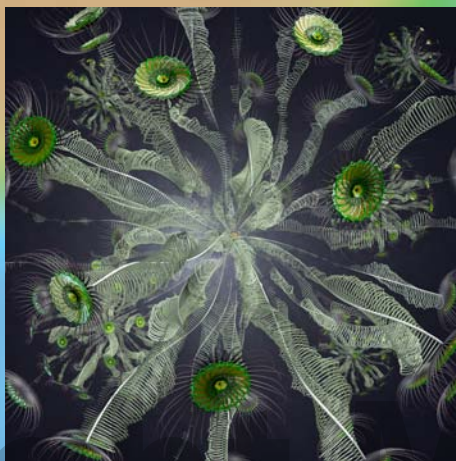




Bio Art is an emerging art practice that responds to the new and often dislocating realities revealed by the advance of the life sciences. This book presents work by more than sixty contemporary artists who blend techniques from the laboratory – such as tissue-culturing and genetic engineering – with traditional art-making. The results evoke an ominous future where human manipulation of the natural world has altered cultural norms, with results both beautiful and alarming.



Bio Art Altered Realities William Myers

# Bio Art

Altered Realities



# Bio Art





# Bio Art

## Altered Realities

William Myers

*With 300 illustrations*



Thames & Hudson

To my collaborators, especially Mariam Aldhahi, Julia Buntaine, Daniel Grushkin, and Wythe Marschall.

Front cover image · Vincent Fournier · Great Grey Owl (*Strix predatoris*) with predator-resistant feathers from *Post Natural History* · 2012–ongoing (see pages 24–25)

Back cover images · clockwise from top left:  
Kate MacDowell · *Daphne* (detail) · 2007 (see pages 48–49)  
Neri Oxman · *Arachne (Self Portrait)* from *Imaginary Beings: Mythologies of the Not Yet* · 2012 (see pages 54–57)  
Mark Dion · *Mandrillus Sphinx* from *The Macabre Treasury* · 2013 (see pages 106–108)  
Jon McCormack · Evolved plant form based on the BP logo from *Fifty Sisters* · 2012 (see pages 184–85)  
Vincent Fournier · Brown-cheeked Hornbill (*Bycanistes attractivus*) with unbreakable beak from *Post Natural History* · 2012–ongoing (see pages 24–25)

Frontispiece · Kate MacDowell · *First and Last Breath* · 2010 (see page 48)

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for Reference Only



# Foreword

## Suzanne Anker

The influence of the biological sciences on the visual arts can be traced back to the furthest reaches of human history. From Paleolithic cave paintings of human–animal hybrids to periods of grotesque and Romantic art; each significant innovation in the sciences and related technologies has created a tier of attendant cultural expressions in the arts. For the Romantics, symbolists, and surrealists, paintings, sculptures, and photography were an expression of tacit anxiety amidst technological and social upheaval that altered stable ways of life. At the same time, the astonishing nature of Charles Darwin’s evolutionary theory and Sigmund Freud’s evocation of the unconscious jolted man’s conception of his own agency, compelling him to reconsider what was already known.

In the present day it is Bio Art that responds to the need for cultural expression in a time of change and unknowns, and it is gathering steam as an international art movement. It is neither media-specific nor geographically bound, and its development is flourishing in art schools, studios, and amateur and professional labs worldwide. In such a climate of experimentation and energy we can fairly say that this genre will continue to thrive, fueled by the rapid advances in biological sciences as well as the growing need for the public to engage with them. As the works profiled in this book collectively attest, the creative output of this practice demonstrates that we are, in fact, living in a “Biological Age.”

Bio Art is an umbrella term for a host of practices that draw from fields such as synthetic biology, ecology, and reproductive medicine, often combining art’s pictorial processes and nature’s living library. Simply put, Bio Art employs the tools and techniques of science to make artworks. Harnessing microbes, fluorescence, computer coding, and various types of imaging devices, it brings to the fore the ways in which nature is altered by humans. Its results are part critique, part irony, and sometimes part hard science. At other times the works resemble science fiction narratives, projecting possible, and sometimes frightening, future scenarios. Bio Art is therefore an arena that requires dedication to two mistresses: the visual arts and the biological sciences. One without the other is insufficient, as it demands both rigorous aesthetic practice and an understanding of biology and its embedded metaphors. And while its close relative biodesign may have utilitarian targets, Bio Art is more concerned with art historical connections and the ways in which ideas, long since dismissed as sterile, are reconsidered.

Bio Art may be the latest in a long line of artistic movements exploring the relationship between humans and nature, but this time our relationship to our environment has changed gear. Many argue we have entered the Anthropocene, an era where human activity has a defining impact on the natural world. Our artistic response to this might be considered as a form of neo-romanticism, perhaps with a slight surrealist accent, echoing the art made during previous times of uncertainty about man’s place in the world. While its breadth of scope, techniques, and intentions mean that Bio Art is not easily defined, we can anticipate that its practices and practitioners will continue to astound us with the possible.

