the artists decided on the direction of the work, they also ran into the challenge of having to produce custom electric boards needed for approximately 250 individual magnetic coils. In the spirit of what has since become a quintessential, representative bioart project, this work eventually achieved a functional harmony with its wetware, software, and hardware in collaboration with a population of non-human species. The installation took the form of imagery explaining the function, installation of the electronics at Naturalis, the natural history museum in Leiden in the Netherlands, as well as the mirror itself, a collection of vessels within which are the controlled microorganisms creating the image-making effects, and the motion sensor. The work has been subsequently exhibited at the Royal Institute of Great Britain, Natlab in Eindhoven, The Factory for Art and Design in Copenhagen, MAXXI National Museum of XXI Century Arts in Rome, and ZKM in Karlsruhe.

Living Mirror (2013)
Photo: Sas Schilten

As an early example of making a mirror and representing a human form using microorganisms, this work fits well with other examples from artists such as Julia Lohmann, who created *Co-Existence* in London in 2010, and Sonja Bämel, who has created works such as *Expanded Self* in 2012. The mix of media and use of synthetic biology also recalls what may now be considered a classic work, the *Hello World* image created as the first genetically-engineered photographic biofilm, from 2005, now in the collection of the Center for PostNatural History in the United States.

Discover more about the artist and this project

VIEW THE VIDEO →

LILIAN VAN DAAL & ROOS MEERMAN

Dynamorphosis, the beauty of inner mechanisms, 2016

Series of 3D-printed kinetic objects

Developed in collaboration with Associate Prof. Renée van Amerongen, Swammerdam Institute for Life Sciences of the University of Amsterdam.

Lilian van Daal and Roos Meerman are designers driven by the possibilities that their practices can respond to and incorporate concepts that remain less-than-understood, be they in the fields of physics or biology. They both incorporate that drive into experiments with new technologies such as 3D printing, or emergent engineering techniques to achieve new forms and functions that might have seemed impossible just a short time ago. They are both entrepreneurial by nature, and have launched products or studios both before and after their successful work together on the Bio Art & Design Award. Van Daal pursued training at the Royal Academy of Art in the Hague and has since worked for Philips and Brundal and introduced several biomimetic designs, following guidance from the natural world, in her practice. Meerman attended the ArtEZ Hoogschool voor de Kunsten in Arnhem and has co-founded Kozie, a brand making products for people contending with dementia, and Filip Studios and Pi Lab, dedicated to design that creates impact through a sense of wonder, based in a knowledge of math and physics.

Together, Van Daal and Meerman made a successful bid for the Bio Art & Design Awards in 2016 with their project *Dynamorphosis, the Beauty of Inner Mechanisms*. The starting point for the work was an admiration for the complexity of human embryonic development. The designers sought to learn more about and mimic the form-generating

Dynamorphosis, the beauty of inner mechanisms (2016)
Photo: Hanneke Wetzer

Dynamorphosis, the beauty of inner mechanisms (2016)
Photo: Hanneke Wetzer

mechanisms of the body and apply what they could of this knowledge to the latest 4D printing techniques, that is, printing in three dimensions but in such a way that the design can evolve, move, degrade, or develop in some way over time, the fourth dimension. Their goal was to make prototypes of objects that could exhibit some of the same bodily qualities so difficult to engineer artificially, such as self-assembly, substance transfer, and maintaining complex equilibrium. They were assisted in this effort by the collaboration of Renée van Amerongen of the Swammerdam Institute for Life Sciences of the University of Amsterdam, a specialist in cancer research as well as a person with passion for art, writing, and theater.

Their work together yielded three designs, the first, titled *Elibricate* is a mimicry of lung tissue, the branching of alveoli in fractal forms, expressed by using 3D printed molds to make what is essentially a complex balloon that changes in response to air pressure variation. *Lactility* is their second object, which is about transporting substances via small tubes, in a way as similar as possible to how milk is transmitted through the human breast to a child. The third object, *Transorb*, is based on the intestine and its characteristic peristalsis, moving food through its passageway by involuntary constrictions. They imitated this via 3D printing different structures onto textiles and experimenting with ways they could be electrically stimulated to induce movement.

As stated in their goals, the work indeed illuminates some of the hidden beauty, intricacy, and still-mysterious effectiveness of the body, which is often taken for granted in organs like the breasts, intestines, and lungs. The project also helped propel the designers, who have both acknowledged this award as instructive to their understanding of where and how science and design can intersect in useful ways. Specifically, they cite the journey of “jointly creating a language enabling everyone involved to understand one another’s processes” as influential and inspiring in a professional sense. They have also made it characteristic of both their practices to include scientific partnerships as a key to the development of new designs. Such design work is aligned with and propels a recognizable trend in the applied arts, and especially in the Netherlands, where designers and artists such as Daan Roosegaarde, Eric Klarenbeek, and Teresa van Dongen are paving the way to a new standard, in which trans-disciplinary creation is a standard rather than an exception.

Discover more about the artist and this project

VIEW THE VIDEO →

MAURIZIO MONTALTI

System Synthetics, 2011

Mixed media installation

Developed in collaboration with Prof. Dr. Han Wösten and the Kluyver Centre for Genomics of Industrial Fermentation.

Symbiosis is the central theme of Maurizio Montaliti's design practice, and informs the processes with which he works. Be it the fusion of unusual materials, or of the human designer with a microbial agent, Montalti's core belief in mutualistic relationships fuels his approach to design and making. Through his transdisciplinary, and often collaborative research-based practice, Montalti takes on the grand contradiction of being a designer head on: how to continue to be a producer of things in a world already saturated with stuff. In response, he has shifted his role, from a creator of products to a researcher focused on new means of creation where natural organisms are his chief collaborators. This switch can be traced through Montalti's training; he studied engineering, which bestowed a knowledge and experience with industrial processes. From there he enrolled at the Design Academy Eindhoven, where his passion for microbiology emerged and he began exploring the possibilities of cyclical, biological systems as alternatives to our cradle-to-grave production standard. For his graduation piece, *Continuous Bodies* (2010), Montalti created a "mycelium shroud", a hand-made felt blanket inoculated with bacteria that would decompose the organic materials lying beneath it. By examining regenerative cycles of decomposition and inserting the human into this rhythm, the work is an invitation for the viewer to consider themselves more holistically as an element of our shared ecosystem.

Montalti's Bio Art & Design Award prize, for *System Synthetics*, continued in the spirit of his previous research, in this case aiming to produce biofuels through the degradation of inorganic materials. Positioned as a reaction to the current dominant approach to production and consumerist "disposable" culture, both of which rely on the continual exploitation of finite resources, *System Synthetics* creates a process of decay for otherwise harmful or toxic materials, such as plastic, so that they may safely re-integrate back into natural life cycles. Through a close and fruitful collaboration with Professor Han Wösten and his team at Utrecht University, the project encouraged a new form of (endo-)symbiosis, a mutually beneficial relationship between two different types of fungal organisms in which one lives inside the other, resulting in a bespoke biological choreography. By combining the behavior of these two fungi, one a wood-rotting filamentous fungus capable of degrading synthetic compounds, the other a yeast able to ferment the resulting biomass into bioethanol, the pair successfully created an energy source with properties that offer an alternative model to reliance on fossil fuels.

When manifest, the project takes the form of an installation composed of a custom, smooth glass apparatus. The transparent bioreactor is designed to reveal the process of fungal interaction. The two fungi, made visible with the addition of bioluminescence, can be seen engaged in a continual

System Synthetics (2015)
Photo: courtesy of artist

System Synthetics (2015)
Photo: courtesy of artist

transaction of fermentation and gaseous exchange. The results of experiments made as part of the project are presented in the form of film and model diagrams. By employing the visual language of science to communicate Montalti's design approach, the work can be read on multiple levels, one of which is as underlining the need for more rigorous transdisciplinary and cross-sectoral, multi-species collaboration. Or, that symbiosis is necessary and ought to be recognized all around us, as figures such as Lynn Margulis, "Science's Unruly Earth Mother"[1], demonstrated so effectively.

Winning the Bio Art & Design Award enabled Montalti to push forward in his exploration of biodesign. He established his practice *Officina Corpuscoli*, which has met with notable success, commissions, and collaborations with institutions around the world. For Montalti, the work that initially developed out of *Continuous Bodies*, that initial staged symbiosis, "could be in fact considered the solid ground base on which my entire studio practice developed along the years". The studio's work has been featured in museums, exhibitions and festivals; and in 2015 Montalti launched an industrial venture, MOGU, that works to standardize and scale-up mycelium production and the subsequent range of naturally grown products produced as an alternative to traditional synthetic materials, such as petroleum-based plastics.

By reverting materials back to the main compound ingredients from which they originate via a crafted biological context, *System Synthetic* proposes solutions for two of society's most wicked problems: disposal of short-life products made from toxic materials, and our ever more pressing need for renewable energy. In addition, the project also makes a striking critical gesture about the design field itself and the specific responsibility that designers hold as not just givers of form, but as initiators of complex systems.

[1] Mann, C (1991). "Lynn Margulis: Science's unruly Earth mother". Science. 252 (5004): 378–381. Bibcode:1991Sci...252..378M. doi:10.1126/science.252.5004.378. PMID 17740930.

Discover more about the artist and this project

VIEW THE VIDEO

CHAPTER 2

Food

Agriculture may well have been civilization's original sin. In fact, just at the time of the agricultural revolution, the end of an ice age brought about dramatic sea-level rise 10,000 years ago, likely flooding the very first places humans successfully planted seeds. If farming was the first biotechnology, fermentation is a good candidate for second, although it would take science thousands of years to understand or describe it well. Figures such as Louis Pasteur and Antonie van Leeuwenhoek laid the foundation for modern microbiology while also inadvertently sounding a call of invitation to artists. The new visual landscape of the microscopic would enter the popular imagination and our growing knowledge of how disease works, especially in the 19th century, set into motion dramatic changes in how we prepare and preserve foods.

Apart from the scientific and cultural progression, food is intertwined as well with politics, climate, and personal health. It is a platform of intimacy well integrated into many of our social customs, and, after all it is the substance that becomes part of our bodies. Bioartists and designers have created a wealth of projects that respond to or use food and the many systems linked to it, from cultivation to transportation to disposal. They have also worked to address the cultural dimension of cuisine, such as in the work of Susana Soares from 2011, *Insects Au Gratin*, which speculates that we may combine insect proteins and 3D printing technology to birth a new genre of food-making. The outputs would feature design touches that help many Westerners and others overcome an aversion to insect consumption.

With the Bioart and Design Awards, there have been four winning projects that link with food, the food chain, and its complex dimensions. The first, *Eat Less, Live More – and Pray for Beans* by the Center for Genomic Gastronomy has a focus on the likely futures we face with worsening climate change and resource degradation. In the approachable format of a cookbook, but with recipes from the year 2030; combined with video and performance, the work sounds an alarm about what kind of life we might expect if our practices do not change dramatically. It also anticipates the work of other artists and designers who have since speculated about the future of food, from Chloé Rutzerveld to the Next Nature Network.

The work of Julia Kaisinger and Katharina Unger, *Fungi Mutarium*, addresses the possibility of hyper-localized production of mushrooms at home, fueled by plastic waste. Theirs is a strong example of what has become a fertile area of experimentation: creating design prototypes for at-home cultivation of food as well as confronting the problematic presence of plastics in our food systems. In contrast, Jiwon Woo's *Mother's Hand Taste (Son-mat)*, is an exploration of microbial lineage detectable through families, members of which lived far away from one

another. It is a multi-layered project at the center of which is a South Korean tradition of making rice wine in a hands-on process, injecting traces of the individual microbiome into the fermentation.

The work of Pei-Ying Lin also links with food, as well as disease and public health, topics of increasing import in light of a global pandemic and the need to adapt and be resilient. In *Tame is to Tame*, the notion of friendly or co-beneficial virus exposure is presented as a possible future strategy for building immunity and co-existence with viruses peacefully. Such an approach, which would include making special recipes to stage viral exposure, conflicts with the traditional approach in Western medicine of eradication of foreign viruses or organisms. As the science around understanding the human virome advances, we may expect to see several more such art and design projects emerge that address it.

The projects in this section examine many of the aspects of foods we take for granted, including their origins and possible futures. As much as one might want to think of other subjects or areas of importance when understanding where we are or where we are headed as a species, it is hard to think of one that touches us all, every day, like food. It is a signal of values and a possible compass for our collective acts of consumption.

Navigate to the artist

JIWON WOO

Mother’s Hand Taste (손맛 Son-mat), 2017

Mixed media installation, including lab equipment, nine 1-channel videos, and an iPad

In collaboration with Prof. Han Wösten, Institute of Environmental Biology, Microbiology group, Utrecht University.

Jiwon Woo is a Korean-American designer, artist, and teacher who probes and expands on the limits of how we interact with biology on a daily basis, and how we think about it. Her practice is multi-faceted, as are her range of interests and experiences, from the study of education access disparities and unemployment, to the uses of new and old biotechnologies that might change the way we live. Woo deftly crosses cultural contexts, languages, and customs with sensitivity and keen observation, having spent significant time in centers of cultural production such as Seoul, Boston, Tokyo, and New York. It is perhaps with such adaptability that Woo is especially equipped to fuse components such as artistic elements, scientific research, and design thinking.

Woo first provoked attention with a project for the Biodesign Challenge in the United States by prototyping a mask that would safely house spiders, making practical use of the webs they weave as an air filter, in 2016. Following this well-regarded project, her interest in how to collaborate with biology in new and useful ways expanded as she grew a more nuanced artistic perspective that drew from her own identity and cultural experiences. In 2017, her approach served a successful bid for the Bio Art & Design Award with her project Mother’s Hand Taste (손맛 Son-mat), which she developed in concert with Han Wösten at the Institute of Environmental Biology, Microbiology Group, at Utrecht University.

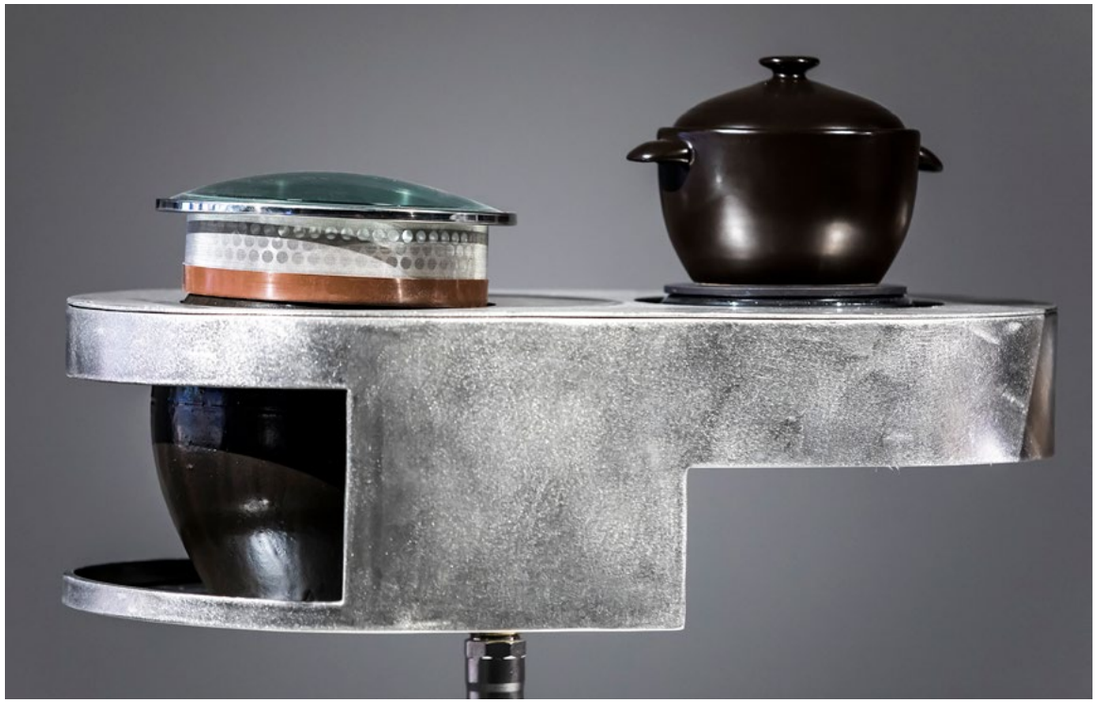
Mother’s Hand Taste (손맛 Son-mat)
Photo: courtesy of artist

To grasp the concept of *Mother's Hand Taste (손맛 Son-mat)* it is helpful to consider the French term "terroir". This word describes the ways in which factors like soil quality, elevation, moisture, sunlight, and a host of other factors influence the growth of crops and their subsequent qualities as foods such as wine, chocolate, tobacco, and tomatoes. It also refers to something subtler, a character, the unnamable qualities that accompany the *experience* of those foods. So, while borders are drawn to mark out official boundaries that make up the appellation d'origine contrôlée (AOC) system that define the origins of wine-making regions in France, there remains almost infinite possibility in the interpretations of quality. Such it is with the tiny traces of bacteria and fungi that are transferred from the hand to the dish in cooking or in preparing food matter for fermentation. One can try measuring and defining what is there, but what is experienced may be impossible to pinpoint.

As a research project, *Mother's Hand Taste (손맛 Son-mat)* began with sampling yeast found on twelve family members' hands across generations and locations, including Philadelphia, Utrecht, Seoul, and Tokyo and then describing and visualizing comparisons between them before and after the act of cooking. The artist also had the subjects prepare (Makgeolli) rice wine in the traditional way, by hand. Compelling similarities were found across generations in some cases, even if they were living thousands of kilometers apart, suggesting that we harbor and pass on microbial markers that can impart unique flavors to things we cook or prepare for fermentation.

At the heart of the project is a most basic and natural longing, in Woo's words "I imagined capturing my mother's 'son-mat', preserve it, and transmit it into my own hands whenever I missed the taste of her food." And so, the installation of the project for gallery presentation took the form of a prototype mechanism to sample, capture, and propagate any person's 'son-mat' along with vessels for cooking, washing, and fermentation. The kitchen-lab aesthetic of this presentation that uses glass and metal suggests cleanliness, control and precision contrasts with the project's deeper purpose, which is to prompt critical thinking about the significance of heritage and the passing down of the invisible. The poignancy of the project is enhanced by how it is performed by an artist who, like so many other people today must question what is gained and what is lost by having family spread across the globe.

The work found remarkable success following its presentation at MU Hybrid Art House in the Netherlands, going on to new iterations of the installation at the V&A Museum in London, in the UK, and Ars Electronica in Linz, Austria, as well as print publications, radio, and television presentations around the world. The collaboration underpinning



Mother's Hand Taste (손맛 Son-mat)
Photo: courtesy of artist

the research was characterized by mutual esteem and a willingness to take on areas of expertise outside or tangential to their previous experiences. Wösten's lab has been focused on fungi, but the dimensions of food making and the personal microbiome represented new ground; likewise, while Woo had some experience in the laboratory and with sampling and propagating samples, the level of control, professionalism and rigor was new.

Mother's Hand Taste (손맛 Son-mat) is a kind of work that relates to food culture as well as artistic tradition, in the elements of exploring cultural identity, heritage preservation, and foregrounding the self and the family in both the research and outcomes. Outside of what is considered bioart, this kind of approach can be seen in the history of such artists as Louise Bourgeois in her investigations of family and sexuality, or Yinka Shonibare in his exploration of cultural and national identity in the context of globalization and immigration. What Woo brings to this kind of tradition is a contemporary perspective, of inhabiting multiple identities in an age when to do so is facilitated by technologies not dreamt of just twenty years ago, and an access to scientific knowledge, tools, and technologies never before witnessed in history.

Discover more about the artist and this project

VIEW THE VIDEO →

JULIA KAISINGER & KATHARINA UNGER

Dynamorphosis, the beauty of inner mechanisms, 2016

Prototype incubator

Developed in collaboration with Prof. Han Wösten & Kasia Lukasiewiecz, Utrecht University, Department of Microbiology.

Julia Kaisinger and Katharina Unger are designers who share a passion for changing the designed components of food systems, and of re-thinking the assumptions embedded in the way they operate. The two studied simultaneously at the Universität für angewandte Kunst Wien (University of Applied Arts in Vienna). Upon completing their studies in 2013-14, they together founded the LIVIN Studio, in order to make concepts for alternative and radically efficient, at-home meal preparation, among other projects.

A signature example of their approach was *Farm 432*, an insect harvesting appliance that one brings into the home and can use to generate protein at a rate of 2.4 kilograms in just 432 hours (18 days), using one gram of black soldier fly eggs and a tiny amount of water and food waste. What makes this possible is the super-efficient metabolic processes of these insects and rapid life-cycle relative to a cow or pig. The fly larvae that are produced contain up to 24% protein, which is about equivalent to that of a beef steak, but without the many months (and subsequent resources) taken to raise it. The design of the process is such that the cycle of harvest can go on indefinitely, potentially freeing the user from some of their need for protein from other sources.

A similar approach informed the team's proposal for the Bio Art & Design Award, which they won in 2014 with their project *Fungi Mutarium*. For the project, the team worked with Han Woesten,

Fungi Mutarium (Growing Food From Toxic Waste), 2014
Photo: Paris Tsitsos

Fungi Mutarium (Growing Food From Toxic Waste), 2014
Photo: Paris Tsitsos

a fungi expert and professor at Utrecht University and research assistant Kasia Lukasiewiecz. Together they developed a novel fungi food product grown on plastic waste, as well as cutlery to consume it. Their starting point included their position that food production and waste stream management are in need of revolutions in order to address the climate crisis. Also, scientific research has shown that fungi can degrade toxic and persistent waste materials such as plastics, converting them into edible fungal biomass.

The team worked with the fungi named *Schizophyllum commune* and *Pleurotus ostreatus*; which are found throughout the world and can be seen on a wide range of timbers and many other plant-based substrates virtually anywhere in Europe, Asia, Africa, the Americas, and Australia. Next to the property of digesting toxic waste materials, they are also eaten in many cultures. As the fungi break down the plastic ingredients and don´t store them in their tissue, they are edible. In their design, which resembles a kitchen counter with smooth, domed shapes,

the fungi are cultivated in “FU” molds filled with agar – a nutrient medium that allows the fungi to flourish. The shapes of the molds encourage the fungi to grow a network of mycelium – the root systems of the fungi – and slowly digest plastic that has been added to the FU. Prior to being added to this system the waste plastic is placed in a UV light chamber, to sterilize it and activate the degradation process. The accompanying cutlery is shaped in elegant curves and smooth finishes, tailored to help with dismantling the hollowed-out shape of the FU.

The design includes a fungi nursery, which a user draws spores from by pipetting a liquid medium called macerate. Over the course of about two weeks the fungi grow well in the system, which is contained under a dome. However, many plastics require more time to break down, as long as a month or more. The designers iterated through many trials to find what combination of materials and species could make a safe match. The devilish complexity of waste streams and the behaviors of fungi make this a significant, but important challenge, one which also seeded a research project in Wösten’s lab to clean waste water from toxic pollutants such as herbicides and pharmaceuticals.

This project made an early attempt at food system reformation, and thinking about entire systems as works of design in need of change. LIVIN was an early-adopter of this technological approach, and of using mycelium and waste streams together for an at-home product that works to hyper-localize food production. In the years that followed the debut of these projects, the field of designed food alternatives has exploded. In the Netherlands it is especially strong, and shows promise in light of all the interest expressed through alternative food startup investment and programs such as the Food Non Food Department founded in 2015 at the Design Academy Eindhoven.

Discover more about the artist and this project

VIEW THE VIDEO →

INTERVIEW

Han Wösten

Professor of Microbiology at Utrecht University

Can you describe the master program you lead in in Bio Inspired Innovation at Utrecht University?

In the past we had master programs that trained biologists to become researchers or managers, and we did not have a program training students to design products or services. Bio-Inspired Innovation was the first master program training biology students to do this, to design products and services either inspired by or using nature. Nature has been evolving solutions in its 3.5 billion years of life's existence. Known examples of bioinspired products are the honeycomb structure that provides strength with minimum material; another example is the way termites cool their mounds in the desert, a strategy that can be used to cool buildings without the need for air conditioning based on non-renewable energy. Students in our master program designed a system to protect plants from freezing conditions based on a plant that naturally covers itself with its leaves when it starts freezing.

Did you have memorable experiences in youth or early at university that gave you a strong motivation to study fungi?

I had excellent grades for biology at secondary school, which led me to continue studying biology. But I came to realize that I was very bad, and still am, at recognizing plants, animals, and

mushrooms. That's why I chose Biotechnology as my specialization and ended up at Gist-Brocades (now DSM) studying penicillin production in the fungus Penicillium. As a result, I was offered a PhD position to study growth and development on the mushroom forming fungus Schizophyllum commune. It took me 12 years to find it in the wild; now I am trained and can find it every time, even on holidays around the world.

It seems your paper on Ustilago maydis in Nature (2006) is widely cited; is there maybe another paper you have done, whether published in journal or not, that you wish was more widely circulated?

In 2005 we published a paper showing that some branching fungal cells (hyphae) release enzymes, while others, actually neighboring hyphae, were not active in releasing enzymes. This was the first time that it was shown that fungal mycelia consist of different cell types and are thus very similar to human bodies with specialized organs like intestines and skin. The PhD student who did the work together with me noticed that nobody cited the paper and he was really disappointed about that. I tried to comfort him, and myself, by observing how it takes sometimes decades before a finding is recognized as a paradigm shift.

Is there a text, book, or film you would recommend that someone who is interested in the Bio Art & Design Awards should see before applying?

My friends always pushed me to read scientific literature but I did not like it much. And then one day my colleague Jos Wessels told me "Han, do not read the scientific literature too much; it kills your imagination". That still is my excuse only to read when I need it. Maybe I will recommend your book Bioart one day.

Can you talk a bit about how your experiences of collaboration were different in the prizes you have won, from Maurizio, Katherina and Julia, Jiwoon, and Dasha? Perhaps a sentence about each one.

Maurizio was the first designer I collaborated with. He is actually also an engineer, and as such, he helped me to understand how designers and artists think by using the language of science. Katherina and Julia helped me for the first time to think "big". To discuss "visible" challenges human societies are creating and facing such as toxic waste, and the impact of food production on the environment. Working with Jiwon helped me to think into more "daily" stories and to integrate "invisible" challenges such as migration and cultural heritage. Dasha pushed me again and again (in a very positive way) during the project to make it happen; she succeeded in exhibiting living artifacts instead of plastic imitations.

In the end, Maurizio, Katherina, Julia, Jiwon, and Dasha have more in common than are different. They all think in concepts and experiment by doing. They “cook” intuitively. In contrast, scientists build on the results of others and “cook” by improving existing recipes with new technologies. The experience working with them has led me to conclude that working together with designers generates synergism!

When you talk about your experiences of the Bio Art & Design Awards with your colleagues at the university, how do you answer the question: "does it bring value to your lab or your own research?"

Funny, nobody at the university asks me this question. I always get this question from artists, designers, or organizers from the Bio Art & Design Awards. I am afraid that working together with artists and designers does not make me more prestigious in the field of science.

Supposing my colleagues would ask me this question, I would answer: it helps me to think outside my own little bubble and to think big. As a result, I make more progress to make the impact I am aiming for. I am still collaborating with Maurizio. The Bio Art & Design Award was the start of a collaboration that ultimately resulted in a new research line in my lab, a start-up company in Italy co-owned by Maurizio, and many projects funded by NWO (Dutch Research Council) and the European Union. The project with Julia and Katharina also seeded a research project in my lab to clean waste water from toxic pollutants such as herbicides and pharmaceuticals. I approached a company to continue the work of Jiwon and I am also still collaborating with Dasha. And yes, these artists and designers also made tangible objects that I could use to illustrate the work I do with fungi in the lab. In sum, the work helps to make science tangible.

Can you mention a few reasons why a designer or artist should really pay attention to fungi as a potential medium to work in?