# Preface

## William Myers

During the course of writing *BioDesign* (2012) I encountered numerous examples of artists blazing trails toward new ways of thinking about nature and the self. These artists were often using living tissues and microorganisms, or even constructing complex ecosystems. They seemed to be testing, playing with, and discovering new forms of expression and articulating positions on what I have come to regard as the most urgent issues of our time: those defining our era as the Anthropocene, the epoch of human intervention with the environment. These artworks were being loosely categorized under the term “Bio Art,” yet were defined by medium rather than in relation to the interplay between culture and the sciences; so it became clear that the topic of Bio Art warranted further study, and called for a new book of its own.

It is first important to address the question of how biodesign and Bio Art differ, which frequently arises in discussion of any creative output that draws from the life sciences. Biodesign is an approach that integrates biological processes and cycles within ecosystems into practices as wide ranging as graphic design, manufacturing, and building. It goes beyond mimicry to integration of the biological, and living material often becomes a part of the finished product or system that has utilitarian application. But biodesign can also be speculative within these parameters, or may consciously reject or critique the design brief. Design, therefore, must be directed in some way toward others, while art may not.

By contrast, Bio Art is a practice that utilizes living biology as an artistic medium, or addresses the changing nature of biology’s meaning through its output. This can be achieved in a Petri dish or in a photograph; what is defining is the work’s connection with meaning in flux. At its core, Bio Art is a response to the cultural dislocations that are erupting as a result of the advance of life sciences research and its application as technology. As fields including biomedicine, ecology, and synthetic biology advance, our shared, foundational cultural concepts of identity, nature, and our relationship to the environment are shifting. An important backdrop to these changes is the era of the Anthropocene and the unfolding tragedies of habitat destruction, mass extinction, and climate change. This blend of elements precipitates the “crisis of consciousness” that many bio artists respond to.

Bio Art also engages with new understandings of the self. As artists such as Stelarc have provocatively argued, the human body is “obsolete” in light of the possibilities of technological extension, digital archiving, and networking. This argument advances further with recent developments in genetic medicine, such as the possibilities of generating both eggs and sperm from a single donor’s stem cells, or the manipulation of gut microbes to manage mental health. Life sciences research in this century will undoubtedly come to be regarded as a golden age. It is a place of accelerating breakthroughs and fundamental developments, such as the rise of epigenetics, which has revealed how we are all in meaningful genetic communication with our ancestors as well as future generations. This pace of discovery creates fertile ground for artistic expression, and calls for art as exploration and translation of what are truly jarring developments in our time.



# Bio Art and the Gnawing Invisible

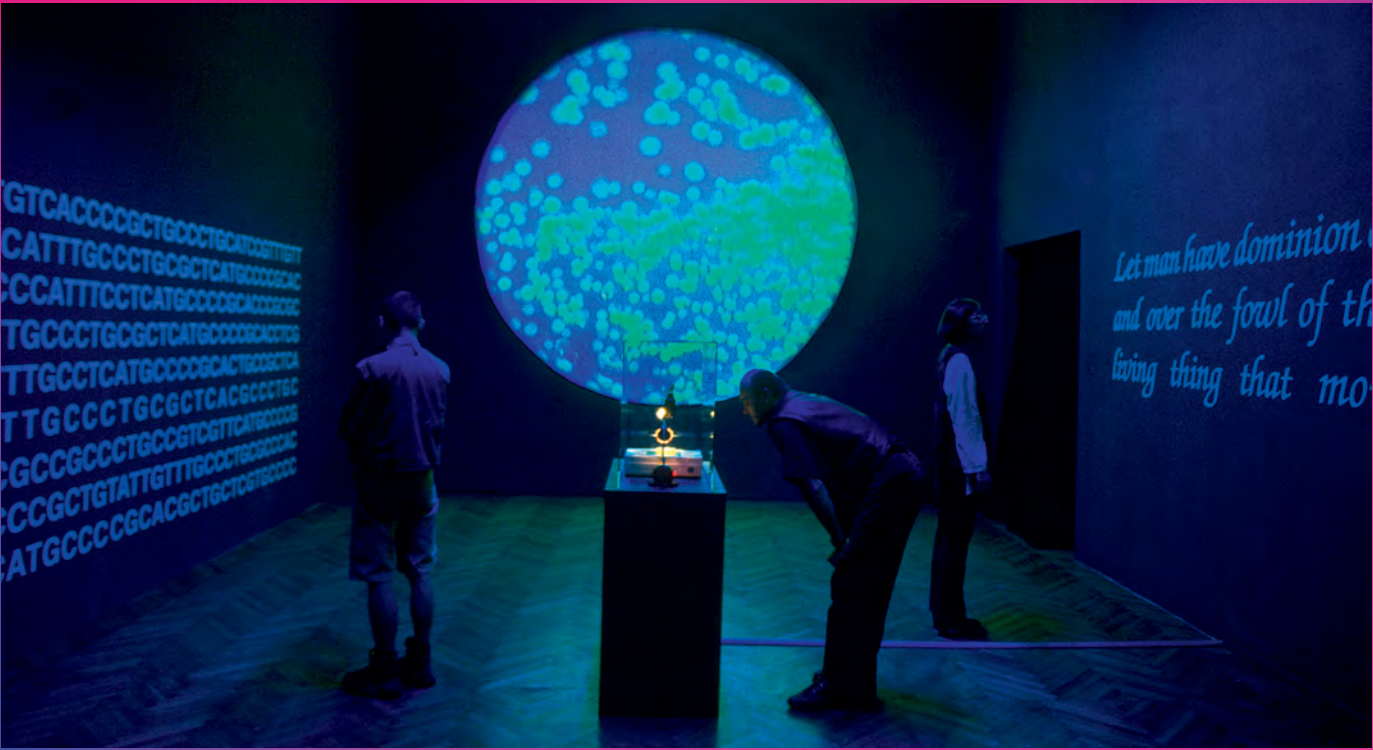
“We do not doubt that in yielding quite naturally to the vocation of pushing back appearances and upsetting the relations of ‘realities,’ it is helping, with a smile on its lips, to hasten the general crisis of consciousness due in our time.”<sup>1</sup>  
—Max Ernst, 1948

The self-proclaimed “surrealists” may be long gone, but they are not yet through with us. Their project echoes through a proliferation of artwork over the last ten years that uses biology as either medium or subject to signal significant cultural shifts caused by alterations in our ideas of identity, nature, and environment. This essay maps out the ways in which these shifts make historical alliteration with upheavals of the early 20th century, particularly those to which the surrealists responded. Bio artists working today are cast as interpreters of cultural transformations, like journalists formulating the first draft of history, but using aesthetic experiences as language to assign meaning. Like the surrealists before them, who struggled with the implications of the unconscious mind and the aftermath of war, bio artists are motivated by an imperative to engage with the crises of their time. This emerging art is not defined strictly by medium, by the use of living material, but instead by its connection with the reshaping and movement of our concepts of the self, and the definitions of life, nature, and community. Dislocation of these concepts is exactly what is happening today, as discoveries in the life sciences propel advances in biotechnology and in our understanding of both the climate crisis and the wider human impact on the biosphere.

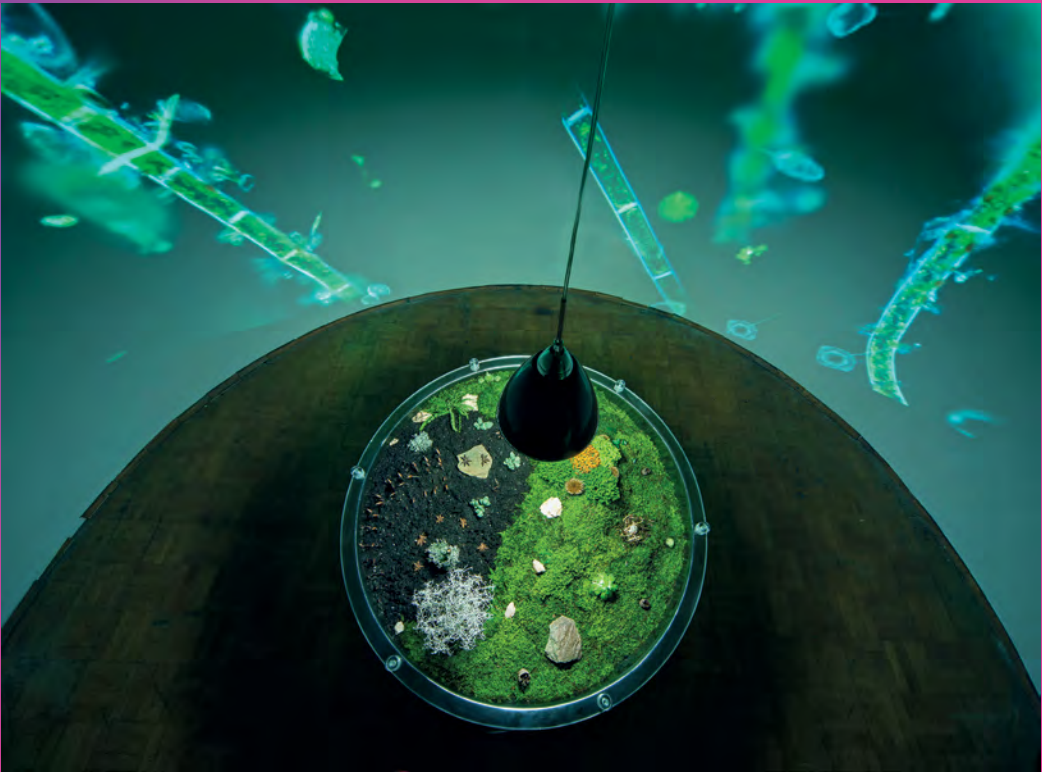
The rise of surrealism is firmly associated with the anxiety and distrust of reason bred by World War I, coupled with a deeper understanding of the unconscious mind, especially as elucidated by Sigmund Freud. The collective, psychological terrain these conditions created within culture provoked artistic responses from figures such as André Breton,