I would recommend designers and artists to create with nature not per se with fungi. Yet, fungi grow fast, tend to listen to us, and if not we can make them listen; and fungi have beauty despite the fact that many people associate them with spoilage, disease, and death.

Your current work on water purification research seems like it is addressing an issue of urgency. Do you think this is an area that is set to grow in terms of research interest? And are there other such areas you sense that will be the focus in the coming 10 years?

Indeed, the water purification project has high societal impact but also the other research lines we perform in the lab with fungi have high impact; think of replacing meat in the diet with

the help of fungi (i.e. mushrooms), reducing spoilage of food by controlling growth of fungi, producing enzymes that can replace polluting chemical processes, producing fungal materials that can replace plastics or other materials that are not sustainable, and producing pharmaceuticals with fungi. These many threads point to the potential of fungi to help to achieve a functioning, sustainable society.

In your own hobby of gardening mushrooms for food, do you sense there is an art or design to what you do?

Gardening mushrooms is a craftsmanship and I still have to learn a lot. But it demonstrates to me that nature is an artist. Monitoring the development of mushrooms is more rewarding than looking at a painting; it's a process in motion, including the first piercing of the small initial tissue of the mushroom through the bark of the logs I use for growing the mushrooms, then their eventual expansion and, finally, they become fully open and mature. Then, of course, there is the harvest and the dinner!

PEI-YING LIN

Tame is to Tame, 2016

Mixed media installation, including metal frames and wire sculptures, graphics, two virus shaped sculptures, two 1-channel videos, board game, and tea samples

Developed in collaboration with Miranda de Graaf, Viroscience Lab, Erasmus MC.

Pei-Ying Lin is an artist-designer who uses her practice to choreograph interactions between the visible and the invisible, in order to explore alternative relationships among humans and other living and semi-living entities. As a graduate of the Royal College of Art Design Interactions program in London, with a BSc in Life Science from the National Tsing Hua University in Taiwan, Lin is well equipped to examine and present narratives about the applications and implications of new scientific technologies. While there is sometimes humor in the execution of her work, Lin chooses to focus on issues with far-reaching impacts, such as sex, nutrition, and disease. Most recently, she has been exploring the biological essence of viruses in relation to our cultural, social, and psychological landscapes.

Lin's work in this area began with her proposal for the Bio Art & Design Awards, which she won in 2016. The resulting project *Tame is to Tame*, a collaboration with virology researcher Miranda de Graaf, aimed to examine the deeply intertwined relationship between humans and viruses. We coexist with viruses on a daily basis, in the form of our human virome, a collection of viruses that are found in, and on the human body. Some of these viruses can indeed cause harm, but others can keep us healthy by making our immune system strong. For Lin, some may even be used to enhance our daily lives: "Not to save the world, not to cure diseases, not to create, but to experience pleasure and expand

Tame is to Tame, 2016
Photo: courtesy of artist

the scope of our sensory experiences." All that is needed for this to happen, is a change in our perspective. Rather than view viruses as a threat or the enemy, *Tame is to Tame* treats viruses as if they were wild animals, creatures that humans have the potential to build controllable bonds with, to domesticate, to *tame*. The ultimate goal of such work is to re-frame how we think about viruses, and propose a more collaborative approach to human-viral coexistence that goes beyond the current narrative: to combat and eliminate.

For their research, Lin and de Graaf became the world's first "virus-tamers" and developed a fictional "virus-taming program", which imagines different human-to-virus and human-to-human interactions. Their program builds upon virology research being undertaken by de Graaf in the Viroscience Lab at Erasmus MC, Rotterdam, and takes the form of a conceptual dance between humans and viruses. In the piece, the tamer's body intertwines with that of an invisible partner, as they move together in a duet composed of a series of body isolations: a lunge, a lean, a body roll. These slow motion movements mimic the training exercises and physical movements of the tamer at work, but also the real life dance that humans and viruses have improvised over time as evolution takes its course.

The presentation of the work, which premiered at MU Hybrid Art House in Eindhoven, takes the form of a "Tamer's Headquarters", an empty stage set with various artifacts, such as the tamer's manifesto, training equipment, and video of the dance. Also included are a series of props, tools, and bodily extensions invented to assist the taming practice: elbow appendages to open doors, draws, and taps, and wrist hooks to assist with putting on a mask and other daily tasks. These props call to mind the image, now iconic, of the plague doctor from medieval Europe. This figure often wore a mask stuffed with strong-smelling substances such as dried herbs or flowers as protection against "miasma" or "bad air"; the doctor would also carry a wooden cane, used to examine patients without touching them. In contrast, Lin's taming apparatus suggests a more mutualistic interaction with viruses that goes beyond the contain and cure approach of mainstream, Western medicine.

Since winning the Bio Art & Design Award, Lin has continued to investigate, shed new light on, and challenge our perceptions of the viral world. For the project *Virophilia* (2018-ongoing) the artist created a cookbook of recipes for cooking with viruses. Written from the perspective of the year 2068, the cookbook retrospectively examines how humans started to develop virus-infused cuisines to produce life-enriching sensations, states of mind, and other experiences. The project investigates the potential to stage healthy human-virus encounters by enacting cultural events of meals, performances, and

Tame is to Tame, 2016
Photo: courtesy of artist

rituals. For these the artist selects a number of virus recipes that use viruses in different ways: as active ingredients, preparation methods, or to simulate symptoms of a sickness. Audience members are invited to eat while listening to stories about the viruses. As with her earlier work, the aim of *Virophilia* is to build new discourses around how we relate to disease and infection, asking whether we can be intimate and accepting of *some* viruses for mutual benefit.

The medical aesthetic and speculative storytelling that are characteristic of Lin's practice have proved eerily prophetic when considering humanity's current predicament with the Covid-19 pandemic. The power of viruses to direct human history and civilization in general has never been more apparent to more people around the globe, and all at once, than today. mRNA and other terms related to viruses occupy more space in individual and public consciousness than ever before, making Lin's work resonate more deeply. However, viruses have once again become our mortal enemies, a view enforced by plague metaphors and wartime rhetoric. The militarization of health in this way is a flawed and misleading approach, as not only does it overlook the complexity of individual cases, often leading to overzealous treatment, but it means that viruses remain identified with only negative connotations. Artists such as Lin make possible a more figurative and less polarizing language to emerge, that points toward the trend of a more holistic consideration of the body, the mind, and the microbiome and virome as an interdependent ensemble.

Discover more about the artist and this project

VIEW THE VIDEO →

THE CENTER FOR GENOMIC GASTRONOMY

Eat Less, Live More – and Pray for Beans, 2012

Cookbook, video installation, eating event

Developed in collaboration with Annette de Deugd and Netherlands Consortium for Healthy Ageing.

Zack Denfeld and Cat Kramer are artists and designers who work at the edge and intersection of our natural and human-made structures. Together, they founded The Center for Genomic Gastronomy (CGG) in 2010, an artist-led research initiative that seeks to understand and re-imagine global food systems. Stemming from an interest in food and a search for alternatives to molecular gastronomy, The Center takes a holistic approach to food by exploring the political, cultural, and technological contexts of what we consume. Their mediums include experimental dinners and eating events, speculative design prototypes, and publications such as unconventional cookbooks. The Center regularly collaborates with institutions including Science Gallery Dublin and Srishti Institute of Art, Design & Technology, and works closely with other artists, such as Emma Dorothy Conley.

The pair have quite different training, which has contributed to the depth and unique intuition of their practice. Denfeld studied public policy as an undergraduate at Syracuse University, but spent his time with video artists. He explains that this experience allowed him to see the connections between the topics of policy making, art, cultural production, and histories of technology, which in turn led him to go on to earn an MFA at the University of Michigan. Kramer holds a degree in design interactions from the Royal College of Art, London, and has a background in visual communications. Her explorations

Eat Less, Live More – and Pray for Beans, 2012
Photo: courtesy of artist

are designed to raise questions, rather than offer readymade solutions to complex issues. Such formative learning equipped them to navigate and translate between the seemingly disparate worlds of different expertise, from synthetic biology to farming to performance that are ultimately part of the same techno-cultural construction we call the food chain.

As an example, for their 2011 piece, *Smog Tasting* The Center materializes the slow-violence that is air pollution, through food preparation. To make a meringue the cook must whip air into egg whites, a process of veritable “air harvesting” that can be used to capture data on air quality. For the work, meringues were created out of egg whisked at several open-air locations in cities around the world, the resulting confectionery were measures for particulate matter. By solidifying air in this way, the work prompts a fresh consideration of the (usual) invisibility of things in the air we breathe. The quippy piece is at once humorous and alarming, two key ingredients of The Center’s work. By using polluted air to make meringue the work confronts viewers with the materiality of what we eat, and hints at all of the unknown pollutants that lurk on our plates.

In 2011 Denfeld and Kramer won the Bio Art & Design Award as The CGG for the proposal *Eat Less, Live More – and Pray for Beans*, a collaboration with Annette de Deugd, managing director of the Netherlands Consortium for Healthy Ageing. The project explores the state of current food systems in the Netherlands and how they might change to ensure long-term food security, and linked with the consortium's Growing Old Together study, in which human subjects are required to eat less and exercise more. The inspiration for the title of the project was a direct result of this collaboration, and investigations undertaken in the Netherlands into both local and global food histories and current food trends, with food scientists, nutritionists, chefs and families. In the Netherlands beans are associated with poverty, insignificance, and failure and there is a litany of Dutch expressions that underline this perception. But beans are also a biotechnology. A result of human bio-engineering by agriculturalists who continue to selectively bred bean plants for optimization.

The resulting project consisted of an illustrated experimental cookbook with imaginary recipes from the year 2030, a video installation, and a series of dinners about four future food scenarios: Community Meat Lab, Pray for Beans, BioConscriptions, MycoAlchemy. Together the elements prototype tools for how individuals, organizations and governments might initiate and react to changes in the food system. In the accompanying video for the scenario BioConscriptions the Minister of Culture and Agriculture is proud to announce the launch of the “BioConscriptions program,” which requires each citizen to preserve a specific fruit or vegetable cultivar. Set in a future Netherlands where the euro

Eat Less, Live More – and Pray for Beans, 2012
Photo: courtesy of artist

has collapsed, and economic growth has ceased. In this speculation, mandatory gardening is an everyday reality for Dutch citizens, seed saving is part of the general curriculum, and the need to take care of the world's natural resources and restore planetary health is now a desperate need. Delivered in the style of public service announcement, the work has an authoritarian tone that gives it an Orwellian feel. It serves as an uncanny warning that if we do not make the right choices now, we may be forced to make them in the future by the structures that govern society.

Denfeld and Kramer might use the future context for much of their work, but it is far from science-fiction. The ten-year anniversary of the Bio Art & Design Award marks the half-way point between when *Eat Less, Live More – and Pray for Beans* was created, and the year in which it is set: 2030 – a year looming as a boundary after which severe climate-related disasters are predicted to be continuous. Like much of their artistic practice, which often serves as a reminder of how poorly the human species is doing when it comes to prevention and mitigation, it serves up our current (food) systems, expectations, and perceptions with a healthy dollop of imagination.

Discover more about the artist and this project

VIEW THE VIDEO →

CHAPTER 3

Bodies

As bioart and biodesign develop, although they often involve non-human species, they frequently center on some part of the human body or identity. After all, humans are biology too and, for humans, it is the most familiar kind. Artists such as Stelarc have declared the body “obsolete” as a speculation or provocation as far back ago as 1995. The use of language here is striking, as it points to how we collectively adopt words from commercial technology and design to talk about ourselves and our bodies. In the 1990s the concept of obsolescence, as regards the fast-moving technologies of that era as personal computers became standard, was subsumed into our lexicon. It is no coincidence that we refer to things like our capacity to take on more cognitive tasks today using terms like “bandwidth”, which are taken from the vocabulary of digital technology that is now dominant in so many cultures. This was one of the departure points for the winning project of Ani Liu, No regrets for what you haven't been, Be the ghost you want to see in the machine.

Power and autonomy with regard to the body are also intertwined in a way that invites artists and designers to respond inventively, such as with protecting the privacy of one’s microbiome, a concept that would have been alien just twenty years ago, and was the subject of MSA: Microbiome Security Agency by Emma Conley. There are also works, such as Ergo Sum by Charlotte Jarvis, the first in a series of three, that offers a challenge to our notions of the self in an age when we can culture our tissue outside of the body. Such work also links to states of sickness and health; concepts in fluctuation as the definition of wellness evolves, as addressed by work such as that of Yiyun Chen in Horizontal Living. In addition, a critical perspective can be read in works about the body when they call into question the productivity obsession in much of the Western world, rooted in an internalization of capitalism. The body that is unwell works less, and how we regard this is telling.

Other works of art and design with or about the body respond to global issues such as climate change or the rise of artificial intelligence via speculation. Works such as Drones with Desires by Agi Haines, or Becoming a Sentinel Species by Sissel Marie Tonn offer ways to think about our possible futures and our own responsibilities to them. They also bring to light what may be thought of as a defining feature that sets the 21st century apart from others: the formation of intense interconnectivity across the globe. One of many questions that these works can help us ponder, and on which humans will have to decide, is whether we can genetically alter our bodies in an ethical way, with respect to our genetic commons, the collectively database of all natural genetic code, and future generations from which we cannot obtain consent.

The following section presents works about, for, and in response to the state of our bodies in our emergent, biotechnical age. In addition to the issues mentioned above, these works touch on a range of body-related concerns including sexuality, deception, and motherhood.

Navigate to the artist

AGI HAINES

Drones with Desires, 2015

Sound and video installation, and custom-built drone

Developed in collaboration with Marcel de Jeu & Jos van der Geest at the Department of Neuroscience - Erasmus MC.

Agi Haines' inspiration comes from the weird and wonderful systems and processes that exist within us. Working with the flesh and blood of the human body as her primary material, her speculative design practice exploits our morbid curiosity to produce works that simultaneously fascinate and repulse. From genetically-modified human babies to entirely bodiless brains, Haines explores the intersection of design with life at its most visceral level. Her practice has developed along a path that started at the Royal College of Art in London where she studied design interactions, and continues with her current PhD research at Transtechnology Research (funded by Plymouth University). There Haines is pursuing study that sits within CogNovo – an Innovative Doctoral Programme that investigates the relationship between cognition and creativity. Working with scientists in this way has allowed her to probe more deeply how design can be used as part of the rhetoric of biomedical and health care sciences.

For *Transfigurations* (2013) Haines custom-designed hybrid organs and physical enhancements for humans to overcome specific illness or (un)foreseen changes in environmental conditions. For the work she produced hyper-realistic sculptures of future human children that have been surgically altered in ways that span from desirable to necessary, believable to dreadful. Presented as a row of speculative transhuman babies, the installation at first appears

Drones with Desires, 2015
Photo: courtesy of artist

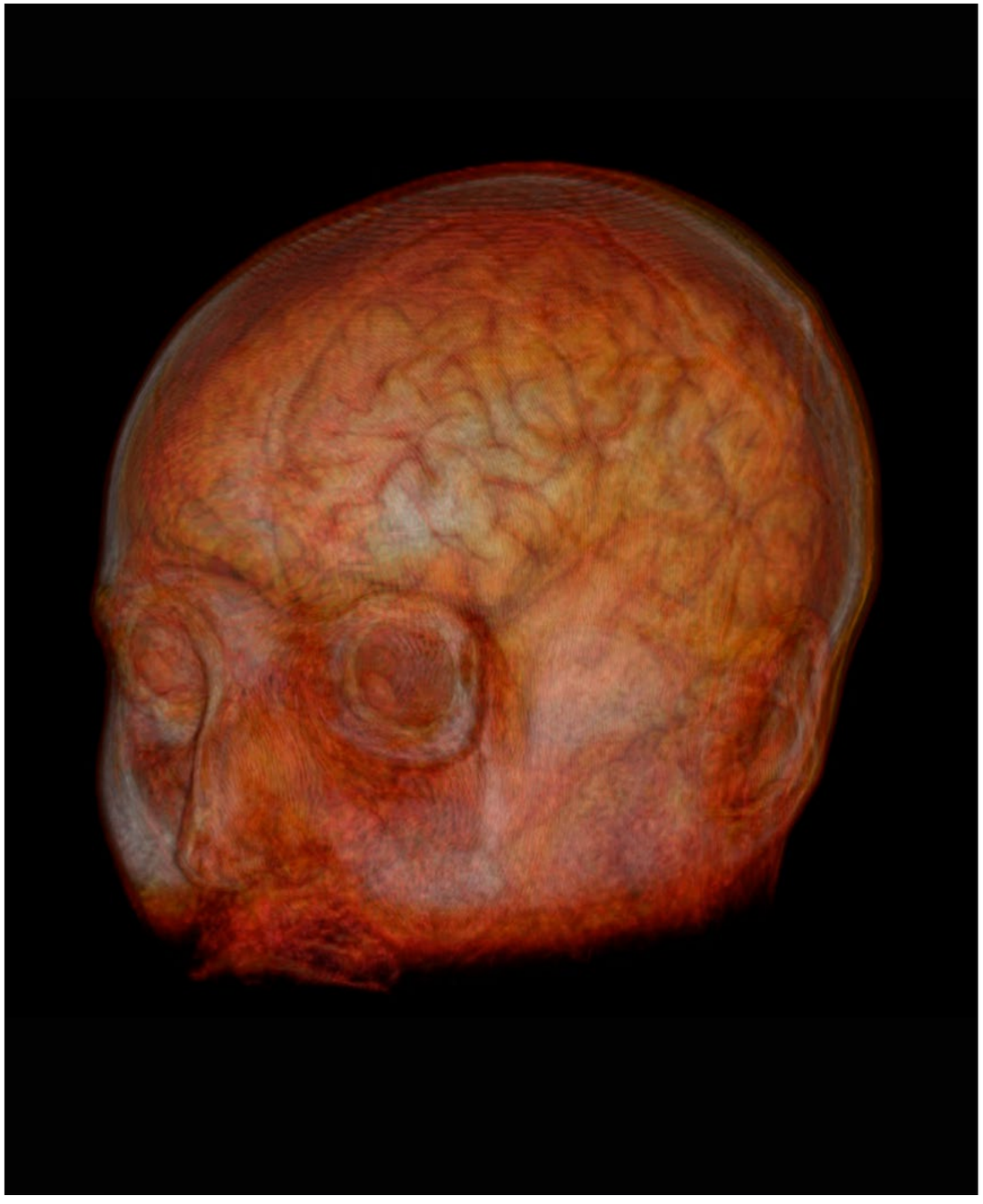
like a maternity ward, but on closer inspection grotesque and absurd features are revealed. One has a head with a high surface area to enable more efficient cooling in a heating world, while another has a more aerodynamic face for reasons that remain unsettlingly unclear. In the wake of technologies that have led to the use of the term “designer babies”, *Transfigurations* asks to what extent we have, should, and might have to go to survive and thrive in a not-so-distant future, and what are the physical, psychological, and social implications?

For her Bio Art & Design Award-winning piece, Haines continued to ask the uncomfortable questions about the malleability of the human form. This time her transgressions go one step further by extracting from the body entirely the organ that is arguably what makes us human, the brain.

For *Drones with Desires* Haines collaborated with neuroscientists Marcel de Jeu and Jos van der Geest from Erasmus University Medical Centre, and Jack Mckay Fletcher, Christos Melidis, and Vaibhav Tyagi from CogNovo to create an artificial neural network using MRI scans of her brain. Data from those scans were then programmed into a drone that would learn in a simple way as it moves around and scans the space around it. The basis of the work was the unique anatomical structure of the artist's brain, intended to grow and adapt over time, evolving into a new set of connections and becoming a more independent brain-drone. This process mirrors the plasticity of the brain which allows for fluidity and variety in the number, strength, and nature of the connections between its hundred billion neurons. By infusing a machine with an analogue of her brain, the work points to how technology might be used to change, or even replace the body, and how in doing so the body can be understood as an open system of design.

Conceived as a result of a multidisciplinary collaboration that pushed the neuroscientists to the edge of their comfort zone, *Drones with Desires* has generated new models of the brain that could potentially inform scientific testing tools. The project remains in progress, working as a platform for Haines to continue learning about modification of the brain, inspiring new works and providing deeper understanding of the processes lying behind the miracle of cognition. The artist credits the open and “intellectually generous” collaboration as having left “an imprint of the way I think, ultimately resulting in a change in how I tackle doing ‘designers-ly things’”.

Exhibited as part of the Body of Matter exhibition at MU Hybrid Art House, Eindhoven in 2015, for which the artist created an enormous floating brain-blob, a pneumatic sphere that appeared as a ball of nerve tissue with wings. Its presence in space can be unnerving to a visitor, appearing as some kind of neofuturist floating body moving of its own free will.



Drones with Desires, 2015
Photo: courtesy of artist

Comparable to the levitating homes and cities of Buckminster Fuller or Archigram in the 1960s, but divergent in that the technology this satellite houses is human intelligence, disembodied. The drone moves freely in a darkened space and visitors are able to walk around it and interact with the piece as it responds to their movements. The work is accompanied by a soundscape that represents the live changes in the neural network, and video showing how it was created.

Consistent with Haines' practice, *Drones with Desires* traces the thin line between natural and artifice to test the boundaries of our human-ness. By examining the role of artificial intelligence in relation to the human body it manifests dystopian fears that technology might take on a life of its own. This forces us to think about the type of a world we might find ourselves in if machines can replicate our decision making and follow their desires.

Discover more about the artist and this project

VIEW THE VIDEO →

ANI LIU

No regrets for what you haven’t been, Be the ghost you want to see in the machine, 2018

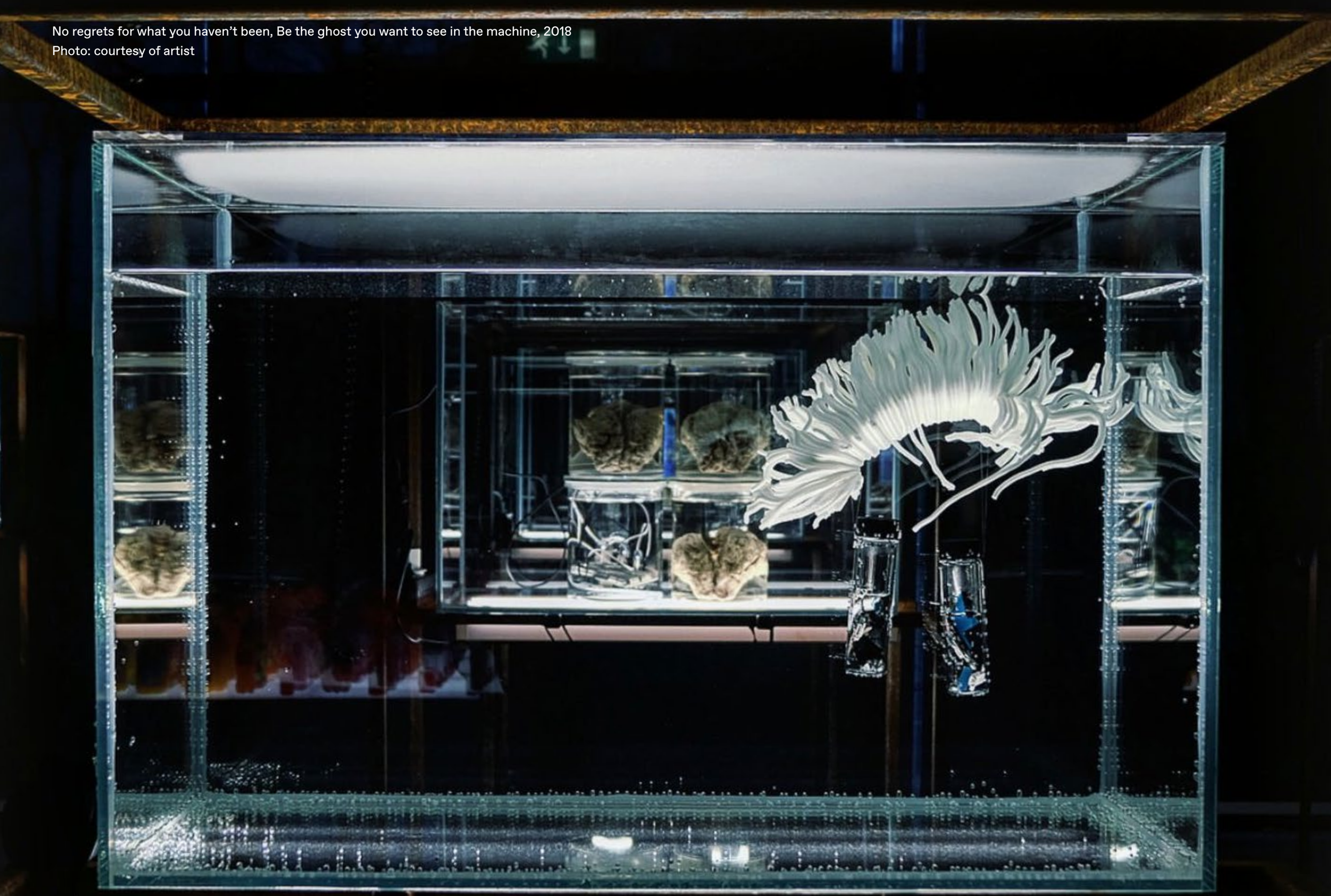
Mixed media installation, including selective laser sintering 3D printed nylon, glass vials, antennas from cellular phones, cow brains, custom electronics, silicone, water, oil, computers, low-leaded glass, fluorescent lights, and welded oxidized steel stand.

Developed in collaboration with Mario Maas, Matthias Cabri, and Onno Baur of the Musculoskeletal Imaging and Top Sport, Academical Medical Centre Amsterdam.

Ani Liu believes deeply that art and science go hand in hand when exploring different facets of our reality. Her research-based practice negotiates the reciprocal relationships between the two disciplines, and probes how they have a unique and combined influence on our human subjectivity, culture, and identity. Liu earned a Masters in Architecture from the Harvard Graduate school of Design, and a Masters from MIT Media Lab, and her multidisciplinary approach has been recognized with numerous awards, including the Princeton Arts Fellowship (2019-2021), the New York Foundation for the Arts (NYFA) Fellowship (2020), the Virginia Groot Foundation Fellowship (2020), the S&R Washington Prize (2018), the YouFab Global Creative Awards (1st place, 2018), and the Bio Art & Design Award (2017). During her time at MIT Liu was introduced to the idea of making with biology, a concept that blew the doors of possibility for her practice wide open.

For Liu, the experience of collaborating with radiologists Mario Maas, Matthias Cabri, and Onno Baur allowed her “access to insights and tools that I would have never dreamed of having access to previously as an artist. Working with them changed my understanding of my own body – oscillating between the lines of scientific knowledge and the evolution of social and cultural forces.” The final, Bio Art & Design Award winning work *No regrets for what you haven't been, Be the ghost you want to see in the machine*, 2018, examines the instability of being

No regrets for what you haven’t been, Be the ghost you want to see in the machine, 2018
Photo: courtesy of artist



human. That what identity means is a social construction, ever changing and recrafting itself with the development of new technologies.

Liu's project is rooted in the art historical tradition of the self-portrait as well as the continually developing scientific renderings of the body. From medical anatomical drawings of the early modern period to the latest developments in digital imaging, these techniques are reflections of the social and technological landscape from which they arise, as much as they are a way of understanding the inner workings of the human body. At its heart is the feedback loop of co-creation of self and technology: as we shape our technologies, they shape us too.

Manifesting as a series of nine sculptures, each of which examines elements of personhood: the anatomical, physiological, genetic, biochemical, but also behavioral, algorithmic, personal narratives, and memory. Every sculpture is in essence a self-portrait speaking about what it is that makes us human from these different points of view. The work is presented as an installation of nine scaffold-like sculptures, all exactly Liu's height and each containing a vitrine that is the volume of the artist's body. All nine contain active digital materials, biological artifacts, and neurological data that represent a specific organ, bodily part, or intellectual capability generally considered to distinguish us as a species. In some of the vitrines, screens are submerged in a non-conductive fluid, playing videos depicting EEG data recorded from Liu's brain while she learned about brains. The piece quantifies the human in multiple ways, while prompting us to question what it means for a person to be represented in this way.