Salvador Dalí, Max Ernst, and Yves Tanguy. They developed techniques such as automatism, and wielded imagery of the uncanny and grotesque, among other strategies for their expression. In the following decades, new media and performance art emerged, each also rooted in early 20th-century experimentation, but driven by a variety of new intentions, and utilizing technologies going well beyond visual experience. The nature of this experimentation and elements of its formal output are also embodied in contemporary art which uses biology as medium or subject. The pioneering video installations of Nam June Paik and the mythological, chimerical imagery employed by Matthew Barney provide vivid examples; works of this kind have influenced bio artists such as Eduardo Kac, whose 1999 work *Genesis* included an interactive website inviting visitors to mutate a microorganism; Saša Spačal, who has staged video and sound installations that facilitate cross-species communication; and Vincent Fournier, who is creating a bestiary of futuristic chimeras adapted to a world dramatically altered by climate change.

These parallels in form and technique, as well as the similarities between particular social conditions, do not imply that contemporary art follows an established cycle or pattern. Just as it is futile to attempt to fit every story into neatly labeled boxes of “tragedy” or “comedy,” appreciating art in its time requires a suspension of grand, linear narratives. As Alfred H. Barr Jr., the founding director of the Museum of Modern Art, New York, summarized in 1946, “art is an infinitely complex focus of human experience.”<sup>2</sup> The particulars of how and why artwork is generated and what meaning it accumulates during the course of its making, display, and interpretation transcend identifiable systems or static labels. Nevertheless, there is evidence that we are entering a new age of surrealism, distinct from but making rhymes with the creative expression of the past, and hastening a “general crisis of consciousness.”



1



2

1 Eduardo Kac • *Genesis* • 1999  
2 Saša Spačal • *7K: new life form* • 2010



Liberating Thought

The surrealist movement of the early 20th century aimed to facilitate creative expression unburdened by reason or aesthetic and moral conventions; as Breton wrote in the *Surrealist Manifesto* of 1924, the surrealists would commit themselves to aiding the imagination in “recovering its rights.”<sup>3</sup> What they sought was a deeper, unseen truth within and around us, one that might be brought to light through materializing dreams, tapping into unconscious thought, and giving voice to suppressed desires. The surrealist practice of automatic writing was an exercise to advance this goal: writing that was rapid, free-form and unedited; an attempt to tunnel a reservoir to unconscious thought and access ideas and feelings in a purer or more authentic form. Automatic writing applied a hope that the creative act itself would move the mind away from the conditioned, reflexive reliance on reason. Contemporary artist Arne Hendriks likens this to a tool for dismantling control, insisting that automatic writing and other techniques like the use of mind-altering drugs were a focused desperation of the surrealists: “Anything to break free from the unseen program”.<sup>4</sup> This is even more difficult to do today, almost a century later, wherein sophisticated algorithms deliver us continual streams of tailored information.