The uniformity of shape and size, and the human scale of the work can generate in the viewer an uncanny feeling. An audience is confronted with an eerie not-so-future human in which the fleshy body is redundant and our essential humanness can be distilled and preserved as quantitative information. The idea of preservation is communicated through the vitrine, a 20th century tool of the natural sciences, used to preserve organic matter in the form of flesh, fluid, and bone. In this 21st century iteration, the body is replaced by data, creating a visual shorthand of what we might deem the preservable parts of our existence in the future.

By working with radiologists Liu was able to expand the scope of the project. As practitioners who transform data into images Maas, Cabri, and Baur enabled her to rethink how to make images of the body. Liu has continued to work with these ideas since winning the award, specifically in considering the body as material, as data, and how what a doctor can know about a person via medical tests differs from what Facebook or Google can know of them from their digital fingerprint. In the work *Real Virtual Feelings*, 2018, which emerged directly from her

No regrets for what you haven't been, Be the ghost you want to see in the machine, 2018
Photo: courtesy of artist

award winning project, a drop of dopamine is collected for each social media "like" it receives. When presented, a custom electronic displaying what appears to be a social media feed is hooked up to an intravenous drip, typically used to infuse medication directly into a person's veins. A reference to life supporting medical equipment, but also addiction. This striking confrontation between the virtual and the physiological, the emotional and quantifiable, communicates the central thesis of the piece: whether revealing the world beneath our skin, or as a tool to represent ourselves outwardly and beyond our bodies, technology is increasingly entangled with how we understand and perceive ourselves as human beings.

Liu's ongoing research acknowledges that despite continual advances in technology, we continue to query whether this magical material sense of self arises. If it can be reproduced artificially, and if so whether human cognition, in the Cartesian sense, really is unique. The sculptures that constitute *No regrets for what you haven't been, Be the ghost you want to see in the machine* are an attempt to render the activity of the brain as material and combine biological matter with technology to give form to an external consciousness. In doing so, the work could be seen as an enactment of 21st century Cartesianism, or "I tweet therefore I am", which ponders what can be known about a person based on a physiological examination of the body versus a digital one?

Discover more about the artist and this project

VIEW THE VIDEO →

CECILIA JONSSON

Haem, 2016

Mixed media installation
Custom made compass, murrini glass-bowl, text, sound, HD-video, water, electronics

Developed in collaboration with Dr. Rodrigo Leite de Oliveira of The Netherlands Cancer Institute. Commissioned by Bio Art & Design Awards 2016 with the support of ZonMw. In cooperation with OLVG West hospital and blacksmith Thijs Van der Manakker. HD–video by Signe Tørå Karsrud and Sergio Cuervo Gonzalez and sound composition by Marcello Sodano.

Cecilia Jonsson's work takes meeting points as its genesis. Be it the nexus of new and existing life inside the body of a pregnant woman, or the interwovenness of our human experience with the planet that is our home. The artist mines raw and unexpected materials, such as iron, water, and anthropological waste to give birth to new forms, and combines disciplines to conceive of unique perspectives for how we understand the world. Jonsson studied Fine Arts at the Bergen Academy of Art and Design and the Nordic Sound Art program, and her artistic work has been recognized by a number of transdisciplinary awards, including COAL Art and Environmental Prize (nominee 2018), Prix Ars Electronica, Hybrid Art (honorary mention 2017), Bio Art & Design Awards (2016) and VIDA 16.0 Art & Artificial Life International Awards (2nd prize 2014).

However, her work does more than bridge disciplines. In her words: "I wouldn't necessarily call it in the interest of the connection between art and science, but interest in how information translates and takes new forms in different disciplinary traditions."

In the work *The Iron Ring* (2013), the artist collaborated with farmers, blacksmiths, and scientists to develop an unconventional approach to the mining of metals. In her effort, Jonsson harvested twenty-four kilograms of *Imperata cylindrica*, a wild, highly invasive grass species from the banks of the polluted Rio Tinto river in southern Spain. The plant is an iron hyperaccumulator, meaning that it can absorb large

quantities of the metal out of the soil and store it in its leaves, stem, and root system. By combining seemingly disparate expertise, Jonsson was able to extract the iron ore from the plant and craft it into a ring. By transforming toxic waste from the Rio Tinto into a harmless wearable object *The Iron Ring* proposes an alternative form of extraction which actually cleanses the contaminated environment. The form of the ring also acts as a symbol of eternity, rhyming with the life-cycle of iron itself as a simultaneously polluting and life-supporting material; it is, after all, a primary component of human blood.

Iron has held Jonsson's fascination as one of life's most vital components to integrate into future work. For the Bio Art & Design Award she won in 2016 the artist worked with Rodrigo Leite de Oliveira of The Netherlands Cancer Institute to extricate it from the human blood found in perhaps life's most essential instruments: the placenta. A transitional organ that contains the blood vessels of both the mother and the baby, the placenta is the frontier where the two meet and begin to communicate as blood carries oxygen and other vital nutrients from mother to embryo. For the project *Haem*, Jonsson and Leite de Oliveira collected sixty-nine donated placentas, cut and dried them in a laboratory, before working with a blacksmith to burn and extract raw iron ore from them. The resulting material was then forged into an iron needle and magnetized to create a working compass.

Haem, 2016
Photo: courtesy of artist

Jonsson sees the compass as a symbol of the process that takes place within the complex network of blood vessels inside the placenta, what she terms the 'labyrinth'. This metaphor continues in the work's visual presentation, where the roughly hewn needle floats on water inside a glass bowl crafted with ruddy red-brown veins to evoke the fetal organ. Accompanying the installation is a sound composition and a selective archive about the process, shown as a register of the donated placentas weight and date of birth and a HD–video. Elevated on a rotating pedestal which viewers of the work can look down into, and spotlit in a darkened space, the experience of viewing Haem is an intimate one. Its presentation

communicates both the fluidity of the vital liquids interconnected within the placenta, and the idea that all of us are set adrift once entering the world. By transforming the maternal resource into a wayfinding instrument and returning it to the symbolic body/maze the work signals the notion of the moral compass and the idea of the labyrinth as something that we are born into and are compelled to fashion guiding tools to navigate, shaping not only who we are, but the world in which we live.

Transforming a total weight of 6.8 kilos of dried placenta into a metallic needle was a unique task, which relied on the intuition and experience of Thijs van der Manakker, veteran blacksmith. Even then, the precise chemistry and physics of what happened inside the furnace during the smelt remains largely unknown. Similarly, the piece would not have been possible were it not for the catalytic collaboration between Jonsson and Leite de Oliveira. As a cancer researcher, Leite de Oliveira brought his expertise in the growth of blood vessels to the project, but also his passion for the creation of knowledge through the melding of different disciplines. Since winning the Bio Art & Design Award the work has been exhibited at multiple venues in the Netherlands and Germany, and Jonsson and Leite de Oliveira have had the opportunity to continue working together. In 2018 the pair collaborated on the project *Haem - Unfolding Paths of the Placenta*, a video documentary about their award-winning work.

This content combines visuals of the laboratory process with testimonies that give voice and body to the life-supporting organs that were the genesis of both works. For Jonsson, winning the Bio Art & Design Award has enabled her to reframe her work and "reconnect with the hybrid nature of my practice - which is derived primarily from joining the dots between things personal and universal, theory and reality."

Haem is a powerful and literal demonstration of such fundamental connections: between earthly elements and human existence. By utilizing iron derived from the placenta the work is inextricably linked to the labor of the female body, and evokes the practice of Ana Mendieta (1948-1985), an artist known for dealing with blood, earth, and the female experience. Her *Siluetas* (1973-1980) is a series of performance works, sculpture, film, and drawing, that renders the shape of a woman's figure as part of the natural landscape. Mendieta would sometimes lie down on the ground and cover herself with organic material in an effort to reestablish the bonds that tie the human body to the universe, and as a tribute to nature as the sacred maternal source.

Considered together, the practices of these two artists work to debunk the nature/culture dichotomy through the female form, making apparent the entanglements of both in our global ecosystem. The earth is not simply a repository of raw materials

Haem, 2016
Photo: courtesy of artist

to be mined, extracted, and used at our disposal. It contains the very building blocks of our lives and is the womb from which we are all ultimately born. Jonsson's method of probing both the physical and the metaphorical properties of iron in work such as *Haem* and *The Iron Ring* communicates ecological thinking in a way that connects it to the physiological core of what it means to be human. By working with materials that form both the basis of human existence and the origins of the earth, her work emphasizes the essential connections between ourselves and the ecosystems that we inhabit. In sum, Jonsson succeeds in implicating us in environmental exploitation, and incites us to nurture the earth: the ultimate mother to us all.

Discover more about the artist and this project

VIEW THE VIDEO →

CHARLOTTE JARVIS

Ergo Sum, 2012

Stem cells grown from the artist's skin, blood, and urine, subsequently grown heart cells, brain cells and blood vessels, custom built incubator, video screens, and framed prints

In collaboration with Prof. Christine Mummery, Christian Freund & Assistant Prof. Harold Mikkers, Netherlands Proteomics Centre.

Charlotte Jarvis has developed an artistic practice that recognizes the body as a liminal space, a site for transformation, hybridization, and even magic. The artist frequently works with scientific researchers and other experts at the frontiers of several fields, from cancer research to reproductive medicine to synthetic biology. For her education Jarvis built a foundation of knowledge and experience first earning a bachelor's at Edinburgh College of Art in 2007, then a masters in design interactions at the Royal College of Art in 2011. An early work soon after that was *Blighted by Kenning* (2012), that inserted text from the Universal Declaration of Human Rights of the United Nations into a bacterial plasmid, the genetic material of the microorganism that is naturally arranged in a circle. By encoding such a "universal text" supposedly above cultures into a medium that adapts rapidly, the bacterial genome, a performative gesture is achieved. The work adds another layer by culturing this altered bacteria and spraying it onto apples grown in Den Haag, seat of the International Court of Justice, which were then exhibited and eaten. Such a combination of critique, aesthetics, and use of new technologies is a hallmark of Jarvis' work. For her winning proposal to the Bio Art & Design Award in 2013, she turned to her own body and the advances offered by medical science to expand the possibilities of portraiture.

The project *Ergo Sum* focuses on creating a second self, utilizing the breakthrough research tool in laboratories, which is to create induced pluripotent stem cells from adult tissue. This is a biotechnology developed by the lab of Shinya Yamanaka, an innovation that yielded a Nobel Prize in 2012, and is incredibly useful for research as it creates cells that can propagate indefinitely and become any other type of cell in the body. Jarvis saw this as an opportunity to create and culture cells from her own body, growing the precursors to organs and tissue, such as her own blood, heart, and brain cells.

The process was also performative, as it began with harvesting sample tissue from the artist in a historically rich setting, the precise location at which Rembrandt witnessed and then subsequently pain *Dr. Nicolaes Tulp* (1632), a surgical theater, now a multi-disciplinary space called the Waag Society, in Amsterdam. The results, which the artist likens to a synecdoche, were presented in exhibition using an incubator to keep the tissue alive, arranged and finished to have aesthetic qualities of both a medicine cabinet and an altar one might pray to at a Christian church. In particular, the artist is keen to connect the presentation to the idea of transubstantiation in Catholic tradition, the process, achieved through ritual, of transforming bread and wine into the body and blood of Christ.

This work, which has been widely exhibited,

Ergo Sum, 2012
Photo: courtesy of artist

became the first in a three-part series the artist conceived and is currently working to complete. The second project is *Et in Arcadia Ego* 2015, which involved extracting tissue from the artist, then treating it so that it becomes cancerous; the cells, potentially lethal to the artist, are then presented in gallery in the form of a medical waiting-room. Finally, *In Posse* is the third and ongoing project in the series, which is a long-term effort to create female sperm in the laboratory, combined with

Ergo Sum, 2012
Photo: courtesy of artist

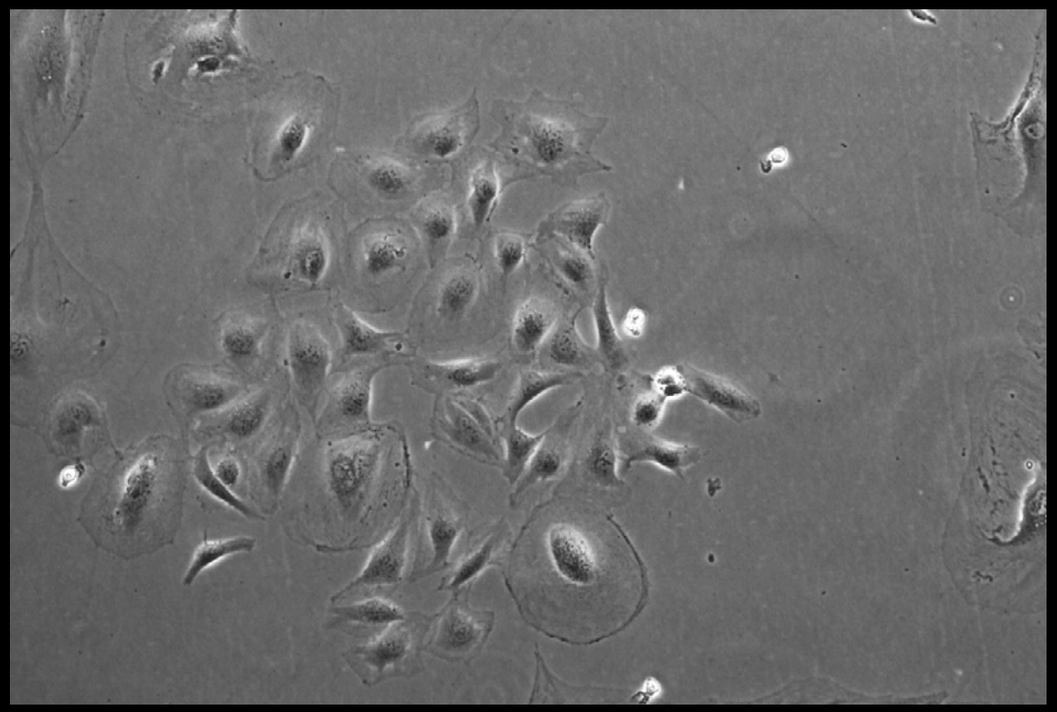
communal acts of having women and trans people make blood donations to formulate the semen, and to re-interpret the ancient Greek Thesmophoria, a fertility festival.

Jarvis' approach to collaboration, critique, and multi-meaning aesthetic language in her work all provide examples to learn from for emerging artists and designers. In her hands, new biotechnologies are platforms to generate new aesthetic experiences for art, as well as to spotlight critical perspectives long in need of development. She has pointed to the genetic modification of humans, probably inevitable, as an area of future interest, and has "returned, again and again" to the writing of Ursula K. Le Guin, which provides thought experiments that reveal our preconceptions and assumptions about which we can drift unaware.

Discover more about the artist and this project

VIEW THE VIDEO →

Charlotte Jarvis



Artist

Given your long interest in the body as a subject and medium, are there new developments in medical science that you think hold a lot of potential for artistic response?

I think we are reaching a watershed point in medical science where as a *global* society we need to make some tough decisions about genetically modifying humans. I think artists have a really critical role here in asking the ethical and cultural questions scientific advances prompt, in order for us to collectively make these decisions.

In 2018, He Jiankui, associate professor in the Department of Biology of the Southern University of Science and Technology in Shenzhen, announced that the world's first genetically modified babies had been born, twin girls (known as Lulu and Nana) who had been made resistant to HIV. This was unilaterally condemned by the scientific community, primarily because he had not received ethical approval to conduct his experiments and to bring these embryos to term.

As things stand, gene editing is still experimental and can be associated with off-target mutations capable of triggering potential side effects later in Lulu and Nana's lives. The children are not capable of consenting to this risk, nor is any genetically altered future baby, and this

poses a difficult ethical question. Babies do not consent to being born with all manner of avoidable conditions, HIV not least among them, and we do not stop people from having children in these circumstances. However, to many people it feels like a distinction can be made between the passing on of genetic conditions and diseases like HIV, and the associated risks – however small – of genetic engineering. Furthermore, I think there is a very real (and justified) fear of opening Pandora's box; of introducing genetic modifications to the human gene pool that cannot later be removed.

On the other hand, genetic engineering has the potential to prevent pain and suffering for thousands, if not millions, of people. I think the question is whether we can, with a clear conscience, turn away from the chance to eradicate things like certain breast cancers and haemophilia in the short term, and, hypothetically, things like childhood leukemia, suicidal depression, or multiple sclerosis in the future? I think it's crucial that artists and designers ask: *At what point does the greater good outweigh the risks? And if science could reduce those risks, at what point would they be small enough to warrant the advantages?*

Are there artists or designers who you would call inspirations? Relatedly, is there a single work that stands out to you as something to aspire to in your practice?

There are many amazing bioartists that inspire (and intimidate) me with their brilliance: Orlan, Maja Smrekar, Mary Magic, Špela Petrič, JJ Hastings, Marta De Menezes, Jalila Essaïdi, Daisy Ginsberg, Ionat Zurr, Agi Haines, Baum & Leahy are just a few!

I also find myself returning again and again to the books of Ursula K. Le Guin. I think of her stories as thought experiments that reveal our preconceptions and assumptions. Her books demonstrate the limitations of our conceptual framework, and give us a peek at something outside. I'm really interested in that – how we can access the other; the things that defy our definitions. It's an extraordinary and radical thing to do – to reveal the 'box' humanity has found itself in – to show its color, taste, and texture – and in so doing to challenge us to imagine something different.

Le Guin's books don't read like manifestos, they ask what seem like quite simple, innocent questions, but which really successfully undermine some of the most pervasive and damaging narratives of humanity – patriarchy, capitalism, etc. It's world-building as a form of activism.

It may be quiet and stealthy, but it is activism none-the less.

In *Technologies of Gender*, Teresa de Lauretis describes another perspective existing in the "social spaces carved in the interstices of institutions and in the chinks and cracks of the power-knowledge apparati." Lauretis talks about the need to find a "view from elsewhere" – a different context for dialogue which exists in between. This is what Le Guin's books do for me – they reveal the great hulking paradigms we carry around with us and – crucially – signal the spaces between, outside, and around them. My practice is all about trying to inhabit those spaces.

The Left Hand of Darkness is the obvious choice for Le Guin, but if you have not read it already I really recommend *Always Coming Home* – it's a genre-defying opus, which I often find myself referencing when teaching. It poses so many questions relevant to our current environmental crisis, whilst still – incredibly – being optimistic… a rare thing.

If you were granted a million euros and 5 years to work on any project, what would it be?

I would like to grow a collaborative placenta. I have just started working on this idea with the amazing Argentinian scientist and poet Patricia Saragüeta. We want to call into being a future of collective, cooperative reproduction by nurturing an embryo with placental cells grown from the menstrual blood of multiple women, trans, queer, and non-binary people. Furthermore, we are hoping to incorporate 'male' cells into this organ of 'radical care'. This would be completely new science, and if we are successful it will be a world-first, hopefully contributing to the field of reproductive technology and furthering our understanding of human fertility.

One million Euros would do nicely to start our project off.

Has becoming a mother recently shifted your perspective about your previous works?

Yes. My work over the past decade has been broadly about seeking some kind of scientific transubstantiation; attempting to shift the context within which we view scientific advancement to reveal existential questions, and to challenge pre-existing assumptions about human bodies. It came as a great surprise to me how effectively pregnancy, birth, and motherhood does these things already.

Pregnancy, labor, and motherhood are a palpable demonstration of the body's mutability. They require us to inhabit the positions of being both binary and singular at the same time; to possess new and different body parts, multiple hearts, extra ovaries, and a new brain. We are forced to accommodate and love a parasite so that the boundary between it and ourselves is completely opaque. During labor we are animal and god; existing somewhere between life and death. Our brains are subsequently hijacked by these new beings - bodies repurposed to serve another.

When we talk about mutating bodies, hybridized beings, additional body parts, alien DNA, and of blurring the physical and genetic boundaries between individuals in the context of new science and technology, it is seen as truly radical – and these are the areas I have sought out in my practice. Equally, if we developed methodologies for one individual to control the mental mechanisms of another, we would consider it profoundly dystopian – I would most certainly want to make work examining the existential implications of this kind of hypnosis.

It is funny to me, therefore, that these are things that millions of women, trans, and non-binary people experience every day. In the last couple of years, whilst myself and multiple collaborators have been working on *In Posse* and expending huge amounts of time, money and energy on creating a transgressive, activistic, queer form of reproduction, my body managed it on its own in just nine months.

EMMA DOROTHY CONLEY

MSA: Microbiome Security Agency, 2015

Interactive sculptural objects and documentation of research

In collaboration with Guus Roeselers, Microbiology & Systems Biology Group at TNO.

Emma Dorothy Conley is a North American designer and artist who creates experiences that lead to critical conversations and new insights. Her Portugal-based practice crosses a wide range of mediums, from exhibition curation to speculative design about the possible future, to experimental eating events. She has collaborated closely with institutions such as Science Gallery Dublin, as well as other artists, including the Center for Genomic Gastronomy. Conley's multi-faceted approach and considerable skills were developed, in part via master's study at the Pacific Northwest College of Art (PNCA), with a focus on collaborative design, in 2013. Her work in academics is ongoing as well, as she advances to a PhD in Design at the University of Aveiro. Topics that the artist explores and confronts includes the future, bodies, climate, and food systems, among others. A representative example is *New National Dish: UAE* (2020), in which four different future scenarios for the year 2030 were told via foods that reflect different severities of climate change effects as well as the culinary traditions of the United Arab Emirates.

In 2015, Conley won the Bio Art & Design Award for her project *MSA: Microbiome Security Agency*, which began with the speculation that in the future we will need to take measures to protect the information within the complex ecosystems of the microbiomes that live on and inside our bodies. Microbiomes are veritable jungles of organisms including bacteria,

MSA: Microbiome Security Agency, 2015
Photo: courtesy of artist

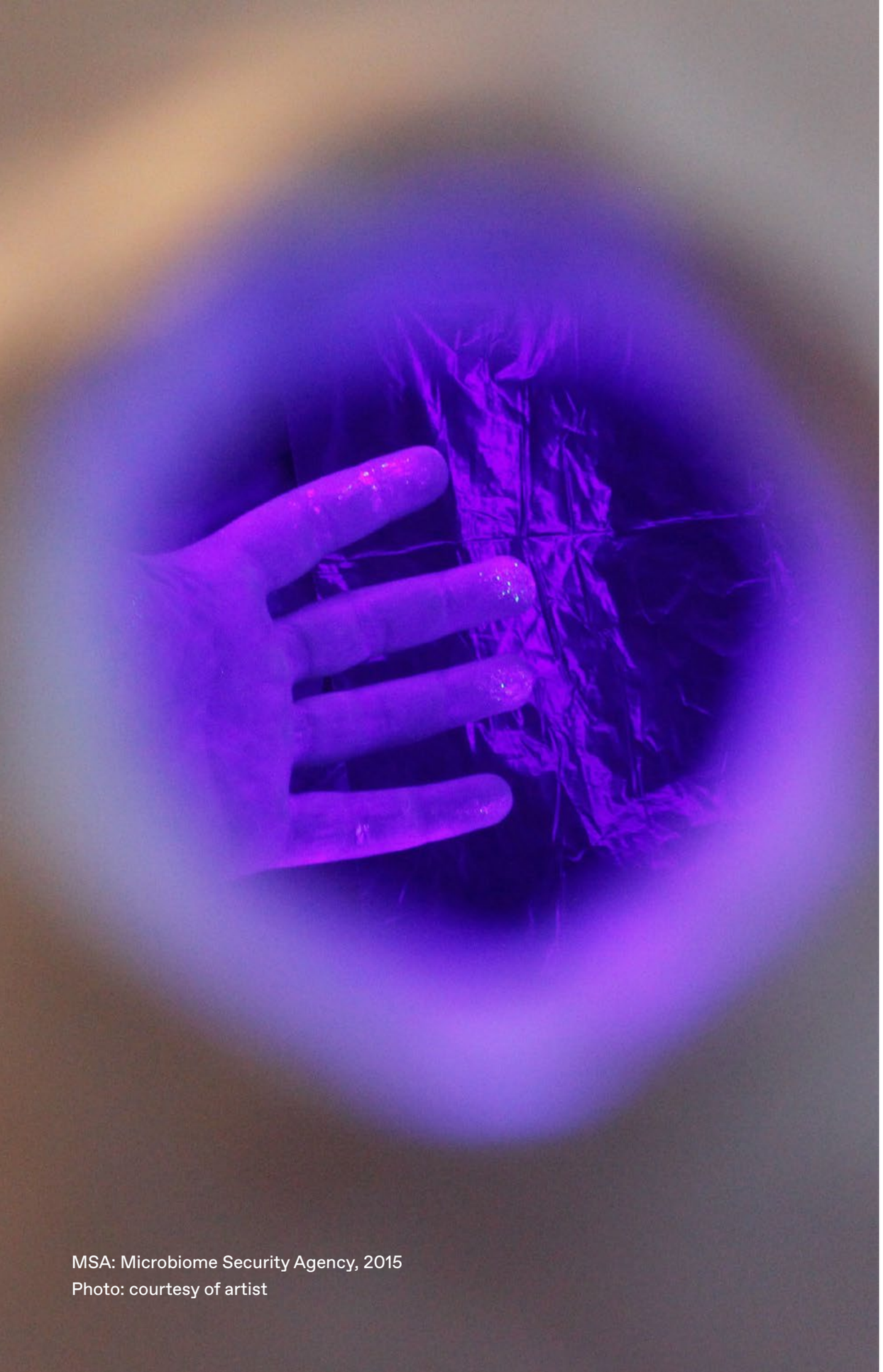
archaea, fungi, protists, and viruses, all containing genetic data. Such data are vast and our ability in the life sciences to read and draw connections between them is growing rapidly. It is conceivable that in a short while that a person's microbiome, perhaps even small samples from the skin, feces, or mouth, can tell detailed stories about past as well as likely future behaviors, from who you will meet or what you eat. This notion of prediction helps to explain the name of the artwork, a reference to the name of the government apparatus of surveillance in the United States the National Security Agency, or NSA, known to use advanced and often-secret methods of data collection in the digital realm, in order to track and predict the actions of citizens.

Work on the project included the study of microbiomes of zoo animals from their feces, which is particularly rich, as well as that of humans, the sequencing of DNA, and testing whether and how one can use everyday items to destroy or obscure the data they are all the time shedding from their microbiomes. Conley also created a *Community Bacteria Bank*, for individuals to donate items from which genetic material can be sampled, sequenced, and multiplied. This is intended to enrich the "bank" of data used to make what the artist calls *Obscuration Solutions*, or tools offered to help one conceal their microbiome data. This is akin to adding gibberish text as an addendum to a signature in email to make "background noise" and protect sensitive information.

Guus Roeselers supported and collaborated with Conley and although the lab restrictions around these processes at TNO (Netherlands Organization for Applied Scientific Research) did not allow for artist access; this helped the artist think of more simple DIY approaches and solutions using items in an average home. Despite this limitation, the artist and scientist reported meaningful interaction, especially in the area of imagining futures and the ethical implications of continuously-better tracking technologies.

The resulting installation at MU Hybrid Art House included a sample of the physical bank receptacle, a publication including documentation of the research, and *AOMs* (Automatic Obscuration Machines, a play on ATM machines), that allow you to donate an object coated with its own microbiome, as well as to place your hands inside them to receive a bit of powder. This substance helps protect the data contained within the microbiome on the hands, by obscuring it with confusing "noise" of dense genetic material inside of it, enough to make inconclusive any attempt to read one's skin microbiome.