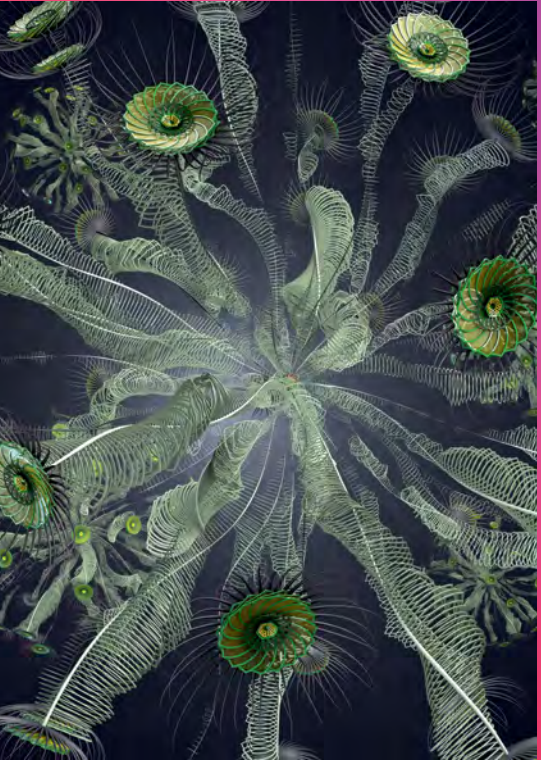
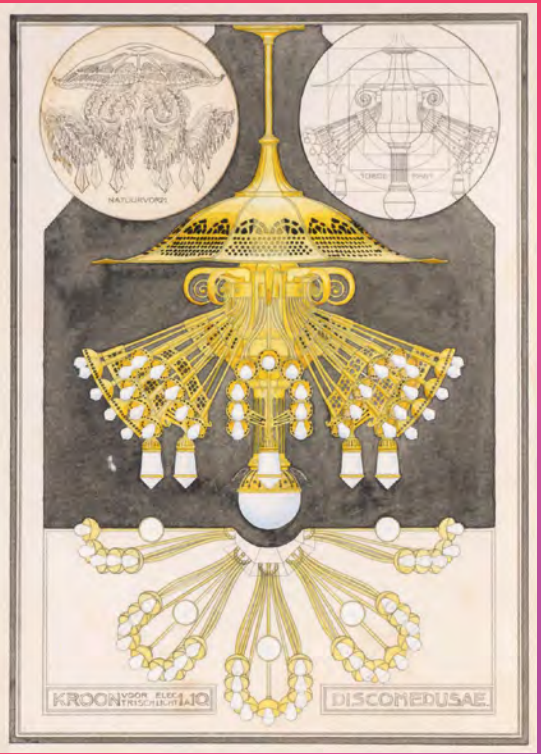
Such experiments were simultaneous with the emerging dominance in art and commerce of the machine, which was establishing a position as central to aesthetic and economic life. Against the context of these events, the call for epistemological reform heard by the artist’s ear was loud: the rule of reason coupled with industrial capitalism had recently mass-produced machine guns, mustard gas, and mortars for World War I, a profound failure of Enlightenment values and the reigning political order. Breton even witnessed the outcomes of this first hand, treating patients in Nantes suffering from shell shock. The war’s worldwide orgy of brutality shoved those who witnessed it over perverse psychological thresholds, force-feeding them death at a speed and scale previously unknown, such as in the Battle of the Somme in 1916 that saw a staggering 70,000 casualties in a single day. Simultaneously, the Spanish Influenza pandemic would claim up to fifty million lives, or about 3 percent of the global population. The new reality of a world of such horror bred confusion about, and disillusionment with, modern life that ran deep and sought outlets, as might a repressed erotic desire. Free-form, spontaneous, and non-rational forms of expression were attempted through collage, frottage, and collective writing and

drawing techniques. Following in this spirit of play that relished veering into the nonsensical, Breton and Philippe Soupault wrote in their seminal 1920 surrealist work *Les Champs Magnétiques* (*The Magnetic Fields*):

“It was the end of sorrow lies. The rail stations were dead, flowing like bees stung from honeysuckle. The people hung back and watched the ocean, animals flew in and out of focus. The time had come. Yet king dogs never grow old—they stay young and fit, and someday they might come to the beach and have a few drinks, a few laughs, and get on with it. But not now. The time had come; we all knew it. But who would go first?”<sup>5</sup>

Freud’s theories about dreams, the uncanny, and the unconscious informed Breton’s ideas, and were a continual source of inspiration for the surrealists. Representing the uncanny became particularly important, a quality described by Freud as a recipe that must include the familiar, even primal, yet profoundly uncertain.<sup>6</sup> Elaborating on this concept, Freud turned to examples such as the effect of watching epileptic seizures and manifestations of insanity, as they excited in the spectator the notion that “automatic” processes, normally concealed beneath ordinary animation, were at work. Essentially, Freud’s theories were understood at the time to have uncovered new dimensions of reality, much as Louis Pasteur and Robert Koch’s research in microbiology had revealed, much more literally, a previously unseen universe at the microscopic scale. These new terrains cried out for new acts of artistic intervention and interpretation because they offered the possibility that neither thought, behavior, nor environment were as they seemed. At the very least they had new dimensionality; they existed on spectrums of scale rather than binary divides such as sane/mad or deliberate/unconscious. This point is extended further by contemporary bio artists such as Vincent Fournier who think about “mixing living forms with synthetic biology, cybernetics or nanotechnologies.”<sup>7</sup>

Surrealists plumbed the implications of Freud’s newly sketched blueprints of the mind as others, including artist René Binet and architect Hendrik Petrus Berlage, drew from the discoveries of scientists like Louis Pasteur and, in particular, the German biologist Ernst Haeckel. These artists elaborated styles in the decorative arts and architecture inspired by biological forms. This effort coalesced in such movements as art nouveau in France at the end of the