The scope of the MSA project is ambitious and prescient, as the life sciences become ever-more data-driven, citizens are in need of such projects to become more alert and understanding of what is at stake. As the world has already witnessed how the digital revolution in technologies such as the internet and smartphones has included a loss of privacy and



MSA: Microbiome Security Agency, 2015
Photo: courtesy of artist

the rise of monopolistic power, it is possible the biotechnical revolution will also create unintended consequences. In this way, Conley's work relates to others in an important and emergent genre of art typified by the work of artists such as Adam Harvey who create, for example, works about how much one would have to disguise their face (absurdly so) to avoid face recognition. *MSA: Microbiome Security Agency* thus helps us to consider what may be necessary in a future characterized by bio-surveillance, and how invisible data are everywhere around and inside of us.

Discover more about the artist and this project

VIEW THE VIDEO →

SISSEL MARIE TONN

Becoming A Sentinel Species, 2020

Video installation and glass sculptures

In collaboration with Heather Leslie (Department of Environment and Health, VU Amsterdam) and Juan Garcia Vallejo (Department Molecular Cell Biology & Immunology, Amsterdam UMC - location VUmc).

Sissel Marie Tonn is an artist who takes the fuzzy boundary between humans and the environment as a source of inspiration. Her work questions where our perceived bodies end, and the environment begins, and is realized through a diverse range of mediums: from wearable, sculptural props that extend the possibilities of the body, to research into not-so-speculative technologies. Tonn earned her bachelor in Arts, Film and Media Studies from the University of Copenhagen in 2012, and completed her masters in Artistic Research in 2015 at the Royal Academy of Art in The Hague, where she is based. Since graduating she has received a number of accolades for her practice, including the Theordora Niemeijer prize for emerging female artists, a residency at the Jan van Eyck Academie, and the talent development grant from Stimuleringsfonds in the Netherlands. In 2020 Tonn was the recipient of the Bio Art & Design Award, together with scientists Heather Leslie and Juan J. Garcia Vellejo for their project *Becoming A Sentinel Species*.

Returning to film for this award-winning work, Tonn worked with Leslie and Garcia Vellejo to create a project that blends science with fiction to explore the concept of the sentinel species. This term is taken from environmental toxicology, and describes a species that acts as an indicator for how our environment is affected by pollutants. In Tonn's telling, these species are our contemporary "canaries in the coal mine" whose health and wellbeing can signal

Becoming A Sentinel Species, 2020
Photo: courtesy of artist

the state of the ecosystems that we are affecting. The concept is reintroduced and reframed in *Becoming A Sentinel Species* through human protagonists. The film opens with shots of mudflats stretching into the distance. Then, close-ups of a miasma-like oozing substance, punctuated by jarring noises. Footprints come into view in the following sequence, and two fictional researchers are introduced. They collect samples of earth polluted with microplastics which they will distill in a lab and infuse into their own bodies, triggering hallucinations of humans' watery origins in the primordial sea. Lab scenes are featured in the work, documenting real scientific experiments conducted as part of the project. Shots of macrophages, the "first responders" of the human immune system, extracted from the artist's blood, are shown engaging in a dramatic battle with microplastics. The story unfolds as an immersive audiovisual installation that invites the audience to connect with the fluidity of their own bodies, and the possibility that we too may become a sentinel species. The project suggests an expanded awareness of how we are intertwined with our world, and a greater realization of the need for multi species coexistence on Earth.

Becoming A Sentinel Species emerged from Tonn's research into immune systems and microplastics, aided by the scientific experience of Leslie, a leading expert in international microplastics research and Garcia Vellejo, Associate Professor and Principal Investigator at the Department of Molecular Cell Biology & Immunology at the VU in Amsterdam. Both of them conduct research concerned with how pollution such as plastic impacts human health, and what can be done to mitigate it. Leslie and Garcia Vellejo are no strangers to working with other disciplines; Tonn describes both as "special unicorn scientists" that already have "artists mindsets" which enabled them to push the project further, speculating along with the artist and enriching it with existing scientific knowledge and it's not-so-distant possibilities. The trio continue to work together on the ongoing project, the film for which has been exhibited at MU Hybrid Art House as well as Kunsthuis SYB in the Netherlands.

The themes of permeability and reciprocity are traceable throughout Tonn's practice, which simultaneously bridges and questions the perceived divide between our human experience and the natural environment. Her works offer a space where the human body and the environment are pushed to their limit and find themselves entangled. In this place boundaries melt, awareness shifts, and we can connect, identify with, and admit that we also are subsumed in and by the toxic environments we have created. A related work is *Sensory Cartographies*, Tonn's ongoing collaboration project with artist-composer-researcher Jonathan Reus that combines the many tools of her practice. It is a critical examination of the interface between the sensing

Becoming A Sentinel Species, 2020
Photo: Hanneke Wetzer

mind-body and the world, in which the pair create methodologies, exercises, and technical instruments that together function as a toolkit to renegotiate our techniques of cartography as a means of understanding and relating to the natural world. The project is documented in an online archive and accompanying research document available on the *Sensory Cartographies* website.

In both works the human body acts as a filter, a function that takes on a concerning significance in *Becoming A Sentinel Species*. The work signals a warning: we are not impermeable beings, but organisms that exist deeply interconnected with our environment, whether or not we admit it. We live in a plasticized environment and the extent of the impacts of microplastics on humans are yet to be fully understood. As a species that experiences the world through our senses we are no more exempt from the effects of changes to our ecosystem than the sentinels whose plastic filled organs we investigate.

Discover more about the artist and this project

VIEW THE VIDEO →

YIYUN CHEN

Horizontal Living - Long Live the Bedridden, 2018

Mixed media installation, including modified wooden bed frame, bed, metal shelves, and electronic motor

Developed in collaboration with Patrick Schrauwen & Vera Schrauwen-Hinderling, Diabetes and Metabolism Research Group - NUTRIM school for Nutrition and Translational Research in Metabolism, Maastricht University.

Yiyun Chen's work is an examination of human health and wellbeing in relation to the environments in which we live. Using the language of speculative and critical design she creates realms where technology and the body connect in order to reframe our thinking about the illness-wellness dichotomy. After obtaining a bachelors in Digital Media Design at Tongji University in Shanghai, Chen went on to complete a Masters in Design Interactions at the Royal College of Art, London. In addition to her design education, Chen holds a diploma in traditional Chinese medicine from the Shanghai University of TCM and has worked as a visiting researcher at SymbioticA at the University of Western Australia and at the department of Nutrition and Movement Sciences at Maastricht University. Her combined interest and knowledge in design and medicine has generated performative artworks that distill both disciplines and offer unique health solutions.
Works such as *Sick Better*, 2016, a speculative design project that presents a fictional home for the elderly, aim to transform the frustrations of illness into something that can be positive, even productive. Electricity is generated from trembling hands, a strong cough becomes a tool for musical production, a sport, or a game. Realized in the form of a series of illustrations, *Sick Better* paints a picture of aging and illness that has positive associations. The patient is depicted in a state that is no longer debilitating but enabling.

Horizontal Living - Long Live the Bedridden, 2018
Photo: courtesy of artist

Physical restraint and limitation and its effects on mental wellbeing are central themes of Chen's Bio Art & Design award winning piece *Horizontal Living - Long Live the Bedridden*, 2018, a collaboration with Patrick Schrauwen and Vera Schrauwen-Hinderling at Maastricht University. *Horizontal Living* is a living environment that prioritizes horizontality. The piece hacks a living space for upright living, and proposes a redesign that explores the lifestyle, perspective and health consequences of living in bed. For the piece, Chen designed a fully functioning living studio on the premises of Maastricht University, which she then lived and worked in alone for one month. During her performative research stay the artist mimicked the lifestyle of the bedridden whilst investigating the effects of horizontal living in a restricted space on the mind and the body.

For Schrauwen, who is Professor of metabolic aspects of Type 2 Diabetes Mellitus at the NUTRIM school for Nutrition and Translational Research in Metabolism, the project's focus on physical inactivity and its impact on human health resonated with the research being undertaken at the university. Together with Schrauwen-Hinderling, the pair monitored Chen's health, and provided her with a diet and exercise plan for her time in isolation and physical limitation. The artist used her time to reach out to others living in this way, inviting them to shoot a video about their time lying down and in their house. For Chen it was important that she was not the project's only subject, but that the work also connected with and amplified the real lived experiences of the unseen and the unheard, the isolated and the disconnected. A sensitivity the artist may have developed as a result of her own, previous, debilitating injury. She broke her spine the year before conceiving of *Horizontal Living*, with the result that she was bed-bound for six months whilst healing.

Horizontal Living can be seen as a work of performance in which the artist tested her physical and psychological limits. The work calls to mind the tradition of performance art that examines the depths of the human psyche through physical endurance and limitation. Specifically, the work of pioneering performance artist Marina Abramović, whose controversial experiments have often involved dangerous and intense physical ordeals. For *The House With the Ocean View*, 2002, Abramović installed herself inside the Sean Kelly Gallery in New York, and spent 12 days living on view to the public, surviving on nothing more than water. The artist's living space was composed of three simple units, or open rooms for sitting, bathing, and lying down, connected via small openings and raised above the gallery. A ladder to each made of sharp knife blades ensured her confinement. As with much of Abramović's work, *The House With the Ocean View* invites the audience to come in and lose themselves in the artist's presence. In contrast, when presented in a gallery space *Horizontal Living* allows the visitor

Horizontal Living - Long Live the Bedridden, 2018
Photo: courtesy of artist

to step inside and occupy the space left absent by the artist. For the duration of the exhibition *ReShape: Mutating Systems, Bodies and Perspectives* at MU Hybrid Art House, Eindhoven, 2018-19 a recreation of the bedroom was open for visitors to book for one to three hours to experience such life without standing upright. This experience was to prompt participants to reflect on the experiences of all those who live horizontally, whether chosen or not.

Central to *Horizontal Living* is the paradox of the bed. It is simultaneously a place associated with inactivity and rest, but for the infirm and the elderly the bed comprises the center of their universe. For the bedridden it is a symbol of their limitations and physical dependence that comes with a host of health implications, such as decreased blood circulation, loss of muscle mass, and social isolation. For Chen the bed is the ultimate paradox of health: "a site of both recovery and deterioration." Increasingly however, many able bodied and healthy people are choosing to conduct their lives from the bedroom. Today it is possible not only to rest and unwind, but to work, socialize, exercise, eat, and even maintain sexual relationships with people thousands of miles away, all without leaving this singular location. *Horizontal Living* challenges our vertical way of living, but also questions our increasingly indoor lifestyles and the internet induced "24 hour culture" that many of us live in. Technology has made it possible for us to liberate our lives from the clock, but to what effect? How is this way of life contributing to burnout, loneliness, and social isolation? These questions have taken on a new significance since the global lockdowns enforced in many countries as a result of the Covid-19 pandemic, and the silent pandemic of mental illness accompanying it. For Chen "the speculation of the body in the project became a prediction, a rehearsal, a reality" with the onset of such a global health crisis.

Discover more about the artist and this project

VIEW THE VIDEO →

CHAPTER 4

Motion

Our physical interaction with, and sensory understanding of the world are experiences that form the basis of bioart and design; which often involve the translation of one mode of knowledge into another, across forms, or through different perspectives. The pioneering artist Suzanne Anker's project *Zoosemiotics* (1993-5), demonstrated the transmutable quality of the nascent bioart movement. A work that presents shapes of animal chromosomes far from their context, cast and mounted as a sculptural alphabet of forms. Artists such as Špela Petrič have chosen to abandon the human gaze entirely and opt instead for non-human motion and its aesthetics, in order to draw attention to and challenge our anthropocentric view on reality. The piece, *Naval Gazing* is an example of what it might be like to experience the sea from the position of a marine dwelling organism, affixed to the hull of a giant, sculptural structure roaming freely in the North Sea. At the other end of the spectrum, designer Tiddo Bakker uses the domestic houseplant as his medium for the work *In Vena Verbum*, which translates chemical variances in the plant into motion to indicate our influence on the planet.

Bioart and design also finds itself in motion in the form of fluidity and transgression; as a gesture towards our developing social awareness, or scientific understanding. Jonathan Ho's study of hermaphrodite species and how common they are in *Sex Shells*, for example, is one that challenges the artificially constructed boundaries around gender and sexuality by Waltzing across binaries and rigid hetero-normal conventions. Works such as Ho's are a rendition of our social fabric in fluctuation; as expressed through the movement of the human body, or that or another organism. Other works in this section dislocate the dichotomy that is all too often set up between nature and industrialized society; to reveal the delicate choreography that exists between them. Such projects illuminate a path towards, and take steps in the direction of more conscious human and non-human interactions.

In many ways, art and design exists to translate the ineffable into the palpable: intention into form or function. Yet, both also assist to translate one form of understanding into another, across disciplines or aesthetic experiences. One might think of Piet Mondrian, whose *Broadway Boogie Woogie* (1942) renders a musical composition in paint, signaling a shift from his earlier style of strict and formal modernism to a type of rhythmic abstraction. This transition breaks from the clear demarcation of zones that were characteristic of the modernism movement and society in general; which divided the world up into neatly defined categories, such as nature and culture. By riffing on Jazz, Mondrian was beginning to open up such boundaries and make them more porous. This the direction in which art was going at the time, which it could be argued society is still trying to catch up with.

In a similar fashion Matthijs Munnik's work *Microscopic Opera*, transforms the movements of nematodes, a workhorse of scientific research like E.coli, into sound via the same image analyzing algorithm used by researchers at The Netherlands Consortium for Systems Biology: the projects scientific partner. Such transmutations point to a larger trend in the sciences: of being able to collect, process, and draw meaningful inferences from scores of data; as a result of new sensory tools and more powerful computers and algorithms. This may lead us to reflect on the dominance of data, how scientists rely increasingly on abstracted information presented on a screen, and the cost of less time in the field or the lab bench.

The learning processes of science, just like art and design, require motion and physical presence, both attenuated by the rise of data science or data processing as a necessary element in every discipline. This importance on movement and interaction is the departure point for some of the works in this section. In addition, the contents here question or critique our tools of sensing and predicting, or propose a reconnection with the lyricism of nature, and between our sensory and technological perceptions.

Navigate to the artist

JONATHAN HO

Sex Shells:
Gender fluidity in the modern age, 2019

Mixed media installation, including aquarium of snails, digitally printed photographs on polyamide fiber carpet, and two channel video

In collaboration with Associate Prof. Joris Koene, Department of Animal Ecology, VU Amsterdam

Jonathan Ho is a creative who challenges society's role in constructing gender and sexual stereotypes. He is very much aware of the oppressive power dynamics generated by the concept of the binary, which he uses, with grace and playfulness, to undermine heteronormative conventions. After earning a degree in Industrial Design from the Royal Melbourne Institute of Technology, Ho moved on to complete the Contextual Design masters at the Design Academy, Eindhoven. There he merged his technical making skills with conceptual design thinking, transforming himself into a multidisciplinary designer. By combining elements from East and West in his practice, he creates an aesthetic that underlines the idea of exchange via commerce, while emphasizing sex as a commodity of connectedness. This is expressed through works that revolve around sex positive cultures and erotic fetishisms, usually presented through mediums depending on the context of each project: gym equipment made to host sexual activities instead of sport exercises, a perforated room divider where the holes can be activated to answer fantasies and desires, or an interior of a dark room inspired by the visual language of churches. Every work he produces becomes a calling for a more liberated modern lifestyle through his design studio CHINTZD.

In 2018, Ho applied for the Bio Art & Design Awards, eventually winning with a project titled *Sex Shells* in which he explored the hermaphroditic

Sex Shells: Gender fluidity in the modern age, 2019
Photo: courtesy of artist

nature and mating behavior of snails, juxtaposing them with the conventional binary norms observed by many humans. Ho's research unveiled a new, relatable potential for us to recognize and reconsider our rigid notions of sexuality by laying bare, for everyone to see, the sex life of snails. He was able to tackle this topic using scientific methodologies and language due to the matchmaking component of the Awards. There he met the scientist and researcher Joris Koene, whose work at the Vrije University in Amsterdam specializes in hermaphroditic creatures. Snails exist successfully as hermaphroditic, gender fluid creatures wherein they are able to choose their sexual orientation based on each individual encounter. The mating process takes quite a while, wherein the freshwater creatures otherwise known as *Lymnaea stagnalis* come together and decide on the spot which from the two will play the role of the male, and the other the female. These same snails can then change their role during a different sexual encounter.

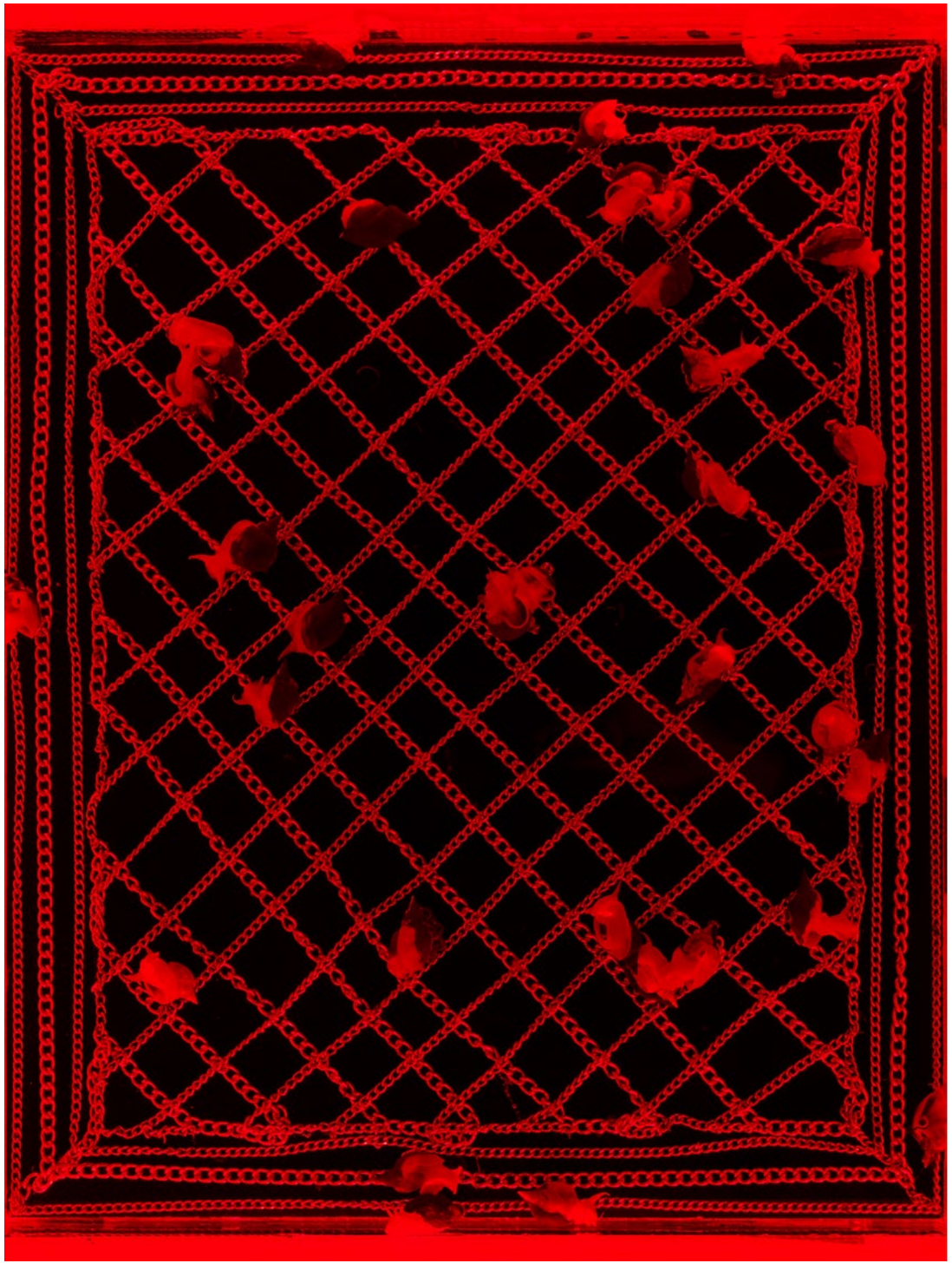
For the project Ho dressed the snails up in a way that presents the superfluous gender expressions that we humans sometimes show using specific clothing items and fashion styles. Through a series of six scenarios that depict different sex parties he placed each theme in small aquariums to create a space of "horny energy" where the snails have more chances to find a mate. In other words, he created nightclubs for them. One of these experiments was to try and replicate a traditional fetish-themed party by gluing chains and metal accessories onto the shells of the snails. Another one was an attempt to create a swinger's party, where they isolated the snails as pairs, and color-coded their shells to identify them as a couple. Subsequently, after several weeks of isolation, the snail couples were unleashed and observed for how promiscuous they turned out to be, based on how many additional partners they mated with. The project went beyond simply adding an aesthetic layer to snails however, but actually modified their sex as well. This part was done in the labs of the Vrije University, with the help of Koene, and consisted of changing the genitalia of a group of snails to make them all female. The snails were then placed in a "butch dyke" theme party scenario and observed. This specific part of the scientific research yielded no mating, rather it was found that the snails would cuddle for hours.

Sex Shells invites us to reflect on socially determined understandings of human gender identity, and points towards the fluid possibilities of sexual roles. Humans are not born with the same fluid capacities as the snails, however we can recognize that in-vitro fertilization, hormone therapy, and sex re-assignment are common and even same-sex reproduction is almost within reach. In a practical sense, we can be almost as fluid as the snails, and should thus reconsider our own behavior towards

Sex Shells: Gender fluidity in the modern age, 2019
Photo: courtesy of artist

sexual connections. The work emphasized ideas of gender fluidity through a parallel component of dance choreography, where human dancers mimicked the mating actions of the snails. For the gallery presentation, photographs of the different snail scenarios were printed on carpets for humans to walk on, and films documenting the animal interactions were juxtaposed with the dances inspired by them. In an installation that evokes *Green Porno* (2008), a series of short satirical films on the sexual behavior of wildlife by Isabella Rossellini, the two elements, carpet and film, combine to create a giant aquarium full of dressed up hermaphrodites.

The smooth collaboration between the scientist and designer as they developed their award-winning project has led to a longer-term working relationship. The two are still in conversation and in agreement that the scientific research they both conducted and the progressive ideas behind it, should take a more commercial role to reach more people. In his current work, as creative director of a major perfume maker, Ho is putting these ideas to the test. As he explains: “Selling perfume is selling the idea of sex”. In the same way that *Sex Shells* translates in a comprehensible way the abstract idea of snail sexuality to the general public, he uses commerce to present to a wider population ideas related to modern day sexuality, pushing us to think beyond binaristic norms and selling a future that is gender nonconforming and sex positive.



Sex Shells: Gender fluidity in the modern age, 2019
Photo: courtesy of artist

Although *Sex Shells* can be categorized as a work of biodesign, on closer inspection, subsumed under the queer politics, there is detectable a critical reflection on the whole biodesign and bioart movements. In a certain light, the success of bioart can be seen as playing on the idea of fetishizing nature without respecting it as a partner or equal in the exchange. Thus, while the art may urge us to imagine ourselves with nature in some new harmony, using biology for art confronts us with the tension between the need to preserve nature and the act of exploiting it without consent. After all, if we remove snails from their usual habitat and relocate them in a gallery, to experiment on them directly and to look at them as art shaped by human hands, we should be reminded of the long way yet to go to find a peace or a kind of love between human and non-human species.

Discover more about the artist and this project

VIEW THE VIDEO

MATTHIJS MUNNIK

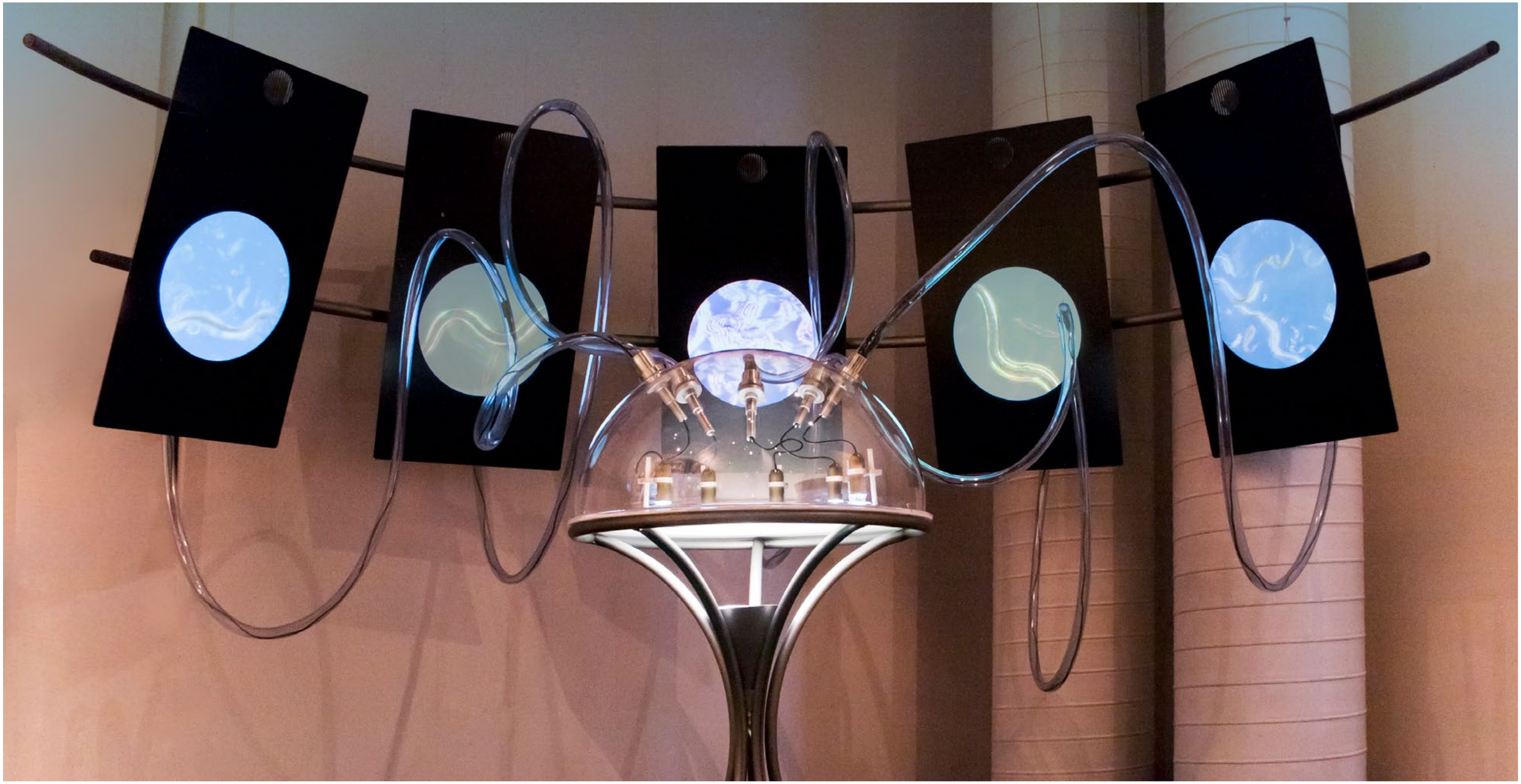
Microscopic Opera, 2010

Custom built incubator containing bacteria samples, sound installation, microscopes, screens, and live video stream

In collaboration with Richard de Boer and The Netherlands Consortium for Systems Biology

Matthijs Munnik, is an artist who creates immersive experiences in light and sound that delight and distort the senses. In 2010, he was the winner of the first Bio Art & Design Awards Bio for the work *Microscopic Opera*. Having earned a bachelor's degree from the Royal Academy of Art, The Hague (KABK), followed by a two-year residency at the Rijksacademie in Amsterdam in 2016/7, Munnik belongs to a movement of established artists who create perception-altering installations with experimental technologies. His fascination with the manipulation of human sensibilities is reflected in his project, which in several ways anticipated what kind of works could be achieved in the future with the Bio Art & Design Awards.