3 Ernst Haeckel • *Tafel 88: Discomedusae* from *Art Forms of Nature* • 1904  
4 Hendrik Petrus Berlage *Study: Crown For An Electric Light* • undated  
5 Ernst Haeckel • *Tafel 17: Siphonophorae* from *Art Forms of Nature* • 1904  
6 Jon McCormack • *Evolved plant form based on the BP logo* from *Fifty Sisters* • 2012



19th century and in similar iterations across Europe and the United States. Thus, while research on the mind and on microscopic life supported quite different forms of artistic expression, both arose from shifts in our accepted notions of the self and its environment. These developments generated irresistible artistic imperatives: any search for truth, beauty or meaning—presumably the business of artists—would have to respond to the new modern reality.

## Merging Technology and Performance

“Skin has become inadequate in interfacing with reality. Technology has become the body’s new membrane of existence.”<sup>8</sup>  
—Nam June Paik

The works of the surrealists, like those of the more anarchically playful Dadaists, anticipated various forms and strategies of artistic expression yet to come, while making visible the undercurrent of unease that characterized European life in the interwar years. One standout example of surrealist creation during this era is *Un Chien Andalou*, a silent film written and produced by Luis Buñuel and Dalí in 1929. Its non-linear narrative includes seemingly unrelated scenes, bizarre expressions of libidinal aggression, and gruesome disfiguration. The experimental character of the film’s funding, acting, and directing was much like that of present-day independent films, while the non-traditional narrative and stylized, if sometimes sloppy, editing preceded various contemporary forms, from the music video to reality television programs. In Dalí’s own time, his vision was recognized in Hollywood and would lead to collaborations with Alfred Hitchcock and Walt Disney.

The most memorable sequence from *Un Chien Andalou* depicts a woman’s eye being held open and slit with a razor, an early film special effect accomplished by a rapidly shifting camera view and the carcass of a calf. This scene still has the power to induce shudders—to shock the unsuspecting viewer with a sharp, visceral fear of pain that is generally only experienced in nightmares. This scene also channels the grotesque and erotic present in the myths of the Sandman and Oedipus, in which wounding of the eyes is central. It is such a gesture, straddling as it does the borders between sensationalism, aesthetic

experimentation, and deep emotional dread, that reoccurs in contemporary examples of fine art film and, as described below, in Bio Art. Then, as now, the horror of the nightmare depicted argues that our perceived reality is a thin, placid surface, under which darker, more consequential forces churn. This becomes especially relevant in our time when we consider the possibility of looming disasters generated by forces that remain mostly invisible, as in pollution causing climate changes or global economic shifts resulting in mass unemployment.

As video recording technologies advanced and became more widely available, they were readily appropriated by artists including early adopters Wolf Vostell and Nam June Paik. Paik, in particular, pushed the use of video in many directions and fused it with emerging artistic modes of performance and installation in the 1960s and 1970s. His was also an interdisciplinary effort: he brought to his experiments his training as a classical pianist and an intense study of Schönberg. The synthesis of these elements can be seen in *Concerto for TV Cello and Videotapes* (1971), performed by cellist Charlotte Moorman, in which television monitors were fashioned into a musical instrument and the images on the screens changed along with Moorman’s movements. In later works, Paik distorted the output of television screens using magnets or appropriated global telecommunications to coordinate live performance across the Atlantic between Paris and New York in 1984. Such works anticipated the integration of interaction design into installation and performance, as can be seen in the work of contemporary artists such as Stelarc, Eduardo Kac, Heather Barnett, and Jon McCormack, all of whom have devised installations in which the viewer participates in form-making mediated by technologies. Kac in particular has authored works channeling these elements into Bio Art: his work *Genesis* fuses information technology, code language, and genetic mutation to create a completely unique, globally designed organism.

If Paik’s works marked the beginning of fusing new media and performance to create novel aesthetic experiences, Matthew Barney’s vast project *The Cremaster Cycle* (1994–2002) may represent a creative highpoint. The series of five films is named after the cremaster muscle, which helps regulate the distance between the male testes and the body in order to maintain an optimal temperature for the production of sperm. Broadly speaking, the subject of the work is creative and destructive impulses realized in different contexts and scales, from the individual to society. The

films also repeatedly refer to both the ceremonies and symbols of Freemasonry and the stages of human fetal development in which sexual differentiation occurs, a point before which the artist regards the fetus as being in a state of “pure potentiality.” Guggenheim Museum curator Nancy Spector described the films as a “self-enclosed aesthetic system” and “metaphoric universe” in which the “creative potential of perversion pervades [its] very genetic code.”<sup>9</sup>