In the gallery installation of the project, a cacophony of operatic voices can be heard emerging from a curious glass dome that is centered in front of a set of five screens. From the dome emerges tubes that connect to the screens. Initially, the set-up looks like a science fiction movie set, with each screen depicting a round, bluish, planet-like vision on a black background. However, upon closer inspection, it becomes clear the screens are actually depicting scenes from a set of microscopes that are observing petri-dishes inside the dome, and the stars of the show are colonies of nematodes (worms) called *C. elegans*. The nematode movements are transmitted live to the screens, and translated into choral tones via a digital program that Munnik



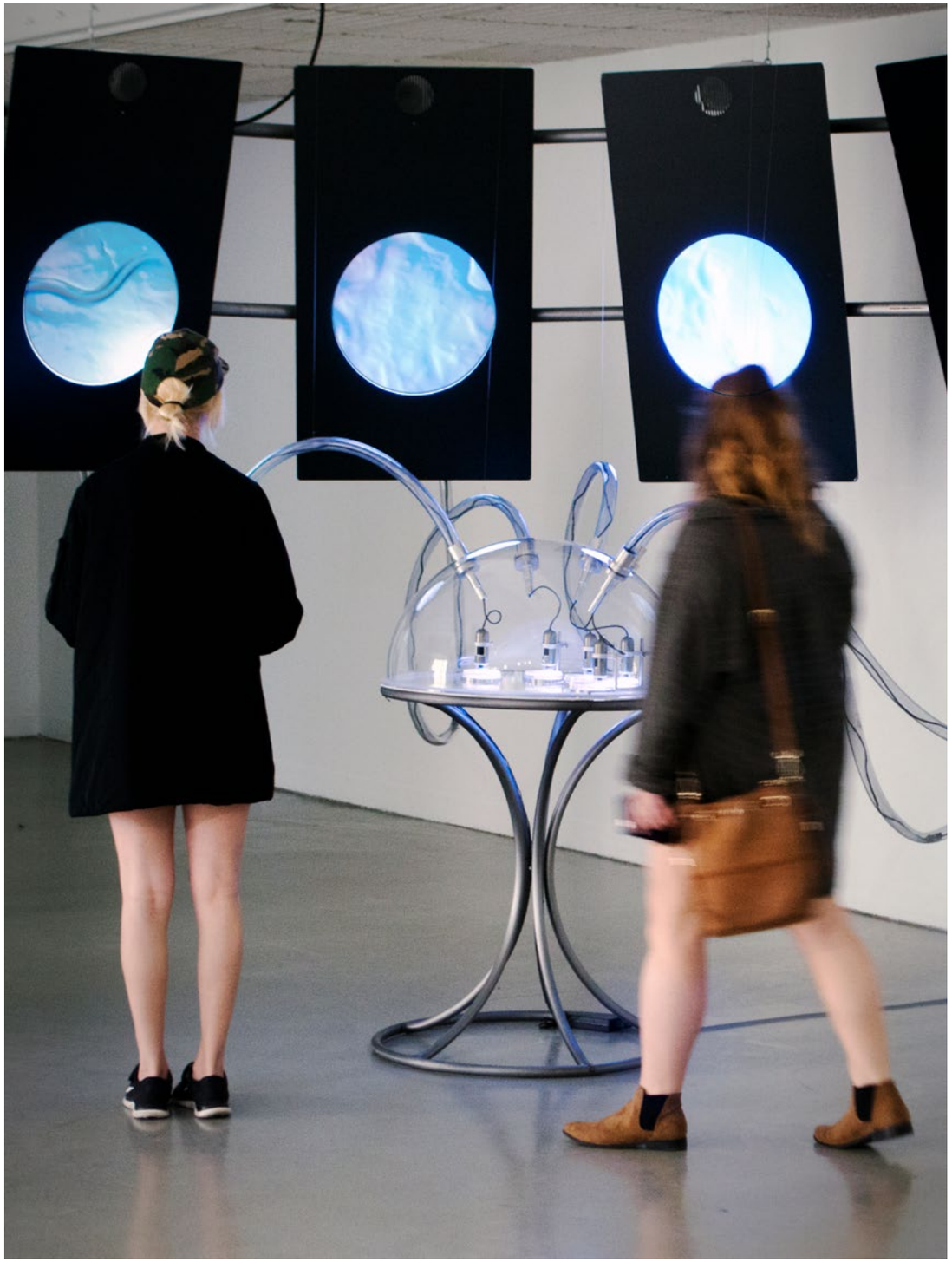
Microscopic Opera, 2010
Photo: courtesy of artist

created. As the *C. elegans* move around on screen, the operatic voices vary based on that motion, with the result that the petri-dish becomes an opera stage.

For Munnik, the purpose of such a set-up is to initiate the realization that we are not so different from the worms in terms of our ability to perceive our surroundings. By associating human singing voices with the worms, he bridges a gap of relatability that usually remains far too wide between humanity and the microscopic animal kingdoms. The movement of the worms becomes an act of high culture in human terms, yet the worms themselves remain completely unaware of their influence. Through such a presentation, the work tricks the viewer into finding beauty where they might not expect it to be, prompting them to reflect on what else of Earth's artistry we might overlook. Understood in this way, the work suggests that there is value to be found almost anywhere regardless of standards of perceived beauty or high cultural quality: from the organisms within our bodies, to the planet's finely tuned atmospheric conditions that make life possible.

The scientific work of Munnik's project was supported by the expertise of scientist Richard de Boer, in collaboration with The Netherlands Consortium for Systems Biology. According to Munnik, the collaboration opened his eyes to a new way of working that was much more structured and observational. De Boer and Munnik met because Munnik was looking for specific animals that he could observe and associate the operatic sounds with. De Boer, who was at the time conducting a study on *C. elegans* for the sake of observing the effect of HIV drugs on human cells, suggested the organisms to Munnik due to their (appropriately) elegant movements and simple maintenance requirements. In fact, *C. elegans* are a very commonly used animal in scientific testing. Their small structural build is composed of only a few hundred cells, including eukaryotic cells (cells with a nucleus) that behave in a similar way to human cells. It is for this exact reason that de Boer was using them as test subjects to observe the eukaryotic cell reactions of specific HIV drugs.

The popularity of the use of the *C. elegans* intrigued Munnik and inspired both him and de Boer to reflect on the way that we use animals in scientific testing without their awareness. Since animal testing in science is something many researchers seek to minimize, Munnik and de Boer saw this project as an opportunity to unveil the informative benefits that the worm provides for science, without it ever being harmed. Finally, having seen the installation in the museum, de Boer also reflected on how the experience of associating sound to the nematodes opened up a new and refreshing way to perceive the organisms that he is so used to studying in silence.



Microscopic Opera, 2010
Photo: courtesy of artist

Since winning the Bio Art & Design Award, Munnik has gone on to pursue a practice that continues to focus on the manipulation of senses to achieve new ways of perceiving our surroundings. Although he has not engaged in other bioart topics recently, his work retains a sense of awe and wonder as triggered by a new or unexpected sensory understanding of the world. After exhibiting *Microscopic Opera*, Munnik explained "There is a lot of beauty in science; in chemistry, physics, biology, mathematics, it's just waiting for artists to take it and use it to create new art, which is not only relevant to the art world but also to the scientific context." Having been one of the first winners of the Bio Art & Design Awards, this statement about the collaboration of design and science appears to ring true amongst subsequent winners.

Discover more about the artist and this project

VIEW THE VIDEO →

ŠPELA PETRIČ

Naval Gazing, 2014

Aluminum, PVC Plastic, nets, *Fucus vesiculosus*, *Ulva lactuca*, other marine organisms, and video documentation of the research

Developed in collaboration with Prof. Klaas Timmermans, Royal Netherlands Institute for Sea Research.

Špela Petrič is an artist who works across a wide range of media, from performance art to experiments with wet labs. Petrič is a former scientific researcher whose practice can be considered as an in-depth investigation into the connections between species, which in many cases requires collaboration with living beings. After earning a PhD in Biomedicine at the University of Ljubljana and an Advanced Master in Arts from LUCA School of Arts, Brussels, she pursued artistic endeavors that simultaneously produce and respond to questions relevant to anthropology, psychology, and philosophy. Through such a practice, Petrič insists on a more egalitarian, self-reflective, and critical view on our (bio)technological societies.

Plant life has been the focal point of her latest projects, with which she combines a critical rethinking of preconceived notions about artificial intelligence. This has led her to propose that perhaps, from the perspective of an algorithm, humans are more similar to plants than we think, in many ways. For example, her most recent work, *PL'AI* (2020) takes the form of a game of tag that unfolds over a period of months, as a result of the movements made by a cucumber plant and a robot. As the plant grows, its creeping tendrils intervene with the robot's computer learning system by grabbing its robotic arms, forcing the system to act in ways that cannot be predicted. This enactment of a game, where both machine and plant learn together while

Naval Gazing, 2014
Photo: courtesy of artist

improvising, highlights the notion of play as an ontological or natural condition of all living bodies. The performance of playfulness by a plant and a machine also invites us to consider these entities as capable of experiencing and expressing joy, a line of thinking that prompts us to confront our reflex to otherize them. With *PL'AI* the artist welcomes more sensitive relationships between our living environments through the help of digital technologies such as AI, machine learning, and robotics.

For her Bio Art & Design Award winning project in 2014, Petrič proposed creating a colossal kinetic structure to be released at sea, which was intended for use by any sea organism, including fish, algae, and bivalves. *Naval Gazing* was released for a time in the North Sea, then temporarily installed as a sculpture inside MU Hybrid Art House in Eindhoven, bringing with it the aromas and textures from the sea creatures that made it home. While at sea, the piece created its own journey – its windmill-like, tetrahedron form caught the wind as a sail and propelled it in a gentle yet unpredictable path. While floating and spinning, the slowly churning object is intended to accumulate a coat of organisms that make its surface their home. At some point the weight of these new organisms breaks the object's finely tuned geometry, rendering the human-conceived piece of marine architecture immobile and left to drift in the ocean where it would ultimately sink. It could simultaneously be argued that *Naval Gazing* is destined to be another piece of debris produced by humanity, yet the work could be considered a micro-ecology, a reef welcoming life to flourish. At a time when excessive exploitation of waters everywhere and the climate crisis are pushing towards the collapse of entire marine ecosystems, a consideration of these conflicts that arise through the project are most urgent. One way *Naval Gazing* can be seen is a critical gesture towards Dutch naval history with its links to colonialism, yet another is that of a gift from humans to the North Sea, one that nods to the notion of legacy joining navel and naval.

When presented in the gallery space, the work resembled Rene Magritte's surrealist painting *L'anniversaire* (The Anniversary) (1959). The extreme contrast in proportions between the room and the sea windmill exaggerated the structure's massive size, while making the visitor feel as if the object was trying to escape the gallery and make its way towards the nearest coast. Accompanying it was a film titled 'Habiton Selfie' mapping the trajectory of the object in the water. A camera attached to one of its rotating arms, as a barnacle to a whale, moves with it through the sea, recording the swimming goliath at times above water and at others under. The film ends with a poetic statement referring to the title *Naval Gazing*: 'As it traverses the waters the habiton performs its inanimate subjectivity.' A final thought that signals to the hazy distinction between nature and culture that are at play in our understanding of the sea.

The project was conceived and realized in collaboration with Klaas Timmermans of the Royal Netherlands Institute for Sea Research (NIOZ). Although Petrič has worked with scientists before, and being a scientist herself by training, the experience at NIOZ was quite different for two main reasons. For one, living on the premises of the research center on the largest island in the Wadden Sea for a month helped her make quick decisions, and gave her rich insights from the engineers who are most familiar with the topic and terrain. In addition, the reactions of the scientists that she encountered there proved validating, as her research was welcomed as supplementary to their work.

Since winning the Bio Art & Design Award, Petrič has continued to develop non-human centered work with critical yet empathic philosophies, which observe and challenge the limits of anthropocentrism. In her words: “With all the gratification, benevolence and good intention that manifests in ‘progress’ there is a side effect, an inconvenience, perhaps even a disaster looming. It is urgent that we keep hands wet and minds nimble to tell stories that disturb the status quo.”

Naval Gazing, 2014
Photo: courtesy of artist

Discover more about the artist and this project

VIEW THE VIDEO →

SUSANA CÁMARA LERET & MIKE THOMPSON

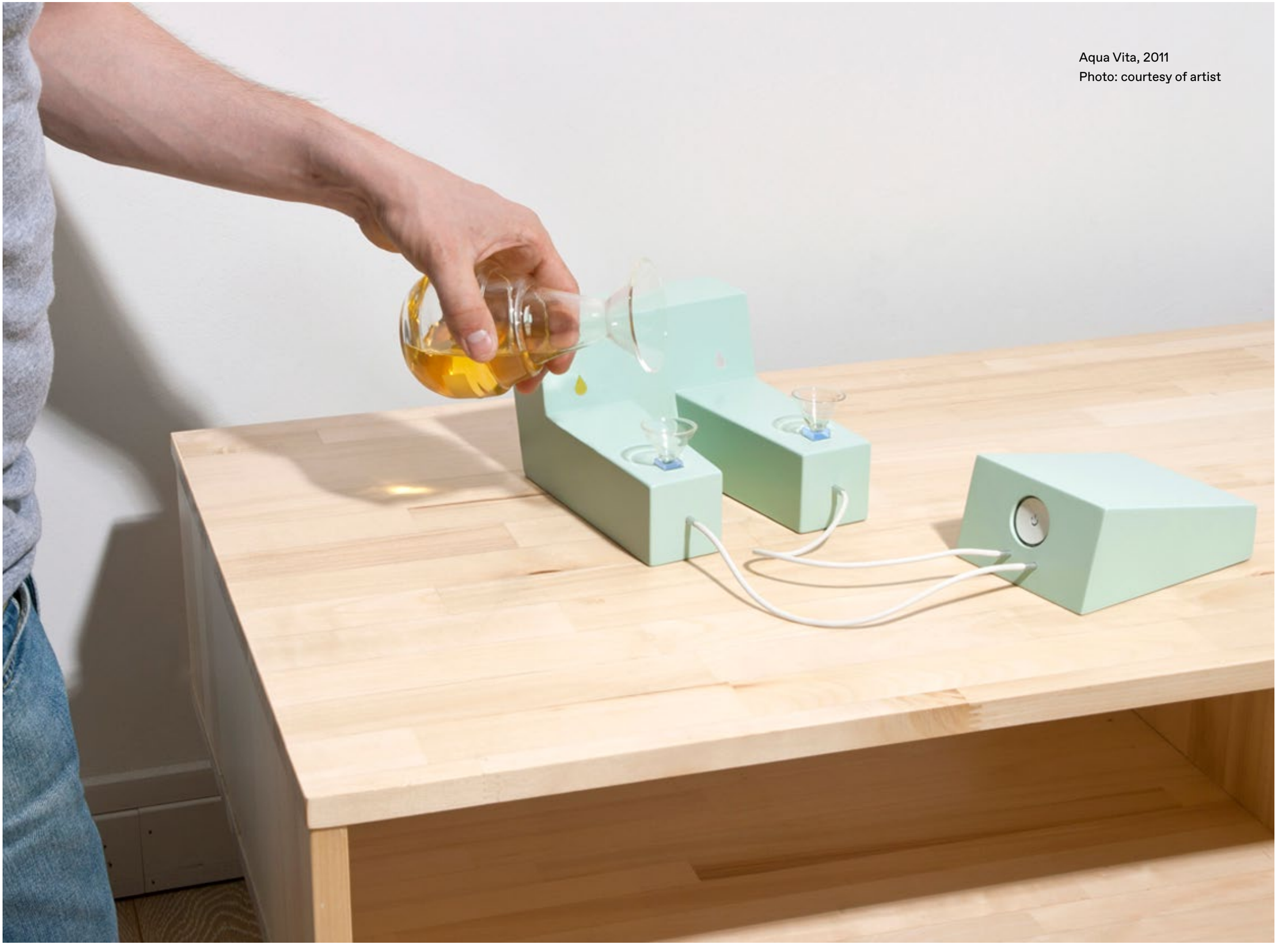
Aqua Vita, 2011

Series of speculative design objects, interactive computer visualization and video documentation of research

Developed in collaboration with Prof. Jan van der Greef, Netherlands Metabolomics Centre.

The practices of Susana Cámara Leret and Mike Thompson converged via study together at the Design Academy Eindhoven. Their interests span a range of subjects, as do their skills in conceiving and producing projects, often in collaboration with experts in science, media, and other realms. To get at what thread is common in what they have created it is helpful to think of the name of one of the organizations they founded and worked under for a time as artists: Thought Collider. The other is WNDRLUST. A collider in science is utilized to speed and then smash tiny particles together to create rare phenomena or states of matter; similarly, these artists collide concepts, conjectures, emerging technologies, and aesthetic experience but to produce art. This in turn can be seen as generating new insights into the nature of organisms, objects, and society. Their work has explored topics such as the detection of biodata from human metabolism, the occurrence of fatbergs (conglomerations of lipids and trash) that clog city sewers, and the ethical problems arising from the collection and transfer of so much personal data in contemporary life.

The artists proposed a multi-part project *Aqua Vita* for their winning Bio Art & Design Award proposal, which they realized with the collaboration of the Netherlands Metabolomics Centre (NMC) and the Sino-Dutch Centre for Preventive and Personalized Medicine. It situates the body as an ever-evolving, resilient system in motion. A starting



Aqua Vita, 2011
Photo: courtesy of artist

Aqua Vita, 2011
Photo: courtesy of artist

point for the research behind the work was the observation that "genetic code" as a phrase to describe genetic material is a limited, linear metaphor that limits our understanding of life and the body. The work's chosen platform for investigation was urine, a biofluid rich in data, and one with a long medical history, such as in medieval Europe and in traditional Chinese medicine. The artists collected and analyzed their own urine, and used a spectrometer to read the presence and concentration of metabolites, which are intermediate or end products of metabolism. These, in turn, were mapped and correlated with self-reported answers to questions formulated by the artists and based in Chinese medicine to diagnose disease.

The results of the process are presented in *Metabolic Painting*, an accompanying interactive computer visualization depicting results over time. In addition, the speculative objects *Fluid Analyzer*, an at-home saliva and urine testing object, and *Echo*, a voice-responsive survey device, complete the installation, along with a documentary video. The intention is to help imagine a future in which the combination of designed objects and technologies allow for regular, at-home self-monitoring of health. The artists both cite the collaboration with researchers in different ways as important, and informing their future practices. For Leret, it was taking steps towards her questioning of how "we come to understand living processes, what constitutes knowledge, and how and where it is created" that has become central to her work. For Thompson, it was more of a springboard to new and broadening collaborations, touching on entomology, perfumery, cell biology, and nutrition science. Although they no longer work together as Thought Collider, their work has certainly progressed independently.

The work of *Aqua Vita* also brings to bioart a much-needed and seldom explored critique of western medical science traditions. By framing the high tech and speculative with the traditional as well as ancient and, to some, provocative in the use of urine, the artists manage to achieve a multi-layered work legible from many perspectives. It also foregrounds the artists' bodies, in a well hewn tradition, in works such as Duchamp's *Fountain* (1917), of challenging audiences with what is both so familiar and yet so unexpected in a gallery or a museum, forming yet another layer of response to our expectations.

Discover more about the artist and this project

VIEW THE VIDEO →

TIDDO BAKKER

In Vena Verbum, 2012

Mixed media installation, including iron, plant, sensors

Developed in collaboration with Henk Jalink and Rob van der Schoor of the Center for BioSystem Genomics (part of WUR Wageningen University and Research).

Tiddo Bakker designs experiences that illuminate unidentified links between humans and nature, and offer new insights into how we interact with the planet as a species. Captivated by the natural world and formally trained as a designer, Bakker hacks form and function to create playful objects and mechanical installations that communicate the lyricism of nature. His practice, which is collaborative and DIY in character, began during his studies at Design Academy Eindhoven in the Netherlands, where he first focused on autonomous conceptual design and later social interactive design, and continues in his present studio practice as part of Collaboration O, a designer collective in Eindhoven.

After graduating in 2011, Bakker won the Bio Art & Design Award for his project *In Vena Verbum*, an installation that measures immaterial bio-chemical activity and the stress levels of plants and translates this into a kinetic sculpture. The starting point for this project was a humble houseplant of undisclosed species or origin. A deliberate vagueness that gestures towards human centric dismissal and neglect of nature through overgeneralization, to the extent where entire families of species are condensed into a singular lingual shorthand such as “grass” or “plant”. The piece aimed to reveal the hidden world of these overlooked plant companions, and encourage people to view them as more than static objects, decoration or scenery, but as living entities capable of a spectrum of responses and experiences comparable to

In Vena Verbum, 2012
Photo: courtesy of artist

human emotion. The goal being to make tangible and visualize these workings and develop an emphatic interface between domestic plants and humans that situates them as equally dynamic actors within the same ecology.

Bakker worked with horticultural researchers Henk Jalink and Rob van der Schoor of The Center for BioSystem Genomics, part of WUR Wageningen University and Research to realize the project. Using their expertise in plant genomics the collaborators used an L.E.D. induced chlorophyll fluorescence transient imager to measure the light reflected by the plant's chloroplasts, which fluctuated when exposed to different light and temperature conditions, CO2 content in the air, and nutrients and water in the soil. Working together, they then made these imperceptible activities, or the plant's stress level visible by transmitting the energy digitally and causing sculptural appendages to move, thereby revealing how the plant responds continuously to its environment.

The resulting project was presented at Naturalis, the Natural History Museum in Leiden in the Netherlands, from June 2012 to January 2013, and took the form of a kinetic sculptural chandelier composed of a rotating iron exoskeleton with a plant at its heart. Throughout the course of its installation, the plant was exposed to different light conditions, the measurements of which guided the movements of the structure. For Bakker, the manifestation of the project is "a dance for which the plant designs the choreography." The gently revolving arms of the structure move with balletic grace, with variation in motion sufficient to remove any suspicion of automation. The juxtaposition of hard metallic surfaces with the fluid motion and delicateness of the plant's structures points to richer possibilities and synthesis between industrialized society and nature, too-often considered in opposing, binary terms.

Since winning the Bio Art & Design Award the project has been shown as part of the *Hands Off* exhibition at the Museum of Craft and Design in San Francisco in 2015 and in the Radix building of Wageningen University and Research. The piece can also be seen as part of an evolving movement to connect with plants more holistically, and non-human species in general. Projects such as *Music of the Plants*, a product from Italian company Streampath designed to "give voice to plants" by connecting directly to the plant perceiving its electromagnetic signals and translating it into musical harmonies, and *Mother Earth's Plantasia*, an album of songs composed by Mort Garson especially for plants, demonstrate our limited ability to connect with plant life on emotional and psychological levels. As part of this lineage *In Vena Verbum* can be related to the growing consciousness of not only the impact of our actions on the environment, but also the view that the world, and everything within it,

exists as a constantly shifting network of relationships.

By visualizing how plants respond to us (their caregivers) the project challenges viewers to think about the experience of the living entities that they share their space with, on a domestic and a global scale. In doing so, the work collapses the illusion of a disconnect between the natural and the human, enabling us to experience nature in its usually invisible sentience, via motion. Bakker's project adopts a plant-centric view of the world, flipping the conventional anthropocentric perspective and inviting all the possibilities that permits, much as Michael Pollan can do in a work of nonfiction, such as in *The Botany of Desire: A Plant's-Eye View of the Word*, in 2001. Finally, a work such as *In Vena Verbum* acts as an invitation to imagine the non-human as more than a material or medium, but rather as a collaborating partner, perhaps not on the same footing, but a step closer than before.

Discover more about the artist and this project

VIEW THE VIDEO →

CHAPTER 5

Society

The labels ‘artist’, ‘scientist’, and ‘designer’, which delimit what we now understand as distinct practices, are relatively modern inventions: the first documented use of the word ‘scientist’ was in 1834 by the Cambridge University historian and philosopher of science William Whewell. Before such terms existed, the people whose work fell into these now accepted categories were operating in ways that were much more interrelated and shaping society in many ways. As an example, Maria Sybilla Merian was studying the interrelations between insects and their habitat, food, and various other species at the beginning of the 18th Century. Her investigations laid the foundation for a new field in the sciences, which would not be named for well over another century: ecology. Skip forward to today and the ideas that Merian’s work gave birth to can be seen as a leitmotif for all of society.

From the climate and ecological crisis, to racism and deep rooted inequality; pull one string and you quickly unravel the web of complexity that makes up our socio-ecosphere. This type of systematic thinking has provided fruitful ground for bioartists and designers, whose practices are, by nature, multifaceted and cross-disciplinary. Take as an example, one of the originators of bioart, Eduardo Kac. Included in his oeuvre is *Genesis*, a marvelous, layered installation that involved translation of a passage in the bible into genetic code. The inventive, critical stance was staged in 1999, and has inspired many artists across concentrations, from digital to performance. In some way or another, all of the works in this volume are a product, response or critique of social themes, which smash together the taxonomies that were constructed in the 19th Century.

In their essence, bioart and biodesign deeply integrate organic entities into artistic and design practices. It is therefore unsurprising that works of bioart and design often take the relationship between humans, the natural world, and the other species it contains into consideration. In the piece, A *Felicitous Neo-past* Guo Cheng examines this interrelation on a microscale to make observations on a macroscale. Taking the Dutch landscape as a starting point, the artist, draws attention to the impact that humans are having on the Earth, specifically in the form of microplastics; and using the artificial Dutch landscape as the work’s entryway, questions what we can consider calling ‘natural’ at all in our irreversibly human-altered world. In contrast, Baum and Leahy investigate human-geological relations in their epoch-stretching work *Microbiocene: Ancient ooze to future myths*. By offering an alternative view on the story of life’s development, they intended to decenter our anthropocentric narrative of the planet, and open our eyes to its more-than-human timespan. For Haseeb Ahmed, the boundaries between the human and non-human, the dead and living are arbitrary:

a moving target. The work, *Fish Bone Chapel*, uses the governing structures of genetics, politics, and religion to examine how understandings of what constitutes life are always changing, and question human influence on natural forms.

Whilst varying in their realization, these works advocate for closer collaboration and empathy across species, and affirm that we can learn from nature to create more ecologically sound ways of living. It is no coincidence that this has emerged as a theme, as the climate and ecological crisis continues to increase in severity. However, works in this section also illustrate the interconnectedness of environmental deterioration and the ills that continue to plague society. Such compounding crises have not escaped the attention of bioartists and designers who use their work to draw attention to, but also seek action against them. As an example, in *The Orders of the Undead* Nadine Botha sheds light on the connection between illness and otherness with regards to the study of infectious diseases, and the emergence of the zombie genre in movies. Such work becomes newly relevant in light of the global pandemic and the intensified interrogation of present-day systems of oppression that continue to carry forward the brutal legacies of colonialism. Violence is also unavoidable in the work of Jalila Essaidi, whose *Bulletproof Skin: 2.6g 329m/s* is a critique of technological solutionism that cuts uncomfortably close when considering global access to weapons and increasing social tensions. When viewed through an intersectional lens, works such as these suggest that it is in fact humans that present the greatest threat to the survival of humanity.

Other artists and designers in this section choose to interrogate current society by conjuring up simultaneously speculative and possible futures. Michael Sedbon's work *CMD: Experiments in Bio-Algorithmic-Politics*, for instance, examines the level to which technology is integrated in our 'natural' experience; how artificial systems of control influence our behaviors in unseen ways, and whether such abstract systems represent an emergent agency independent of human existence. From a post-human future, to one where we relate to other species and technologies differently; Studio PSK also conceptualizes a semi-plausible future in *The Economics of Evolution: The Perfect Pigeon*, a work that combines imaginative forms of data encryption, synthetic biology, and pharmacology. By borrowing from the tools of science fiction these works reveal unseen layers of our contemporary society and, in so doing, advocate for more cognizant awareness and application of them.