There is a dizzying array of elements and references jammed into Barney’s films: Celtic mythology, dental torture, Masonic lore, early 20th-century skyscraper architecture in New York City, and bizarre feats of athleticism featuring, among other obstacles, a salacious female kick-line and a mosh pit. A joyous jumble of aesthetic experience springs from this epic, thanks largely to its maker’s attention to detail and eye for luscious color and composition. This tremendous output includes photographs, drawings, set-pieces, and sculptures, not forgetting the films themselves, produced as limited-edition DVDs. Telling among the casting choices is that of Aimee Mullens, the double-amputee who uses advanced prostheses for lower legs and has become an accomplished athlete, fashion model, and frequent talking point in arguments concerning the use of technology to alter the body. In the films she functions as a doppelgänger of the protagonist (Barney) but also, perhaps inadvertently, introduces into the films the notion of the enhanced self, a manifestation of narcissism amplified with technology. Variations on this theme of the hybridized self are frequently explored in contemporary Bio Art, such as in the work of Jalila Essaïdi and Sonja Bäuml, in which human augmentation is attempted through cross-species production.

Mullens’s character is one that must be defeated by Barney in his journey from Apprentice to Master Mason, in which several travails are endured. At the end of the final film, *Cremaster 3* (they are presented non-sequentially), Barney completes his quest by bludgeoning her, allowing him to ascend to a higher level of being while subjugating the reflected self, his female double. There are many ways to read this film, aside from its symbolic connections to Freemasonry or its pernicious misogyny. The representation of a human-like chimera in the film in the form of Mullens as part machine and part animal and as an abomination challenging the protagonist, presaged the emerging art forms we see that address identity and the definition of nature. The disruptions in these concepts of the self and the environment have only increased in importance in the decade

since Barney’s project concluded. In fact, we have come to ambivalently regard ourselves as something new: supplemented by technologies that monitor and enhance parts of the body. A more detailed understanding of the human microbiome also forces us to consider ourselves as a superorganism controlled in part by trillions of microbes that live within us. Might we in turn feel a need to translate such technologies and organisms, or their symbols, over to a new metaphorical plane and bludgeon them?

## Flourishing Infection

“Microbes Maketh Man”<sup>10</sup>  
—*The Economist*, 2012

Just as new explorations of the worlds of the mind and the microbe challenged conventional thought in the late 19th and early 20th centuries, fundamental and accelerating developments in the life sciences now disrupt our accepted notions of identity, our definitions of life and nature, and our relationships to our environment. The first of these, a changing conception of identity, stems in part from rapid advances in genomics and biomedicine, including research on the human microbiome and the expanding field known as epigenetics. The human microbiome is the vast and complex ecosystem that exists on and within our bodies, consisting of trillions of bacteria and other microorganisms that interact with human cells, sometimes symbiotically. As we are rapidly discovering, this non-human life is essential to our body—to such functions as digestion, maintenance of the immune system, and even possibly our psychological health. Human DNA contains about 22,000 genes that code for proteins, the building blocks of life and all its functions, while each of our microbiomes contains a cumulative three million genes. Keeping in mind that we evolved along with microbes, it seems quite probable that we have developed to rely on this vast library of genetic resources to which we play host. The rate of discovery in this field is increasing, while its impact on our thinking about the self strains to catch up: recall that it has been not much more than a decade since the completion of the working draft of the Human Genome Project in 2003; just thirty years since the development of polymerase chain reaction (PCR), a basic tool for genetic research and experimentation;



and the very structure of DNA was only first described around sixty years ago, in 1953.

Increasingly, studies of the human microbiome demonstrate that humans are staggeringly more complex than a linear code of DNA, a string of letters, would suggest. “Code,” as in Morse code, suggests a string of information, discrete and unchanging. Popular perception has for a long time been anchored in the sludge of this powerful but inaccurate metaphor. As research is beginning to show, slight changes in the non-human life thriving inside and on our bodies may have profound effects on how we feel and think. Like the surrealists, artists and designers today are driven by an impulse to visualize these new discoveries, to comb them for cultural meaning and to uncover (micro) forces that shape yet escape our perceived (macro) reality. Edgar Lissel’s work *Myself* (2005), for example, allows elements of the artist’s skin microbiome to populate a petri dish, tracing the imprint of his hand and making visible another scale of life. Another such work is *Co-Existence* (2009) by Julia Lohmann, an artist whose practice often highlights material relationships between humans and other species. This particular work utilizes 9,000 Petri dishes to form large, pixelated portraits of two reclining nude figures. Each dish features a photograph of cultured microorganisms, with their placement in the portrait corresponding to the part of the body from which the sample originated. Anna Dumitriu also explores this new reality in the work *Hypersymbiont Dress* (2013), for which microbes known or speculated to have various effects on their hosts are stained into a dress. The garment proposes an imaginative conjecture: that it could impart to the wearer new or enhanced abilities, such as protection from pain or improved powers of creativity.