Bioartists and designers are uniquely attuned to the nuances and the connections that make up the fabric of the world in which we live. They are a barometer, but also a guiding compass, which in this case points to a restoration of the philosophies of

early naturalists, such as Merian or her 20th Century counterpart Lynn Margulis, a key proponent for the significance of symbiosis as an evolutionary force who co-developed the Gaia hypothesis, whereby the Earth functions as a single, self-regulating system. Both women are examples of the necessity of working holistically, and across disciplines. The works in this section follow a similar trajectory: departing from one social topic, but often traversing many. They continue to take on new resonance; and importantly leave the door open for ongoing dialogue, critique, and resolutions.

Navigate to the artist

BAUM & LEAHY

Microbiocene:
Ancient ooze to future myths, 2018

3D-printed sculpture using sea sediment

Developed in collaboration with Prof. Stefan Schouten, Julie Lattaud, Laura Schreuder & Gabriella Weiss, Department of Marine Microbiology and Biogeochemistry, NIOZ Royal Netherlands Institute for Sea Research, Texel.

Baum & Leahy are designers that have collaborated since 2015 upon their meeting while studying at the Royal College of Art in London, both in pursuit of their master's degrees in Information Experience Design. Their work crosses over what are considered concentrated expertise with inspiring results, such as interactive installations, art direction, and experience design. They collaborate regularly with scientists and other experts, from architects and microbiologists to physicists to make projects that are exhibited in venues around the world. The starting point for many of their works, such as *Host* (2019), made in collaboration with architect Richard Beckett, is the recognition that the cross-species relationship between humans and non-humans needs to be urgently reconfigured across time and scales. This ranges from the practical, to imagining probiotic and regenerative space for contemporary humans to re-thinking how biological history has unfolded over billions of years.

It is such a re-thinking that informed the designers' winning proposal *Microbiocene: Ancient Ooze to Future Myths*. A project that carves out ways of relating to the microscopic view of matter and life, by honing in on a species of single-cell algae that is found on the seafloor and leaves behind sturdy fossils. They studied this species, *Emiliania Huxleyi* with the assistance of Julie Lattaud, Gabriella Weiss, and Laura Schreuder from the Royal Netherlands Institute for Sea Research (NIOZ). In the

Microbiocene: Ancient ooze to future myths, 2018
Photo: Boudewijn Bollmann

Microbiocene: Ancient ooze to future myths, 2018
Photo: Boudewijn Bollmann

development of the project they collected cores of sea sediment containing fossils as old as 10,000 years. The designers worked with them to identify forms and meld them with interpretations of language and data generated by the study of such fossils and the stories they reveal about earth's conditions many years ago. The overall drive in such an effort is a de-centering of the human narrative, to make a journey of thinking through deep time from the perspective of the non-human.

The resulting installation included monumental sculptures 3D printed in collaboration with the Dutch company Vertico, with the help of Volker Ruitinga. These sculptures contain samples of the studied sediment and sand to reference the source of the project. In addition, a system of symbols rendered graphically and as sculptural objects, fossilized into the sculptures and projected onto the wall of the exhibition space, suggested some sort of alien hieroglyphics. These act as invitations to visitors to contemplate the more-than-human time spans and possibilities for communication, storytelling, and mythmaking.

Through such media, *Microbiocene* presents microbial life as a gateway to think about other worlds we may want. The designers cite the "vibrancy and materiality" of the invisible microbial life they observed in the laboratory as revelatory to them, as a high point and influential moment on the way to constructing a non-human perspective. The designers see the Bio Art & Design Award as a critical moment for them to become woven into the community of artists and designers working with biology. They also observe that they have developed a sense of biophilia or "microbiophilia", a love that allows them to free their imaginations and transcend disciplines via a sincere admiration for the world-building capabilities of such tiny organisms over eons.

Microbiocene stands out as a work with a long life in terms of its impact and all the iterations of it being represented or being exhibited in one way or another, such as at Future Proof in London and The Farm in Denmark. Additional works have emerged based on similar concepts and approaches, including *Mikrobia* (2020) and *Interterrestrials* (2019). As such, their practice relates to the works of other leaders in the field, such as artist Alexandra Daisy Ginsberg, Suzanne Anker, Neri Oxman, and Maarten Vanden Eynde. These and other figures help us to escape, if only briefly, our flawed and limited human imagination to step into a space of possibility that is characterized by cross-species empathy, joy, and the mutual preservation of life.

Discover more about the artist and this project

VIEW THE VIDEO →

GUO CHENG

A Felicitous Neo-Past, 2017

Multimedia installation, including soil monoliths, one-channel video, webcam, rubble, wind vane, and a neon sign

In collaboration with Heather Leslie, Dept. of Environment and Health, VU, Amsterdam.

The notion of *a trace* is a contradictory one, for it is something left behind, forgotten, abandoned; but a trace is also what persists and remains. Guo Cheng's body of work oscillates within this paradox. It shows us that we live our lives constantly leaving traces and that it is impossible to avoid doing so. Forgotten or overlooked aspects of our surroundings provide fertile ground for the artist to excavate, unearthing material artifacts, and untold or neglected histories. From industrial wreckage, to landfill pollutants, accidentally lost everyday objects, or the ghostly remains of radiation, Cheng manages to disentangle all that constitutes the human footprint from the natural environment, and restage it, as if the earth were a giant time capsule.

Cheng intentionally conceals elements of his research and thinking inside a humorous yet technical skin. In the work *Amber* (2019-2020), for example, he transforms the familiar into the strange by exposing artifacts found solidified in concrete, either on purpose or by accident, such as steel wires or plastic cutlery. This makes for an exercise that could be described as Anthropocene archaeology. The concept of "high and low technologies" is a layer that is also often present in Cheng's work. In the ongoing research *The Net Wanderer* (2019-ongoing) the artist creates a map of firewall proxies that block Chinese users from roaming the Internet freely. It may seem that the technology here is complicated, but it is, in fact, a simple mapping

A Felicitous Neo-Past, 2017
Photo: courtesy of artist

technique, the use of which demonstrates the power of basic or hidden technologies. A unifying thread between the approaches of such projects is their ability to slow down our attention and invite us to rediscover archaic tools with a calmness of thought; producing perhaps a space to be critical.

In recent years, Cheng has accumulated several awards and fellowships, including the Special Jury Prize of the Huayu Youth Award, in Sanya (2018) and an Ars Electronica Honorary Mention, in Linz (2020). These successes have grown from many experiences and foundational training, such as graduating from the Royal College of Art in London in 2012 with a masters in product design. Cheng is a serial applicant for the Bio Art & Design Award, having applied in 2015 and 2016, before winning the award in 2017. This experience, and subsequent process of collaborating with the scientist Heather Leslie to create a new work, constituted an important milestone in his artistic practice.

His award-winning project, *A Felicitous Neo-Past*, begins with a powerful gesture: digging up a one square meter hole of artificial land in the area of ADM, on the outskirts of Amsterdam. Formerly part of the North Sea, this reclaimed land was abandoned after WWII; it was later occupied by a community of squatters and transformed into an artist's village. Once excavated, Cheng meticulously separated the soil into natural and artificial components, a process intended to remove any human trace: such as synthetic micro-plastics, various chemicals, rubble from old constructions, and even bits of munitions from WWII. This "cleansed earth" was then returned to the hole, resulting in a man-made geological marker that contains no human fingerprint or message on the plot of land that was itself artificially engineered by the Dutch many years ago. It is thus a materialized poetic paradox created from soil and placed back into it.

When presented in gallery, the work took the form of a multimedia installation. In it, a series of soil monoliths from the excavation were arranged upright, held by a wireframe pedestal, with a mechanism that scans them for evidence of human debris. Each monolith had two distinct faces, one untouched and still containing all human traces, and one scrubbed of them. Complementing this arrangement, all the rubble filtered from the soil was poured onto the floor to make a bed for a neon sign displaying an official slogan from the post-WWII Marshall Plan, for European reconstruction: "Whatever the weather we only reach welfare together". This phrase can be understood as a nod to the collaboration, while subtler meanings can be detected in its reference to the overall Marshall Plan's mission to prevent the spread of communism, despite the communal spirit of the slogan, and the irony of it being used by a Chinese artist.

In order to ensure a robust partnership, Cheng contacted Leslie to have exploratory conversations even before meeting during the matchmaking event of the competition. This led to his fascination with (micro)plastics and subsequent search for them in the project. Leslie also helped Cheng to select the eventual site of excavation, where the ADM community in Amsterdam had fostered a vibrant environment for artists. This location was also used periodically for musical performances, a fact known by Leslie as an outgrowth of her passion for playing the cello.

The collaborative aspect of *A Felicitous Neo-Past* went further than one between artist and scientist, as Cheng joined the squatter-artist community for two months and was granted a home and a workspace to develop his project. This enabled him to obtain specific, local feedback, which proved to be very valuable in shaping the final work. In sum, the project touched on many scales and concepts, from the Anthropocene and the multiplicity of our notion of the natural, to that of community. The backdrop of ADM also adds layers of meaning. As a place reclaimed it continues to be reborn. Soon after Cheng's intervention, the artist community living there was removed, and the small plot in the Port of Amsterdam is now being used for new private commercial development.

A Felicitous Neo-Past, 2017
Photo: courtesy of artist

Discover more about the artist and this project

VIEW THE VIDEO →

INTERVIEW

Heather Leslie

Senior Researcher at Department of Environment and Health, Vrije Universiteit Amsterdam

Given your research into how industrial practices impact human health and ecosystems, is there a single material invention or practice you would remove from the world, to choose just one thing for humanity to not have invented?

Technology is known to bite back. Plastic certainly is no exception. Even though life would be very different without it, and it's hard to imagine our technoexuberant contemporary society doing any of its normal activities without it. For all its good, plastic also has a dark side. It's an artificial material and largely incompatible with biogeochemical cycles. The earth gets scarred by resource extraction, production and the scarring continues right through till end of life. Plastic is our message to the future, maybe even the year 3000 there'll still be traces of our plastic pollution kicking around on the planet and in space. Plastic's been the vehicle that the drivers of our consumer society have used to bring fast moving consumer goods to the global market. This process is not exactly democratic, people are turned into consumers by massive advertising budgets, while ecology and human rights are not necessarily respected. Does the world need more plastic stuff or are we in some ways choking on it all? Who has made a comprehensive cost-benefit analysis and what criteria would be good to use for that? We probably will discover many old mental models and myths that don't serve humanity or non humankind much.

Human consciousness appears not to be advanced enough to apply plastic in a way that is congruent with our best science and our best human values. It's super hard to make and use and discard plastic while upholding dignity for all.

Did you have memorable experiences in youth or early at university that gave you a strong motivation to study microplastics?

As a child I was an anti-litterbug, and anti-pollution. I wanted humans to be nice to nature. I equate that with human dignity. After my bachelor's degree I left Canada to see the world and I saw and smelled a lot of pollution along the way. After a year on the road I decided it was time to learn how to measure it and I started studying ecotoxicology and analytical chemistry. This helped me understand how to diagnose problems that pollution brings. That path eventually led me to plastic – a big source of chemicals and polymeric materials that escape technological cycles and become pollution. I also wanted something constructive to be done with the knowledge about the level of pollution and the harm.

Can you talk about your interest in playing the cello and how you think it may affect how you think or your research?

Well that is something I'm never asked. I think playing music connects us with something big, it expands and thickens our experience. A musician's brain apparently has more connectivity, according to neuroscience. Connectivity is a good thing when you're thinking, analyzing and creating, and everyone can benefit from that, not just scientists and artists. I have written and performed a few songs related to my work. Sometimes you sit down to write or prepare a lecture and then a song comes out. Lately I've been writing spontaneous limericks about microplastics. I'm not claiming they're brilliant or anything but they amuse my colleagues who are starting to write me emails in limerick form from time to time! I also have used the cello as an example of a product that fits into a 'circular economy', the buzz word for good ol' reducing, reusing, recycling and avoiding toxic chemicals. My cello is not disposable. Is over a century old, its reusability is shown through a variety of different cellists who have played it, and it is repairable, it's made of natural materials. It's not toxic, rather it increases the quality of life by soothing souls and harmonizing with other instruments. It is versatile and has created sounds from Shostakovich symphonies to bossa novas, Hungarian czardas to pop. At the end of its long life (sometime in the hopefully distant future), the materials will be easily recycled – this is what I call technology that does not bite back.

Is there a text, book, or film you would recommend that someone who is interested in the Bio Art & Design Award should see before applying?

I think it's important to follow your own star, and read something that inspires or intrigues you. I wouldn't want to prescribe a reading list, but rather just trust that everyone is going to bump into the right book(s) or film(s) or podcast(s) or knowledge at the right time.

Can you talk a bit about how your experiences of collaboration were different in the prizes you have won, from Sissel and Cheng?

My first Bio Art & Design Award experience was with Cheng Guo. This got me hooked! Cheng makes art at the same nexus as I make science: humans-technology-nature. This project was about a discovery we made when we tried to erase our plastic pollution traces from 1 m^2 of the earth. Among other things, this curiously led me to question why I *a priori* label pollution as something undesirable. Whether or not it's ok to leave a trace that we were here, pondering the right to be here and to change something about the earth. Is it inherently wrong to leave a trace, and how could we live without leaving a single trace? Even erasing the trace leaves a trace of erasing the trace. This leads into what I think we have been taught by PR or propaganda (whatever you want to call it), that the earth is polluted thanks to every single one of us, the idea of the Anthropocene. Anthropos doing the damage all together. This word makes you feel guilty that you've been born, when you hear how much a human in your home country is going to pollute over the course of a lifetime. Whereas it is highly questionable that we 'all' started the pollution. Wasn't it enabled by the few, who used their power to sell the new way of living to humanity as a whole, and then locked it in? That's why some use the term Capitalocene instead.

In the project with Sissel Marie Tonn I brought immunologist Juan Garcia Vallejo on board, so we were three minds instead of two. With the *Becoming a Sentinel Species* project, we used science fiction, which I personally thoroughly enjoyed because it allowed for more stretching of the imagination, i.e. going where science cannot go (yet). With Sissel we talked a lot about the fluidity about where a human body starts and where it ends. We ended up co-writing a lot of text during this project, on top of the film. What was the same with both was that the collaboration was smooth, trust-filled, and both projects touched on deeply philosophical ideas about our human relationship with nature.

When you talk about your experiences of the Bio Art & Design Award with your colleagues at the university, how do you answer the question: "does it bring value to your lab or your own research?"

I like the mind expanding part of art-science collaborations. I like zooming out of the details of day to day lab work and indeed discussing philosophical ideas about our human relationship with technology and nature. That gives more meaning to the day to day lab work. I like discussing extraordinary topics, which happens when you go out to the edge of your discipline and look around. I don't like to try to measure impact indicators or value for the lab, I mean, I do not expect an artist to help solve technical issues we are facing or generate results or future revenue for my research projects or other tangible, quantifiable outcomes. Our society is always talking about valorization. I would love to just say that we do art-science primarily for the intellectual jazz and the lack of protocols to follow, and to use it as a free exploration period. This can sometimes lead us down a path we would have otherwise not found, though I suspect in most cases these are more intellectual paths and less technical lab innovation-oriented. Sometimes such a path will not be exciting but sometimes it will. These are the risks of science, art and life in general. I think it's important to let curiosity flow freely, explore the avenues that draw you to them, and learn as much as you can. Do I mean that we should be making art-science for art-science's sake?

Can you mention a few reasons why a designer or artist should really pay attention to microplastics as a potential medium to work in or address?

Microplastics and plastic pollution in general is interesting to artists and scientists alike because it is simply connected to everything. To our financial system, to our consumer society, to our behaviors, to our health and immunity, to telecommunications, to energy, to manufacturing, to art and design, to waste, to pollution. There's a human rights component, there's a global component, equity. It's impossible to run out of ideas on how you can relate to and think about and examine and work on the topic of plastic pollution. Besides that, we need to experiment with all angles of thinking, feeling and acting when it comes to plastic pollution if we ever want to actually clean up our global act. Art has an important role to play in shaping our society's present and future.

In your opinion, what are the skills or insights that a design or artist possesses which is most fascinating to you as a research scientist?

Transdisciplinarity is an important element in the toolbox for scientific progress and

excitement in general. The best thing about artists, I find, is they have no fear to just let their thoughts go, to be creative, to try things and to make mistakes. I think this kind of freedom is bashed out of a lot of students of science and professional scientists by the technocratic nature of the university system and the constraints of the scientific establishment. Science students are inundated with performance rubrics and they learn to study more for points, and less for knowledge. Professional scientists have become drawn into jobs that require them to spend more time doing management tasks leaving less time for thinking and research. Science these days must be valorized, serve state and business interests, and create jobs. Meanwhile, the question is asked, have scientists forgotten how to think, feel, and imagine? Isabelle Stengers writes about this in her book *Another Science is Possible: A Manifesto for Slow Science*. I found she hit a lot of nails on the head in this book.
Artists and designers each have their own unique set of skills and talents that they bring to the table, as do scientists. It's the diversity that I find fascinating. I find artists are able to engage with scientists in a fresh way that encourages research scientists to question the questions. Bio Art & Design Award artists and designers invest time in reading about science and other societal issues, often using a broad variety of sources, broader than the average scientific colleague perhaps. It's great to exchange reading lists with them.

If you had a project to propose to an artist, kind of a reversal of roles, what would it be?

I might propose something that erases traditional borders between roles of: the artist does this, the scientist does that.

What new developments in the study of microplastics are most exciting to you now? Is there, for example, viable replacement materials proliferating or welcomed policy changes or restrictions?

The most exciting science thing currently is that we have started to look at the relationship between plastic pollution and human health. We have discovered how plastic has contaminated the entire planet and part of outer space even. I think it is high time to understand how plastic we are on the inside. That's what I want to show next. Humans legitimately want to know how safe and healthy it is if they carry plastic inside them. People naturally pay more attention when it's about plastic in their own bodies or those of their kids, compared to some plankton species they may have never heard of. Of course the next step is to take this knowledge and information and use it for good.

Do you feel you have new insights into your research, or your playing the cello, or other aspects of what you do that have come from creative collaboration with artists?

Every time I have a new conversation with an artist, I learn something. I hear about a new concept, I end up reading books they recommend, I experience their art works and learn about the concepts embedded in them. Afterwards, I don't think I ever can keep thinking or being exactly the same way as before. With the music I play, well that is perhaps the purest communication that I can do for the world. It's amazing especially to improvise, because the notes are coming from somewhere, yet you have no idea from where exactly. The next best thing to music making is thinking: these are very closely related as they are both all about energy and vibrations: the keys to the universe if you take it from Nikolai Tesla.

HASEEB AHMED

Fish Bone Chapel, 2013

Mixed media installation including, plaster, 3D-printed bio-plastic, milled foam, paint, wax candles, enamel on wood, video, screen, and projector

Developed in collaboration with the Netherlands Toxicogenomics Centre.

Haseeb Ahmed infects contemporary science with premodern and religious thought via his art practice. From his five-year-deep research work into insemination, fertilization, and incubation to sculptural-architectural spaces that function as modern-day memento mori, Ahmed's work connects technology, architectural ornament, and ancient ceremony to explore the vicissitudes of life and death. This fusion of approaches was developed during the artist's training. Having received a Bachelor of Fine Arts from the Art Institute of Chicago, Ahmed subsequently completed a Masters at the MIT program in Art, Culture and Technology, before completing a PhD in practice-based arts at the University of Antwerp. For his first solo exhibition *The Common Sense*, which opened at Around the Coyote Gallery in 2007, the artist constructed a functioning mosque inside the gallery. This was the first instance of the artist using the vocabulary of religious architecture to communicate the meaning of his work, which in this case led the visitor towards contemplating their preconceived ideas of faith and its increasing politicization in the years following 9/11. Ahmed returned to iconic religious structures for the Bio Art & Design Award in 2012, in this case beginning with a typology from Catholic architecture and infusing it with formal, bio-technical, and ethical aspects of a single organism: the zebrafish.

Fish Bone Chapel brought together the latest in genomics research and emerging digital fabrication

Fish Bone Chapel, 2013
Photo: courtesy of artist

techniques in a space that the visitor can quite literally inhabit. Working in collaboration with Jos Kleinjans from the Netherlands Toxicogenomics Centre, Ahmed exposed zebrafish to toxins to prompt genetic mutations. The skeletons of these modified creatures were, in turn, copied and enlarged by a medical CT scanner and 3D printer to create the building blocks for the "chapel" of the final piece. Inspired by the bone chapels of southern Italy, specifically the Capuchin Crypt in Rome which is decorated with the skeletal remains of thousands of Monks and poor laymen, aquatic forms in the work cover a series of structures that mimic church architecture. *Fish Bone Chapel* presents a hybrid biological and architectural space. The work's floating vaults are supported by genetically modified fish vertebrae, 3D printed columns constructed of mutated spinal cords, and frieze panels adorned with exploded views of embryos, with the result that genomics research is materialized in a way that invites visitors to step inside of it.

The piece repurposes mutation, normally understood as something undesirable or to be feared, by using it as a generative tool to produce new forms. The building blocks of Ahmed's chapel are the building blocks of life itself, a visual metaphor that simultaneously refers to and challenges the use of nature in the construction of scientific knowledge, and the right that humans have to do so. Commonly used within genetic testing, zebrafish are not legally considered to be animals for the first five days of their lives. Instead at this stage they are defined as "organic material", a loophole exploited by the scientific research community allowing scientists to freely carry out experiments on the fish without having to go through lengthy and costly ethics-approval procedures. The European law holding the zebrafish in this liminal state between life and death is the same that prevents animal testing and protects human abortion rights. Thus, bound up in the laws and systems that govern scientific research is the definition of life itself. Coalescing around the form of the zebrafish, *Fish Bone Chapel* explores the relationship between science and religion, our changing concepts of life and death, and human's influence on natural forms. Since winning the Bio Art & Design Award, Ahmed has dedicated his artistic practice to such transdisciplinary collaborations.

The work was initially realized in the atrium of Naturalis, Natural History Museum in Leiden in 2013, a storehouse of centuries of scientific research into the natural world and fitting location for the chapel's first installation. By placing the work in the pseudo-religious architecture of the museum space the piece evokes not only the grotesque bone chapel tradition, but also the use of biology in art and architecture as seen throughout the 19th century that replaces religious iconography with features from nature's kingdom. The work of natural historians such as Ernst Haekel (1834-1919), whose fantastical

studies of tiny animals and sea creatures in his *Art Forms in Nature* (1899-1904) blur the line between artistic creation and natural beauty and have influenced artists and architects for generations. In *Fish Bone Chapel* nature is more than a source of inspiration, it is the medium and tools used by the artists through a process of genetic alteration and manipulation. An act that echoes and critiques the hand of the artist, designer, and scientist alike when intervening in nature. Using skeletons as its sculptural vocabulary the chapel is a tribute to life, death, and the not-yet-living that also challenges these definitions.

Discover more about the artist and this project

VIEW THE VIDEO

JALILA ESSAÏDI

Bulletproof Skin: 2.6g 329m/s, 2010

Mixed media installation, including incubator containing sample of bulletproof human skin enforced with spider silk and video installation

Developed in collaboration with Marcel Piët at the Netherlands Forensic Institute.

Optimistic, insightful, and ambitious, the body of work of bio-artist and entrepreneur Jalila Essaïdi can be considered a call to arms. Unlike the traditional meaning of the phrase which hints at violence, Essaïdi incorporates the newest technology and ideas and proposes future opportunities for humankind's well-being, survival, and protection from itself. After earning a bachelor's degree at the Fontys Hogeschool voor de Kunsten in Tilburg in 2009, she continued her educational journey, combining business and social entrepreneurship with her masters in bio art and art education. It is not surprising that Essaïdi's impressive CV earned her the title of Regional Top Woman of the Brabant area of the Netherlands in 2017.

In parallel with her artistic practice, Essaïdi founded and leads the non-profit organization BioArt Laboratories in Eindhoven, where she actively scouts and develops young, talented people working at the cross-sections of biotechnology, art, and design. She also develops biofabricated new materials and products for her own company Inspidere. Prior to these accomplishments however, the artist won the Bio Art & Design Award in 2010 with her project *Bulletproof Skin: 2.6g 329m/s*, which worked to elevate her profile and that of the award, across the Netherlands and the world, as it was covered by the global media.

The idea behind the project came from research conducted by Randy Lewis, a molecular biologist at

Golden Orb Weaver

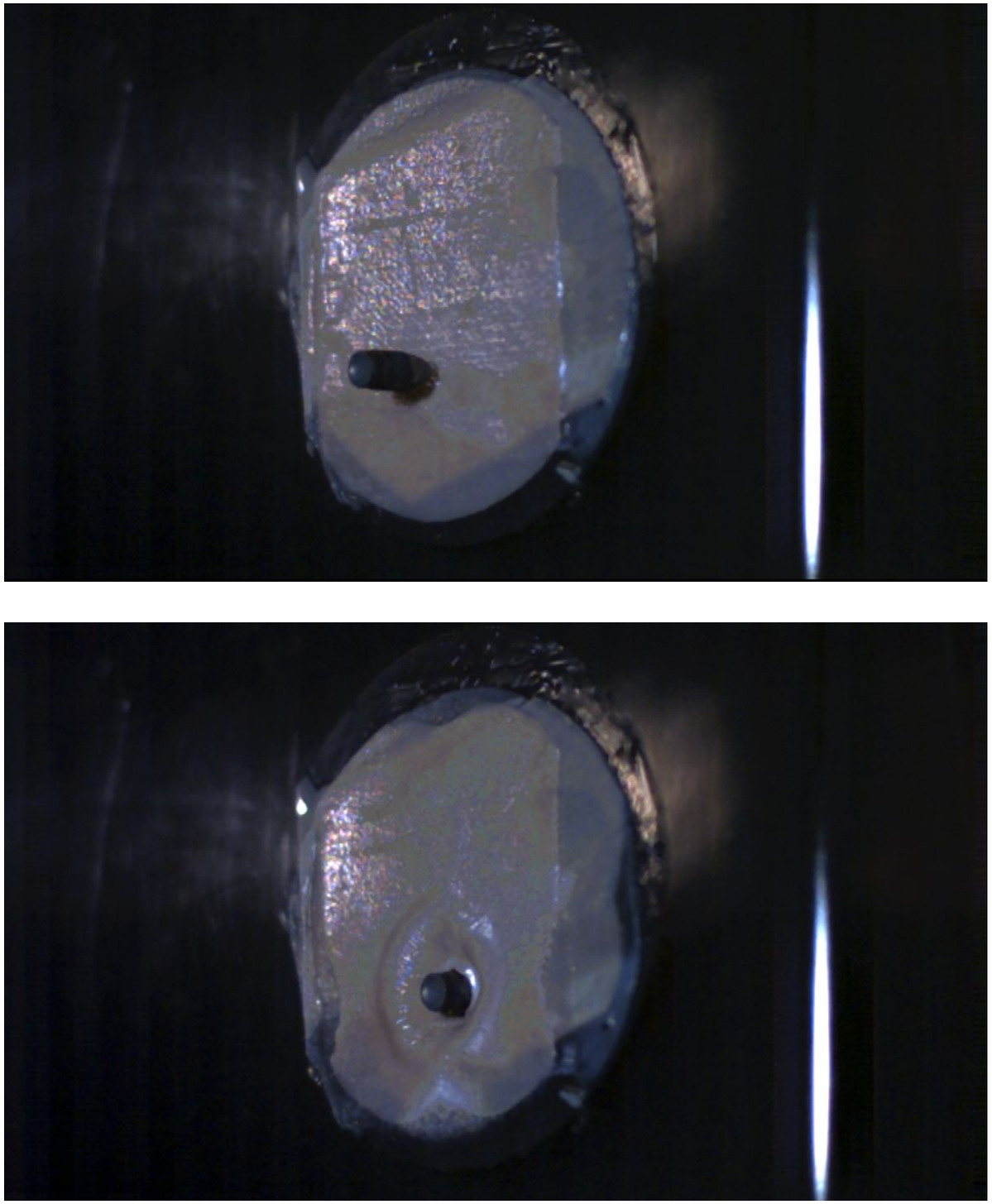
Bulletproof Skin: 2.6g 329m/s, 2010
Photo: courtesy of artist

the Utah State University, where he was creating bulletproof vests made from the silk of tropical spiders. This new approach sought to make the standard, stiff bullet-proof garments lighter and more flexible. Upon Essaïdi's involvement, the concept was pushed far further, as the artist proposed to use the silk to create an actual bulletproof human skin. In collaboration with scientific partners Marcel Piët of the Netherlands Forensic Institute, and Kees Tensen and Abdoel El Ghalbzour, scientists at Leiden University, Essaïdi used a genetically modified goat, with special spider genes, that produces silk proteins in its milk for the creation of the material. This specific kind of silk protein has incredible material properties: it is ten times stronger than steel and a worthy competitor to Kevlar, the material that is usually used for making bulletproof vests. For creating this special skin sample for the project, the silk was blended with actual human cells, which were woven into a peculiar type of tissue: half human skin and half silk proteins.

The artist then created a block of ballistic gel to simulate the density and viscosity of human muscle tissue and placed the bullet proof skin on one of its sides. This unique surface was then set up at a shooting range to be the target of a .22 caliber Long Rifle bullet. When shot at a slower speed than usual, the skin stopped the bullet and was not pierced. Although they did not create a fully functional bullet-proof skin, the project was successful in highlighting how our conversations about safety and technology, particularly biotechnology, can unfold in ways that are stimulating, but sometimes incomplete or problematic. One of the questions the project poses indirectly is: at what point does the search for technical solutions to a social problem become absurd?

The innovative idea of extending the limits of our own skin and its resistance in a way that had never been done before, allowed Essaïdi to confront the reality of our own bodily capacities in regards to gun laws and global violence. If humans would be able to produce this tissue and wear it, would we *then* be completely safe? This question itself may be moot however, for as new technologies develop for protection, so too can we expect weapons designers to respond with something that can penetrate it, or perhaps, those who would fire a bullet to select another form of violence instead. Despite this work not actually being able to make our skin bulletproof, Essaïdi explores the social, political, ethical, and cultural issues surrounding safety in a world with access to new biotechnologies, the backdrop of which is the ancient human desire for invulnerability. This work may prompt us to regard safety for what it is, a relative concept in motion, with technologies being just one aspect of how and where it is distributed.

Over the course of the research and making processes, the artist proposed different approaches to explore in terms of electrospinning, weaving



Bulletproof Skin: 2.6g 329m/s, 2010
Photo: courtesy of artist

different types of scaffolds, and trying multiple skin models. Essaïdi has said that: “There is a huge amount of untapped potential hidden in-between fields of specialization. Low-hanging fruits for individuals who can pierce the veil of society's compulsion for structure, order and specialization.” This cross-disciplinary type of work is embedded in her practices, which is proving to be a worthy and necessary reassessment of the status quo in a world where daunting humanitarian and ecological challenges are not only mounting, but converging. Ten years on from the inception of *Bulletproof Skin: 2.6g 329m/s*, and in the continual wake of social injustice and state violence, the potency of Essaïdi’s work is unsettling.

Discover more about the artist and this project

VIEW THE VIDEO

MICHAEL SEDBON

CMD, Experiments in Bio Algorithmic Politics, 2019

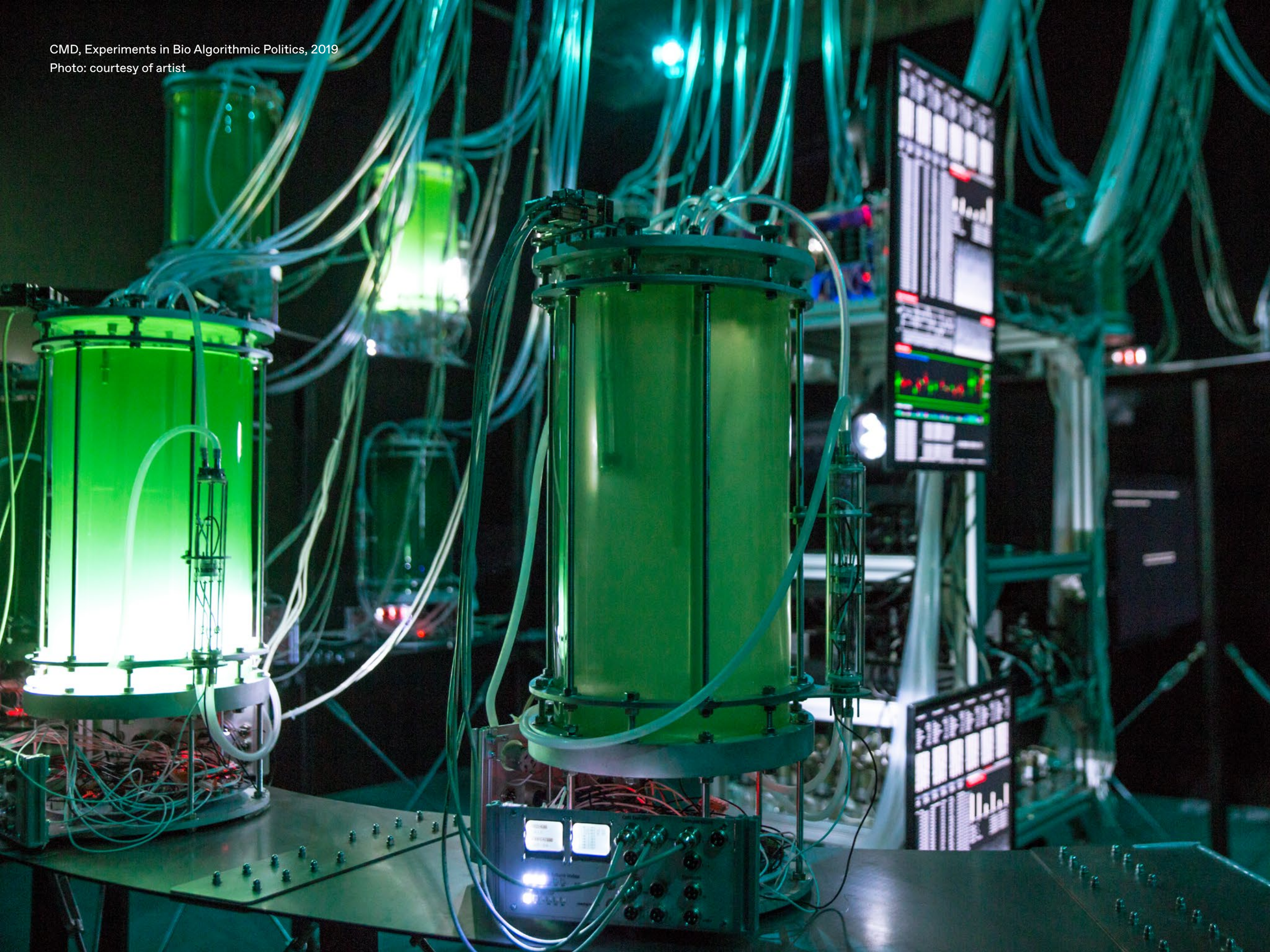
Mixed media installation, including bioreactors, light source, sensors, screens, and computer visualization of live data collection

Developed in collaboration with Assistant Prof. Raoul Frese at the Hybrid Forms ArtScience media lab, Vrije Universiteit Amsterdam.

Human driven design proved itself to be one of the most harmful expressions of our existence: fulfilling our needs and disregarding their impact on ecosystems. Various scientists, thinkers and even artists are thankfully proposing alternatives to this anthropogenic way of life. Micheal Sedbon, the winner of the 2019 Bio Art & Design Award is one of them. The Paris-based interactive designer and artist draws from the writings of Donna Haraway, Gilles Deleuze, Jean Baudrillard and leads a practice embedded in evolutionary design paradigms. A recurring element in his creations is the construction of miniature environments that marry microscopic life with digital and technological entities that make us understand technology as part of our natural environment.

In his 2018 work Alt-C he places an economic system in the hands of the weather by using the electricity produced by plants to power a computer mining crypto-currency. The neural network created predicts this mining based on the weather forecast, as it tries to come up with a strategy to reinvest the grown and harvested money into farmable land. The system then expands and attempts to plant more trees in order to provide the required energy. In this scenario where money seems to grow on trees, Sedbon speculates a boost of our economy by simply reversing our deforestation.

CMD, Experiments in Bio Algorithmic Politics, 2019
Photo: courtesy of artist



CMD, Experiments in Bio Algorithmic Politics, 2019
Photo: courtesy of artist

With the same witty spirit, he highlights the infinite benefits of photosynthesis in his Award-winning work *CMD, Experiments in Bio Algorithmic Politics*. The project appears to be taken from a science fiction film set but is actually a functioning life support machine. In it, two colonies of photosynthesis cells can claim access to light thanks to credits earned after their oxygen production. These are monitored by bioreactors that are hooked through a web of tubes to a computer. The photosynthetic cells Cyanobacteria, and the computer, experiment with different political systems granting access to the light source, while a genetic algorithm created by the artist changes the conditions in which the bacteria exist in order to optimize their production. This system links the living organisms with a market that wants to profit from them and for them. It oscillates between collaborative and competitive states while it records gene and historical data from one generation of bacteria to another. This collection of information is used for an increase in profit, something that is quite close to home, as data is becoming the biggest force that impacts our human societies and environments.

The project aims to highlight the tension between the prediction of bio-phenomenon and the repercussions these computations can have on life systems when they are implemented at a large scale: systems like the stock exchange or even a forest can be looked at as exhibiting a form of intelligence emerging from the sum of their own conscious actions and not us interacting with them. The efficiency of this data collection apparatus is ultimately dependent on the precision of the sensors that are the fruits of the collaboration between Sedbon and Frese, assistant professor at the Vrije University in Amsterdam. To achieve the high level of engineering and knowledge about Cyanobacteria required for the project, Frese's work to develop protocols for high resolution imaging of photosynthetic membranes proved crucial.

CMD, Experiments in Bio Algorithmic Politics is a critique on anthropocentrism, fitting into the movement of post-humanism and new-materialism. The designer manages through his work to translate scholarly writing that is usually considered quite dense or niche to a wider audience. It recognizes us humans as key agents for change and shows capitalism's relentless imperatives to expand itself. As most life on Earth is now modulated by human actions and infrastructure, we are led to ask: how our technologies and ecosystems interact, how our life-support apparatus is designed, and what politics do they serve?

Discover more about the artist and this project

VIEW THE VIDEO →

NADINE BOTHA

The Orders of the Undead, 2020

Installation of four 1-channel videos

Developed in collaboration with Prof. Henry de Vries at the Department of Infectious Diseases, GGD Amsterdam.

Nadine Botha is a journalist turned research-designer who works to highlight stories about repression, justice, and colonialism. From her work as co-curator of the 4th Istanbul Design Biennial in 2018, to developing and performing as part of the *TVclerici* exhibition of Design Academy Eindhoven at Milan Design Week in 2017, Botha has experience of bringing together diverse teams to create multimedia installations. Her artistic practice begins with archival research, which enables her to draw parallels between a wide range of disciplines and topics. This ability proved foundational in her bid for the Bio Art & Design Awards in 2020, which she won for her proposal that stood out for its in-depth and critical analysis of a specific theme in entertainment: zombies.

The Orders of the Undead is a project that highlights how ideas and behaviors that originated from the violence of colonialism continue to be propagated in our media, and feed everyday prejudices. The project demonstrates how these biases become magnified under the stress of crises such as the global pandemic, and how, despite being repeatedly debunked scientifically and socially, dysfunctional narratives of otherness continue to proliferate faster than one might shoot them down, just like the undead rising in their hordes.

Botha worked in collaboration with skin infections diseases specialist Henry de Vries, of the

The Orders of the Undead, 2020
Photo: courtesy of artist

Department of Infectious Diseases, Public Health Services Amsterdam; and the Department of Dermatology, Amsterdam University Medical Centers. The pair immediately clicked, both in terms of interests, but also shared convictions about the need for science and art to become more responsive to the social and political dimensions of the challenges we all face as global citizens. Their project started with conversations about colonialism, tropical medicine, and public health, but it was when Botha started researching what movies people were recommending watching during pandemic induced lockdowns, and her subsequent surprise to find that almost all of them were zombie movies, that the project really began to take shape.

The notion of the zombie emerged from Haitian voodoo practices, and was brought to Hollywood in the early 20th-century, where it manifested as a fear of the Black 'other'. As a result, early zombie films were usually racially loaded. A striking example of this being, the *Night of the Living Dead* (1968), a film that shocked audiences by casting Daunte Jones (a Black man) as the male lead – an affront to the social structures of the time, which were being mirrored in film conventions that often-resigned Black actors to secondary, often derogatory, clichéd, or offensive roles. The zombie also has its origins in colonialism, as when colonizers traveled to new and unfamiliar places they were also exposed to new diseases. The threat of infection became linked to indigenous and enslaved people, usually people of color, who were viewed as a threat to the White colonizers. These racial codes are still embedded in zombie movies, and the trope of the zombie as one of an infected person, who can also infect other people, and turn them into zombies, remains. The main ingredients of the zombie movie genre: colonialism, othering, the threat of infectious diseases, all converged during a year that brought a global pandemic and intensified calls for social justice.

For the final work and installation, Botha created four short films compiled of clips pulled from various zombie movies, that aimed to unravel the war-like language and metaphors of contagion used to 'other' and oppress different people and organisms, which have re-emerged during the pandemic. Three of the four reflected on negative aspects of zombie movies and their impacts on our society. A fourth film examined how, having learned what we have about infectious diseases and colonial legacies we might move forward, to undo the systemic injustices and everyday prejudices perpetuated by zombie mythology.

When presented at MU Hybrid Art House in Eindhoven, the films were projected in a completely green room, a reference to the green screen used for after effects in films; but also, digitally, through an annotated online archive and four custom social media filters available on Instagram and TikTok.

The Orders of the Undead, 2020
Photo: courtesy of artist

By entering an immersive and interactive 'green screen' environment, supplemented by augmented reality, visitors became part of the archetypal zombie film themselves, with the intention that their entanglement in the not-so-fictitious narratives of dominion was revealed.

This is a continuing theme in Botha's practice, which she uses to direct our attention to the oppressive metaphors around us, and reveal the lack of alternative stories present in mainstream consciousness. *Sugar: A Cosmology of Whiteness* (2019-ongoing), is a work that imagines an alternative, rhizomatic view on history that starts at the level of the sugar molecule, and is generated through a series of performance lectures and workshops. Using the sweet element of sugar, Botha manages to highlight the darker side of the transatlantic slave trade and the contemporary food industrial complex — or how the industrialized nature of our food systems has changed not only what we eat and how we produce it, but also our economy, ecology, culture, and even our individual minds and bodies.

For Botha, "The zombie project in particular has initiated an ongoing interest in the colonial origins and legacy in the sciences... It is very urgent to think how we talk about science critically without throwing the life-sustaining baby out with the merchants of doubt and conspiracy." Indeed, de Vries concurs that the way that knowledge about infectious 'tropical' diseases has been constructed is based on colonial, racist ideas. What the rise in racism and xenophobia prompted by the pandemic, and popularity of the zombie movie suggest, is that, although moving into the third decade of the 21st-century, such antiquated ideas continue to proliferate and are long overdue a redress.

Discover more about the artist and this project

VIEW THE VIDEO →

STUDIO PSK

The Economics of Evolution: The Perfect Pigeon, 2014

Mixed media installation, including video, graphics, selection of narrative objects, bird cage, and live pigeons

Developed in collaboration with Prof. Jan Komdeur at the University of Groningen, Centre for Ecological and Evolutionary Studies.

Patrick Stevenson-Keating is a trans-disciplinary designer who defies easy description, having worked in many roles, from instructor to creative consultant, in organizations just as varied, from Google to choreography Studio Wayne McGregor. Perhaps one of his defining abilities can be captured in the mission statement of Superflux, the creative agency where Stevenson-Keating first worked in 2012 after university training: “translating future uncertainty into present day choices.” To develop such a skill set early-on paved the way for opportunities including teaching and the eventual founding of his practice Studio PSK which then worked with clients such as museums as well as known brands like Sony for example, on a prototype to create immersive storytelling experiences in any sized room with new technology.

In 2014 Stevenson-Keating won the Bio Art & Design Award with the project *The Economics of Evolution: The Perfect Pigeon* in a proposal developed jointly with Jan Komdeur from the Centre for Ecological and Evolutionary Studies at the University of Groningen (BESO/CEED). Their starting point for the work was to examine the history of carrier pigeons, which stretches back as far as two millennia ago, when the birds were utilized to spread news within the Roman Empire. Subsequently, they have also been used in taxidermy, for entertainment in racing, and in smuggling of small items like narcotics into prisons. The team’s approach was to think of

The Economics of Evolution: The Perfect Pigeon, 2014
Photo: courtesy of artist

The Economics of Evolution: The Perfect Pigeon, 2014
Photo: courtesy of artist

them in the context of a speculative future in which competing biotech companies need to share sensitive information and do not trust digital transfer.

The team constructed a narrative around this, focused on two companies working in partnership to make health and medical products in Genome Valley in Hyderabad, India. They tell the story through objects, graphics, video and the presentation of live pigeons. As the story goes, the two organizations develop an elaborate system of security in which flocks of pigeons carry encrypted genetic data in their bodies, only a few of which have the correct data. Once those few pigeons, four in this story, are received, only then a fifth bird with a de-encryption key is released, makes the trip, and is received and used to unlock the information. Such a project borrows from the worlds of science fiction and encryption science, breaking down with simple language and animations how such a system could work, in an echo of how sci-fi authors such as Neal Stephenson construct plausible but slightly absurd scenarios to illuminate complex concepts in such books as *Cryptonomicon* (1999).

One of the inspirations for the work was learning that a few departments within the Indian police force were still using pigeons for communication with some communities as recently as 2004. The work also relates to other visionary speculations about how we might relate to non-human species in the

The Economics of Evolution: The Perfect Pigeon, 2014
Photo: courtesy of artist

future, either as they become genetically-modified service animals, or the relationship is more commensal, in which one party benefits and the other is unaffected. Such works include *Pigeon D'Or* (2008) by Revital Cohen and Tuur Van Balen, a project about using pigeons to clean the city, the *Crow Vending Machine* (2012) by Josh Klein, about training crows to collect useful objects, or, the more practical Guard from Above, which is a business that since 2013 trains eagles and hawks to destroy drones entering into restricted areas, such as airports. The work *Perfect Pigeon* was materialized in exhibition form with video, graphics and props including taxidermy pigeons, fictional annual reports, pharmaceuticals, and maps to relate the narrative, as well as a custom-built coup, housing live pigeons.

Regarding the collaboration, Stevenson-Keating points out the openness of the scientists to his approach to using speculation and narrative objects. In particular he came to think that the processes of his studio and that of the lab had overlap in their attitudes towards research generally, and in attention to detail in particular. The result of this collaboration, which is a rare combination of many-layered work that can be read on levels of different attention, education, and interest. The gallery presentation was complex, but it had entry points for many demographics to make it accessible, which is not universally found in art that takes in so many topics simultaneously, from cryptography to synthetic biology; in perhaps a symbol of its potency, before long there was an egg and nest found in the pigeon cages at the gallery.

Discover more about the artist and this project

VIEW THE VIDEO →

XANDRA VAN DER EIJK

Seasynthesis, 2017

8-channel sound installation

Developed in collaboration with Prof. Han Lindeboom and the Marine Research Institute Wageningen University.

Xandra van der Eijk is a Dutch designer and artist who uses her practice as a form of climate activism. The natural (yet human-altered) landscape, and our responsibility towards it is both the starting point and end goal of each of her projects, which span theory, fieldwork, documentation methods, and material development. Van der Eijk honed her methodology of merging art with ecology, supported by rigorous research after graduating from her studies. She completed a bachelors in Graphic Design at the Royal Academy of Art, and has a masters from the Interfaculty ArtScience at the Royal Conservatory, both in the Hague, the Netherlands. Her academic work continues in her current PhD undertaking at Ulster University in Northern Ireland, and her teaching for the MA Ecology Futures at the Master Institute of Visual Cultures in 's-Hertogenbosch, which she leads. She views both as an extension of her practice.

Urgency and empathy are themes that run throughout Van der Eijk's oeuvre, which communicates the climate crisis at the scale of human emotion and cultural identity. The project *RETREAT* (2019) examines the notion of ecological grief, or the profound sense of sadness and loss we feel at the disappearance of land to sea, ice to land, and animals to history. By the use of 3D printing technology Van der Eijk and her team recorded the retreating of a glacier in the Swiss Alps, and documented how the drastic changes in the landscape are

Seasynthesis, 2017
Photo: courtesy of artist

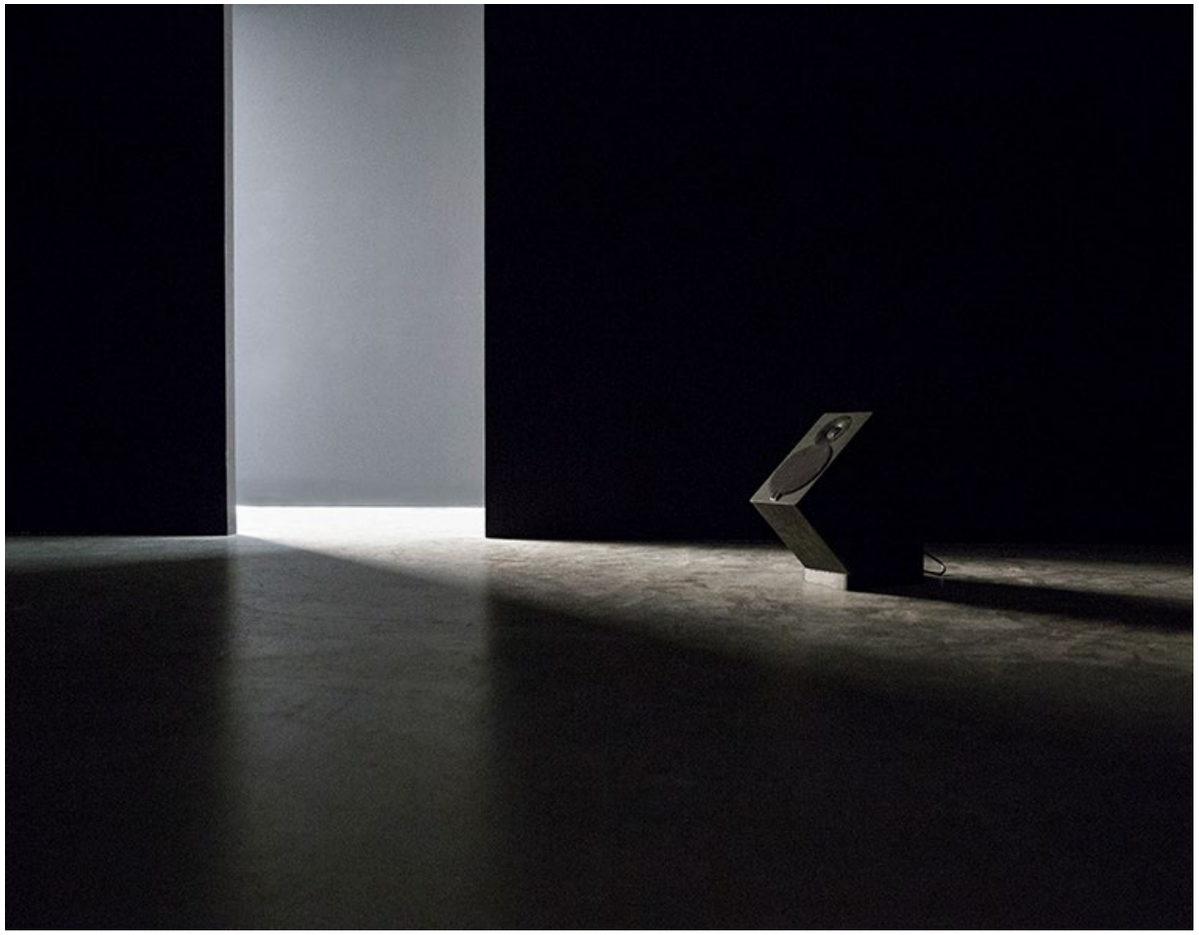
affecting local life. The project aimed to reveal how deeply interconnected humans are with the natural environment, and to bring awareness to the existential threats that are also a result of our overheating planet.

For her Bio Art & Design Award-winning proposal *Seasynthesis* (2017), Van der Eijk turned her attention to the North Sea. As one of the most highly trafficked stretches of sea in the world, the body of water is host to freight carriers, fossil fuel extraction, fishing, wind farming, and sand mining, among other activities. It is also the source of much of the cultural and daily lives of the people who live by it, holding a special place in their memories and imaginations. Yet how much do we really know of the North Sea, or any sea? What happens beneath the waves? And what can we understand of this from our limited terrestrial human perspective? These questions are central to *Seasynthesis*, which provides access to the North Sea through listening.

For the project, Van der Eijk worked with Han Lindeboom, Professor of Marine Ecology at Wageningen University / AEW and Royal Netherlands Institute for Sea Research (NIOZ) to record the underwater clamor of human industrial activities that take place everyday in the North Sea and bring this unknown soundscape to the public. Their process involved developing a special hydrophone that was capable of recording independently and at depth. The hydrophone was taken out to sea and left far off shore, where the sea is rough and hostile, where it recorded sound for several days.

These initial soundscapes provided an immense amount of data that was rendered as a two-and-a-half-hour, 8-channel immersive sound composition for its initial presentation in the exhibition *Life Time, Biological Clocks of the Universe* at MU Hybrid Art House, Eindhoven. The effect was a sensorial installation which leads visitors by the ears into the underwater world of the North Sea, immersed in a surreal cacophony. In this materializing of anthropogenic noise pollution, through sound and vibration, the project aimed to engender a feeling of inter-species empathy, whereby humans are transposed temporarily into the aquatic life of the North Sea.

Part of the collaboration with MU included a masterclass where participants learned how to construct their own underwater microphones. Winning the Bio Art & Design Award has enabled Van der Eijk to develop this branch of *Seasynthesis* into an ongoing research project, which includes promoting crowdsourcing data on sound in the sea. By making listening to underwater worlds accessible it is her hope that citizens can begin to monitor human activities in the North Sea. Such ecological conservatorship could be seen as the next iteration of the relationship between locals and the sea, one of special significance in a country such as the



Seasynthesis, 2017
Photo: courtesy of artist

Netherlands. With an international reputation for water management, and as the home of monumental industrial projects such as the Delta Works, the interconnection between land, people, and water is historically contentious and complex. *Seasynthesis* in this context is an instrument that might inspire a more harmonious kinship, based on empathy and respect.

For too long the effect that human sonic activity impacts underwater ecosystems has remained conveniently hidden, allowing for exploitation of these grounds to continue. *Seasynthesis* not only brings these activities to our consciousness, but equips us with the emotional and practical capabilities to do something about it. By taking an anti-anthropocentric approach to the environment the work signals the urgency to alter our collective treatment of the North Sea, and the planet in its entirety. Simultaneously, Van der Eijk points our attention towards the need for large scale systematic changes that are required if we are to live more emphatically with other species.

Discover more about the artist and this project

VIEW THE VIDEO →

Xandra van der Eijk

Artist and Researcher

Given your long interest in ecology as a subject and medium, are there new developments in climate science or policies for climate-change-mitigation that you think hold a lot of potential for artistic response?

That is an interesting question, because ecology and climate science are actually two different fields of research. Thinking traversal and transdisciplinary is typical for the arts, not for the climate sciences. That's also immediately where the potential for artistic response lies in my opinion; to draw those connections and look at the questions that are not being asked by (climate) science. I am a strong believer in *staying with the trouble*. Climate science has done the majority of its groundbreaking work already; proving human-induced climate change is real (by being unable to prove climate change is *not* real, after years and years of research). *How* changes will take place has also been long predicted. The discussion is now political and social. Also in terms of mitigation — it requires political action and social support to take measures serious enough to limit the effects. Art can play a role in this, alongside other disciplines.

Did you have memorable experiences in youth or early at university that gave you a strong motivation to work in ecology and to support and participate in activism?

Two memories come to mind; a moment when I was pondering the concept of time at age 10 (or so), walking past a pool on holiday thinking: “isn’t it weird, now I’m here, and in a moment, I will be there.” That simple thought experiment, connected to place, in some way still drives me. Markers of time and processual change are still at the core of my work. Another memory goes back to my stepfather, who has always voted liberal. He is (although I was of course not aware then) the perfect example of a privileged white male and a strong believer in capitalism. In my early youth I lived in poverty, though I only learned that through the change in marriage — my mother took care of us very well. But this change did probably influence my thinking. My stepfather said to me: “I understand you would vote for equality now, but wait until you grow older and earn money. You will change your vote to work in your own best interest and protect the money you’ve earned”. I profoundly disagreed, and I still do.

Are there artists or designers who you would call inspirations? Relatedly, is there a single work that stands out to you as something to aspire to in your practice?

I’m currently most inspired by the exhibitions and long-term research projects taking place, such as the Critical Zone project at ZKM Center for Art and Media Karlsruhe, or the Anthropocene Curriculum project at HKW Haus der Kulturen der Welt. I rarely find singular works exceptionally interesting, also not my own work. I find inspiration in how works collectively can address the complexity of a topic such as environmental change. They all become parts of a puzzle that challenges my thinking and forces me to (re)position myself. There are of course artists or projects I find inspiring; *Resurrecting the Sublime*, a collaborative project between Alexandra Daisy Ginsberg, Sissel Tolaas and Ginko Bioworks for instance. The collective work of Forensic Architecture. And the material poetics of Cecilia Jonsson’s work. Most works are collective efforts, and are not one-dimensional. The latter is certainly something I aspire to in my own practice.

In what ways has winning the Bio Art & Design Award influenced your creative practice?

I would say in every possible way. It has given me confidence, allowed space for my practice to develop and see the worth of the work in every stage, it has opened my eyes to new methodologies, new theories and new ways of presentation. And it landed me in a vibrant and colorful network that I am happy to be part of.

Can you talk a bit about your experiences of collaboration in your projects, such as with Han Lindenboom, and one other?

In the end, all collaborations are between two persons who share a common goal. Winning the Bio Art & Design Award with Wageningen Marine Research, it turned out that the institute did not facilitate a lot of practice-based research. And my project was about gaining access to the North Sea, a difficult (and very practical) task on any given day as it is a rather unforgiving environment. Luckily, Han Lindeboom, with whom I was collaborating, also had a position at the Royal Netherlands Institute for Sea Research (NIOZ). Through his network, we managed to realize the project. I dare say there are not many scientists working with North Sea sound who have not yet heard my name by now — it took time to create understanding for the proposal and the extra tasks it meant for the researchers going out to sea. But in the end the recordings are valuable and of interest to other scientists. And this is precisely what makes art-science collaborations interesting; you do the thing you both would not normally do, and that may produce something unexpected and interesting. It's a leap of faith from both sides. That is at least how it works in most of my projects; I rarely end up where and with whom I've started.

Can you please name one or two things that surprised you (or continues to surprise you) about the process of collaborating with a scientific partner?

What continues to surprise me is the well-defined area of expertise of a scientist, and how that compares to me as an artist who is trained to see infinite possibilities and connections between, well, anything. This is not to say that scientists are not creative, not able to find connections, or something like that. I mean to say that this creativity and connection-seeking is happening within that specific area of expertise. What also continues to surprise me, is how close artistic and scientific methodologies come together. I would argue art and science have much more in common than they are different, which is the general assumption, that they are two worlds apart.

If you are granted a million euros and 5 years to work on any project, what would it be?

I would get a fully interdisciplinary team together, work in-depth on a geographical place that demonstrates the complexity of environmental change in full and map these complexities out in every possible way. And to do this in the West! Not being on the frontline of the effects of climate change, and having the financial strength to solve any issue at hand, removes

the feeling of urgency in our European societies. So there is a task here, to uncover how the different systems operate through and alongside each other, and whom that is affecting; also in terms of neocolonialism. It would be quite amazing to do a project like that, in unison. I think that is why I am inspired by for instance Forensic Architecture, or Follow the Money, or Bellingcat. On an anthropological level by Ana Tsing. And on an artistic level by the aforementioned research projects. But there is space, and need, to do much more.

Was there anything distinctive about the exhibition-making process with MU that stands out to you?

Yes, the incredible production support. You can come with ideas and their team will think with you on how to make it reality. Furthermore, you always have the guarantee of a great exhibition with good names, and a good side program that allows you to think about extending your project into a talk, performance or workshop.

What do you think of the state of the bioart and biodesign fields in the Netherlands now? Are there other places that you think have become (or are becoming) prominent in supporting such content?

I definitely think it gained traction… The Bioart Society in Finland is going strong, as well as the Kapelica Gallery in Slovenia. But it is still a niche, especially bioart. I also feel all communities have their own specific character, and therefore they strengthen each other more than they become competitive. In the field of biodesign, you see that it is quickly being promoted and adapted. Atelier LUMA is one example, and the Growing Pavilion by Lucas de Man is also getting a lot of attention. However, I don't see it going much further than Mycelium, Kombucha (bacterial cellulose), and working with waste streams or making materials from renewable resources. These efforts are already years old and are only just becoming mainstream now. The MA Ecology Futures at the Masters Institute of Visual Culture in Den Bosch (which I am course leader for) is the first and only education program in the Netherlands that focuses on bioart (and design, but beyond the above-mentioned). I'm pretty proud of that and we wouldn't have chosen that direction if there was a lot of competition. But there is still so much work to do!

Do you foresee future collaborations with scientists, in your ongoing efforts to advance an anti-anthropocentric view?

Well, at the moment I'm undertaking my PhD with two scientists as supervisors, a glaciologist and an oceanic geologist. So it may be expected! However, it is not an easy track to pursue, and I always like to keep my options

open for the work to develop in any direction it may take. I am certain I am describing my methodology for others to build on in the future, which is inherently monist, as it departs from the *materiality of place*. This is my red thread, always, through any collaboration and any subject.

Can you talk a bit about your teaching practice and how it has evolved in the last few years?

Over the past three years I have had the absolute honor to develop the curriculum for the MA Ecology Futures. It has been the most amazing journey, where I keep on finding myself challenged and excited. At the moment I don't teach, but I am responsible for developing the curriculum, the team, and the collaborations. It's pioneering, and that's what I love doing. At the entrance of the school we have a professional biolab and adjacent project space. We run four electives on bioart and design, given by Adriana Knouff and Emma van der Leest. So far, we've worked with mycelium, bacterial cellulose, slime molds, lichen, body bacteria, and cyanobacteria. Classes range from material making to conceptualizing social and political issues through what we know of microorganisms. Besides placing bio at the heart of the masters, we also teach ecological art and activism, sensory technologies, mapping strategies, worlding, and ritualistic practice. All this is accompanied by strong theoretical and writing training founded in race theory, disability theory, ecological thought, and science fiction. I'm incredibly proud at how we are growing together as a team and community — in September 2021 we started our second year, and in June 2022, the first Ecology Futures graduates emerged. I can't wait to see what they will do.

“The Grey Zone”

GUEST ESSAY

A plea for the undefined, untried, and ultimately, the uncontainable

By Xandra van der Eijk

The undefined

In the Dutch Eastern Scheldt, where the River Rhine and River Meuse find their way to the North Sea, a particular ecosystem developed because of the installation of a revolutionary storm surge barrier after the disastrous floods of 1953. The barrier opens and closes according to the rise in seawater level, transforming the delta into a “controlled” environment with an altered tidal zone, in turn leading to an altered ecology. Whereas the installation of large technocratic structures often leads to a negative effect on biodiversity, the barrier in the Eastern Scheldt created an eerily beautiful place for life to thrive. Organisms traveling aboard or attached to the ships moving through the body of water, enjoy the area’s calm shallows, and make their home there. This is particularly true for colourful and diverse macro-algae, seaweeds, that in the Eastern Scheldt find rocky substrates to attach to, otherwise missing along the Dutch coastline.

Further south, another significantly human-altered tidal zone sets the parameters for life to develop in a comparable way. In the French region of Guérande, traditional salt evaporation ponds have been in operation since Roman times. The clay-rich coastal soils are shaped into pools that become increasingly shallow as they stretch inland. As the water moves from basin to basin, the power of the sun saturates the seawater to the point of crystallisation. The whole system is an equilibrium of forces; the Anthropos – the human –, the sea, the sun, the tides – ultimately leading to a specific ecology that exists by the grace of the entire operation. The salt-rich basins form an important and unique habitat for extremophile micro-algae; micro-organisms that have a certain superpower, such as, in the case of Guérande, an extremely high tolerance to salt. Under the right circumstances, algae blooms turn the area into abstract squares of stunning colours, as their sheer quantity makes their hues easily visible.

In the Eastern Scheldt and the Guérande, the Anthropos is an important force in the emergence of their specific ecologies, and so becomes an evolutionary agent. In western societies, where nature is generally considered separate from culture, this fact contributes towards a sense of anthropocentrism and human domination – a top-of-the-food chain narrative, further supported by the positive effect of unintended increased biodiversity. However, different perspectives reveal themselves when probing the natural history of these two regions. In the case of Guérande, centuries of equilibrium have been recorded, non-invasive anthropogenic practices that work with other natural forces and do not disrupt ecological cycles. In the case of the Eastern Scheldt, this remains to be seen. What is sure, is that equilibrium has, so far, not been reached; invasive species take over native ones, and when there is little influx of fresh water, oxygen depletion creates an environment hostile to life.

For the exhibition Fluid Matter, held at MU Hybrid Art House, Eindhoven, in conjunction with the Bio Art & Design Awards in 2016, both ecosystems were re-enacted alongside one another by means of prototypes in the works *Estuary* (2016) and *Genesis* (2016). Artistic research with and through the materiality of each place was used as a method to investigate the role of the Anthropos as evolutionary agents. *Genesis* was presented as a laboratory experiment; whereby groups of Erlenmeyer flasks containing samples of wild harvested cultures from Guérande's salt evaporation ponds were exposed to several artificial environmental scenarios. Altering levels of salinity, temperature, and light, the aim was to trigger the organisms' ability to change color, ultimately attempting to recreate the hues of their original habitat.

Estuary consisted of four glass cylinders, containing different types of invasive Eastern Scheldt seaweed. As the saltwater algae within decayed, due to a hostile freshwater environment, plentiful life sprung from its forced death. This process visually unfolded through the release and change in colours produced by the different seaweeds and organisms taking part in the work. The dynamics of color change in the work drew the public in as observers of a fast-tracked evolutionary process; one where organisms decayed and thrived in an ecosystem initiated by the artist, the Anthropos. Spectators could return to the work and observe multiple natural cycles that normally unfold over timespans ranging from months to centuries, in a timeframe that was comprehensible in relation to an anthropogenic sense of time. The work was conceived with the intention to evoke thoughts of who has the right to live (or even thrive), and to challenge the idea of anthropogenic control and domination.

In the ecosystems of the Eastern Scheldt and the Guérande, and those of the respective artworks, the border between human and

non-human is fluid, and not definable as *a one singular thing*. Rather, it is an undefinable patchy assemblage of many things that are in constant exchange and transition. In "Staying with the Trouble" (2016), ecofeminist scholar Donna Haraway argues that no *thing* makes itself, rather everything happens collectively and collaboratively. Perhaps then these places (and by extent the artworks) can be considered *grey zones*, defined by the Oxford Dictionary as the "intermediate area between two opposing positions; a situation, subject, etc., not clearly or easily defined, or not covered by an existing category or set of rules."

The untried

In her thesis "Uncontainable Life; A Biophilosophy of Bioart", feminist scholar Marietta Radomska defines bioart as a form of "hybrid artistic-scientific practice" (2016); which moves through and beyond such dualistic boundaries as living and non-living, human and non-human, organic and inorganic. Additionally, she understands bio-artistic practices as focussing on the exploration and enactment of life, characterizing them as processual and uncontainable. This is certainly true for those that have been involved in the Bio Art & Design Awards over the past decade. Yet rather than adhere to any clear definition, the research projects and artworks that have emerged from the award have, more than once, returned to the same, crucial question: "what is human?" and by extent: "what is life?"

For Evolutionaries, the 10-year anniversary exhibition of the award in 2020, winner Sissel Marie Tonn and collaborating scientists Heather Leslie and Juan Garcia Vallejo, centralized microplastics in the science fiction film *Becoming a Sentinel Species*. Microplastics traverse timescales and ecologies; from their organic origin as crude oil, through the processes of human transformation of matter into plastics, to their degradation into microplastic particles that travel the waterways to the sea – entering the human body on their way. In stating that humans are thus a marker of environmental change, and by suggesting humans might have the agency to *actively welcome* this new matter into the body, Tonn exposes the intricate weavings of a material protagonist that is never static, but that is vibrant, and lively. In doing so, she questions where the body begins and ends; the body itself becomes a *grey zone*.

Whereas Tonn invites the outside in, Cecilia Jonsson, in collaboration with scientist Rodrigo Leite de Oliveira, explores the *grey zone* of the inside-out. In the installation *Haem*, 2016, placentae were collected from donors, to extract the iron within, which was then forged into a compass needle. The placenta is a temporary organ, which facilitates a process of exchange between mother and developing child. A complex maze of blood vessels, the placenta primarily moves blood, the iron in the blood in turn moves oxygen to the foetus. For Jonsson's project, 69 mother-child bonds, 621 months of pregnancy, and thousands of hours of labour were compressed into a single needle, an inner-outer compass that points to the Earth's magnetic north. The bodies' mineralization is forged into a highly symbolic object, proving that biology is simultaneously geology, constantly interacting with the forcefield of the planet to which all are subjected. The projects by Tonn and Jonsson together portray *life* as a *grey zone*, a primordial soup of fluids in constant exchange. The borders between inside and outside, body and environment, biology and geology, human time and deep time, are fluid and constantly re-inventing themselves.

The outcomes of both projects were manifested as artworks without any living matter present in the gallery. Rather, they materialize as experience-based, sensory spaces that immerse the spectator in another reality. The ability to create worlds is an expansion of the toolkit that artists have at their disposal, one that invites the spectator in to explore the agency

of the artwork, *building intra-actions*, a term coined by feminist theorist Karen Barad. In their words, "intra-action understands agency as not an inherent property of an individual or human to be exercised, but as a dynamism of forces" (2007). The spectator-artwork relationship might then be considered another *grey zone*. This type of exhibition making, both from the viewpoint of artists, and the curatorial and award team, seems to be characteristic for this community. Denouncing the often made, but narrow definition of bioart as artworks that solely use living matter as a medium, the curatorial team has always emphasized the importance of a broad framework in which the newly made works should be viewed, as they often address urgent environmental and social questions that require contextualization. In doing so, the community embraces the *grey zone* of bioart in all its diversity; enabling exhibitions to bring together an unlimited range of methods and media including documentary and speculative film, soundscape, olfactory, material design, choreography, core drilling samples, performance and, of course, installations featuring live organisms. "Processual and uncontainable" indeed.

The uncontainable

At the heart of the Bio Art & Design Awards is the desire to bring together art, design, and the life sciences. If there is such a thing as a *grey zone*, the art-science collaboration is certainly the greyest of them all, as it is subjected to all the potentials and pitfalls of misunderstanding to which building art-science relationships are prone. In the different ways art-science collaborations may take shape – as communication tool, to facilitate dialogue and express learning, and as a means of transformation (Bentz, 2020) – the latter has always been the goal of the award. It is generally seen as having the most profound effect: "The outcomes (...) may greatly differ from those of engagement in or with art in the sense that they potentially create a deep, long-lasting impact on the participants and audiences, which can then enable transformations in the way they relate to, feel about, and act (...)" (Ibid). Art as a means of metamorphosis is characterized as evolving in an act of co-creation, by being transdisciplinary and open-ended, and as generally process-oriented. To agree upon co-creation is an important acknowledgement for both parties, as it clearly indicates a relationship between artist and scientist that is mutually beneficial, and in which both must mutually invest. In other words: "both sides need to be prepared to be surprised and challenged, to invest time in getting to know one another and to trust their different expertise" (Nature 590, 528, 2021). Thus, by departing from common ground "both [scientific and artistic] communities aim to discover, explore, and illuminate" (Leavy, 2015).

In the life sciences and physics, matter is increasingly considered an open, complex system with porous boundaries, which creates the need to reconsider the interactions between physical and biological paradigms. As such, these fields of research are ahead of the arts, working on futuristic scenarios and already understanding the present as different from what is generally accepted as fact. Specifically, biotechnology is leading the way with revolutionary breakthroughs such as CRISPR-Cas9 for editing genetic material. The artist's invaluable quality is to contextualize and criticize these developments, as well as speculate on their possible implications and possibilities. In her six-year long research project *In Posse* (ongoing), Charlotte Jarvis utilizes her position as artist in a process of co-creation to develop 'female' sperm with professor in developmental biology, Susana Chuva de Sousa Lopes. Chuva de Sousa Lopes' techniques and understanding of sex is ahead of the generally accepted binary of men and women, yet Jarvis' additional contextualization from the perspective of activism, "to disrupt the hierarchy that is evidenced by the symbology of semen, and to basically, undermine patriarchy" (Jarvis, 2021) brings a

whole new layer to her research. “It certainly is fun”, De Sousa Lopes says, “having Charlotte in my life makes me a better scientist”.

Science can already explain that sex effectively does not exist; and that if it does, it exists somewhere *in between* chromosomes, DNA, the brain, and the body. By genetically altering DNA Jarvis gives her own cells agency; and explores their storied quality in the form of installation, ritualistic performance, and film. The intra-actions between artist and scientist, subject matter and context, living cells and their manipulation, and artwork and spectator in turn all produce new intra-actions, leading to an uncontainable effect. In doing so, Jarvis practices “the sexualized nature of matter itself and the radical immanence of power relations and their effect upon the world” (Dolphijn and Van der Tuin, 2012).

To work with living matter as an artist is to manipulate life, thus embracing fully one’s position as an evolutionary actor on par with other living and non-living agents. The migratory ecologies of invasive seaweed, the UV and salt tolerance of extremophile algae, microplastics traversing intertidal zones and bodies alike, iron forged inside and outside the body, and the location (or absence) of gender in the human body, all voice their agency through the process of art. The research-driven projects of the Bio Art & Design Awards push the untried into lab- and gallery experiments that become explorations of a *grey zone*. If the aim of bioart in general is to “contribute to a more nuanced understanding of life”, the true treasure of the awards (and the community that it cultivates) lies with feeling empowered to move *in-between*. Collectively refusing any clearly defined notion on what life is, never placing a limit on what life can be, and embracing the complexity of ecological entanglements, allow all kinds of different forms of life, art, and scientific research to co-exist and intra-act with one other. Beyond that, no matter how *the grey zone* is explored and interpreted, there is always the humus on which it lands: the fertile grounds of MU Hybrid Art House; including a curatorial team *and* audience that knows how to read, translate, and position the works, even if they are in a constant state of becoming. The Bio Art & Design constellation has thus been a literal breeding ground for “hybrid artistic-scientific practices”, a stubborn big patch of bacteria, together practicing horizontal evolution.

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INTERVIEW

Angelique Spaninks

Director and Curator, MU Hybrid Art House

Can you describe some of the challenges that are unique to exhibiting bioart and design? What advice would you offer to curators or others involved with exhibition making in this field?

Of course, there are specific challenges to exhibiting bioart and design as it is sometimes (not always) alive. This means it requires more regular, often daily attention. Sometimes it is specifically DO TOUCH instead of don't touch. Often the living matter needs feeding, watering, cleaning, adding light or darkness etc. or it touches other senses than the eyes – it smells/stinks, moves, multiplies, comes to life or dies and dissects etc. It often also requires both staff and audiences to be sensitive, open and respectful about our human perspective in relation to non-human lifeforms. Most museums and exhibition spaces are only beginning to be able to deal with these kinds of engagement, but the best way to do it is to simply begin and experiment with it - don't be too afraid or fall back on video registrations when it can be done live. That's what we did eight years ago and it has taught us a lot.

You had first studied and worked in journalism prior to exhibition-making and artistic leadership; can you say how that earlier experience influenced your practice? For example, are there parts of the storytelling process in text that relate to exhibition design?

I have a mixed, more generalist background – I am trained in journalism and studied Arts & Cultural Sciences at Erasmus University and was always looking at where the fields of media, art and science meet and intersect. And that is what after 25 years of practice is still the most interesting to me, in fact I see it growing over the last couple of years. For me the art world has never been that interesting as a world in itself, that is why I did not study art history. I think the most interesting contemporary artists and collectives use research methodologies from journalism and science, combining these with esthetic but also ethical or even activist practices. They explore new ways of storytelling, new narratives, new media and are open to less controlled, more experimental and hybrid, non-linear and intuitive ways of making sense of the world – both in the now as what can be learned from the past or projected into the future.

Can you talk about your experience working on the Guangzhou Triennale in 2018? In what ways are audience expectations and engagement different there, as relates to bioart and biodesign?

The experience was a rocky but also very enlightening process for me as well as for the Chinese Museum team. They specifically asked me and my two fellow-curators to bring in digital, technological and bioart and design and so we did. But the Chinese museum system is rather rigid in planning and giving space to newly made artwork – not only censorship needs to have all details months in advance and sometimes gives a final say about two weeks before opening (a lesson we learned the hard way), also the (state run) museum system requires strict policies in materials and no surprises in outcome. Especially in bioart and design that is almost undoable as it is alive and dynamic in essence. But the often young and culturally eager audience is hyper interested to learn and discuss. And with their roots in Buddhist and other cultural philosophies the Chinese have quite some different approaches to working with living matter, non-human life forms and biotechnology that are highly intriguing and able to open up our Judeo-Christian biases and assumptions about life in general and the relation between nature and culture, humankind and the non-human.

Are there common elements you witness in the most fruitful collaborations between scientists and artists or designers that have been involved in the Bio Art & Design Award?

The most interesting collaborations seem to be the ones in which both parties are highly interested in the other, sometimes to a level that they almost switch positions – like the artist not wanting to leave the lab and diving deep

into theory and research and the scientist going loose on speculations and free associations. Of course, each project and collaboration is quite different and there is no blueprint for these types of temporary intense co-creative processes (and there shouldn't be) but I do think after seeing so many different teams working together that it is most fruitful when both throw themselves in completely and first let go of their respective roles and disciplines to explore their shared fascinations and then go back to the project at hand. It looks like teams that have found each other on that meta level of interest not only are most fruitful in the eventual Bio Art & Design Award project but they also stay in touch much longer and develop the collaboration much deeper and far beyond Bio Art & Design Award itself.

Have there been some unexpected reactions by audiences to work in the MU Bio Art & Design Award presentations? If so, can you please describe them?

What I notice over the years in which we have set up yearly thematic bioart and design exhibitions around the three Bio Art & Design Award winners is that the audience has learned to appreciate, question and explore more and more. I think the fact that every winter school group could come by and dive deeper into questions around biotechnology and biodesign, seeing how science informs art and the other way around has built up quite a following. We notice it especially resounding with a young audience – and we see a growing group of art students open to working with it themselves. And of course, that was one of the aims we've had from the beginning. It is not pure science dissemination and it is not pure art what we are doing – it is a hybrid practice that since the beginning of the Bio Art & Design Award 10 years ago has found its momentum by jumping out of the wetlabs and frontrunners studios into the cultural field in many different ways.

What do you make of the proliferation of exhibitions, books, courses, and awards that include bioart and biodesign? It seems these were uncommon just a few years ago, and now these topics are popular in many countries.

I am really happy the field of bioart & design (which I deliberately keep mentioning in one breath because it underlines its hybridity in a meaningful way) is developing so rapidly in all directions as I believe it can and will have such a huge impact in the upcoming years that it deserves full attention and many perspectives and ideas and practices to join. Also, I think it is highly important that a wide audience becomes familiar with it and learns how to critically reflect and learn what the biotech revolution means for our everyday lives and

culture – if only to not run into the same trap as we did with the digital revolution 40 years ago.

What do you think the impact of the Bio Art & Design Award has been in the Netherlands in the cultural sector?

I think the impact is quite deep and still growing. Over the past 10 years a wide network of interested artists, designers and scientists has been established for which the Bio Art & Design Award has been the breeding ground. From there a lot more collaborations and relations have formed and are still proliferating – both national and international. Also, I like to think of all the winning artworks as a collection of highly interesting and pretty diverse examples of what bioart & design can be. When we started there were only a couple of institutions and festivals working in this field in a not so public way, mainly wetlabs and research based smaller art spaces. In the past eight years, we've seen many institutions appear, grow more mainstream and reach a wider audience. Also, some festivals like Sonic Acts, Dutch Design Week, Fiber, Today's Art and STRP have widened their view from pure digital and media arts to more emerging arts including bioart & design. I think the more attention the better as there is still a lot of knowledge and awareness to be questioned and shared.

Can you talk about an artwork or design project from the Bio Art & Design Award you feel has not gotten yet enough attention and consideration?

I would sincerely like to ask full attention and consideration for the last three winners of the Bio Art & Design Award: artist Sissel Marie Tonn with scientists Heather Leslie and Juan Garcia Vallejo; designer Dasha Tsapenko with scientist Han Wösten and designer Nadine Botha with scientist Henry de Vries. They have worked so hard and under such challenging circumstances due to Covid to develop their projects and succeeded so well only to be able to show their great works in our exhibition for not more than three days before the third lockdown was denounced. And that one lasted almost half a year so even the prolongation with an extra two months on show did not make any difference for them – there was no audience allowed. Luckily, we were able to make short clips about their projects that we and they can share online – but they would have deserved a live audience that could feel, smell, immerse, and interact with their projects. Same goes for the other nine artists that were part of the Bio Art & Design Award anniversary exhibition Evolutionaries. They were all previous Bio Art & Design Award winners and we had planned to tour the exhibition to China after it was on show at MU but

the unpredictability of Covid and all safety regulations and sensitivities around biomatter makes it probably impossible to go there any time soon.

Can you talk about the context of Eindhoven and how the Bio Art & Design Award may have influenced or enriched the cultural context? For example, supporting the BioArt Laboratories startup?

I think the fact that BioArt Laboratories and MU teamed up to bring the Bio Art & Design Award to Eindhoven have meant a lot to both of us and to putting Eindhoven on the map as a hotspot for bioart & design in general. Jalila Essaïdi, founder of BioArt Laboratories, was one of the first winners of a Designers & Artists 4 Genomics Award (DA4GA the predecessor of the Bio Art & Design Award) and has experienced herself what it meant – for her own practice but also for media and audience attention for the discipline. As curator and director of MU I was already very interested in her work and the discussions around biotech, and bioart and design, and Jalila was looking for places to show work and get a wider audience interested. Together we initiated a small conference at our former location in De Witte Dame and things went from there when we moved to our current space on Strijp S. After three years of showing only the three Bio Art & Design Award winners in science museums Wilma van Donselaar of ZonMW was looking for a partner in the art world to bridge the gap to the cultural field in a more consistent and contextualized way. She came to visit our new space and we decided to collaborate, with MU not only helping produce and show the three winning projects each year but also curating a bigger bioart and design exhibition around them. And that's when the Bio Art & Design Award took off and started generating a yearly growing interested audience and wide network of related artists and scientists.

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