The field of epigenetics further complicates ideas of the genetic self, given that it is the study of the relationship between environmental stimuli and gene expression. As recent research has found, devilishly complex environmental factors control when genes are “switched” on or off and to what degree. Some of these environmental factors are governed by life experiences, and some even by the behaviors of past generations.<sup>11</sup> Thus, trauma such as famine or extreme stress experienced by an individual’s great-grandfather could express itself as a propensity toward obesity or susceptibility to disease, for example. The mechanisms of this influence across generations are a long way from being fully understood, but the implications for how we regard our identity and our responsibilities toward, and interconnectedness with, future generations are significant. Complementing this

research is the recent confirmation that more than 90 percent of human DNA—previously little understood and even mischaracterized as vestigial “junk” because it does not code for proteins—in fact significantly affects how genes are expressed; again, the previous understanding of genes as a straightforward set of blueprints is woefully inadequate.<sup>12</sup> The artist Boo Chapple regards this emerging science as “both fascinating and terrifying” and goes on to say that it “speaks to tangible material relationships existing between an individual and their world over vast scales of time, space and circumstance and offers the potential for new understandings of self, for radical legal precedents as well as for Orwellian interventions into public health.”<sup>13</sup>

A further indication of the future direction of artistic engagement with biology—and a challenge to our definitions of life—appeared in 2010, with the creation of the first synthetic life form: “Synthia,” a cell generated entirely from artificial DNA inserted into a host. This effort, led by entrepreneurial scientist J. Craig Venter, consumed many years and millions of dollars and may be a harbinger of an entirely new and virtually limitless medium for creative output. Indeed, artists such as Kac are eager to wield these new technologies and discover their potential for creative expression. “One of my goals,” he recently said, “is to completely and thoroughly design a new life form, to conceive every aspect of it.”<sup>14</sup> Kac has been working in this medium for some time, creating the first multicellular transgenic artwork, *GFP Bunny* (2000), and more recently *Natural History of the Enigma* (2008), in which the artist isolated a gene from his own body that codes for part of a blood antibody, and then successfully inserted it into the cells of petunia plants that were in turn cultured and grown for exhibition. This small human addition to the plant makes it unlike any other that ever existed, as in each of the red veins of the plant’s flowers, a genetically *human* protein is present.

The tension between bioethics and technology is likely to underpin the most significant cultural developments of our age, and so the language of the life sciences—broadly speaking, and including its symbols, protocols, and objects—offers a rich communication tool for artists to use in probing our shifting ideas of identity. Consequently, numerous questions arise from projects that take advantage of our new ability to design life at the scale of the molecule using techniques from the rapidly developing field of synthetic biology, an engineering approach to designing organisms with abstracted,



7



8

7 Julia Lohmann • *Co-existence* • 2009  
8 Eduardo Kac • *Natural History of the Enigma* • 2009



interchangeable blocks: are these human-made creations “natural”? What responsibilities do we have toward them, and what limitations can or should be applied to these practices?

Finally, Bio Art addresses a new and critical cultural development: the concept of the Anthropocene. This is the name given to the current geological epoch, characterized by the largely destructive impact of humans on the environment. Widespread acceptance and understanding of our global interconnectedness and shared responsibility for phenomena like human-led climate change, for example, is still relatively new and offers opportunities for artistic response. How will we and the species around us adapt to a vastly changed landscape of scarcer resources and extreme weather in the future? One vision is offered by artist Vincent Fournier in his growing encyclopedia of potential future species, *Post Natural History* (2012–ongoing). This work consists of portraits of animals that we might design a hundred years or more in the future using genetic manipulation: creatures specialized to satisfy human needs or to survive in a harsher environment. These animals appear familiar but uncannily grotesque, sometimes blending attributes of two or more life forms. They are also rendered in a photorealistic manner that, as in the surrealist paintings of Magritte, makes the animals eerily alluring while amplifying cognitive dissonance in the viewer; a discomfort reflective of all the troubling implications embedded in the images, specifically the alarming notion of designing animals dramatically different than those shaped by natural selection.

In light of our continued and increasingly sophisticated tinkering with the genetic blueprints of life, the widely understood concept of evolution will shift. If we continue to shape whole ecosystems by introducing genetically modified species as we have done with agriculture, then evolution is undermined as reproductive success as a driving force of change becomes secondary to the decisions of those humans wielding the ability to design life. It has been argued, albeit controversially, that our dawning biotechnological age might be thought of as a welcome return to a time, over three billion years ago, in which adaptive genetic changes were shared among microbial species rapidly through widespread horizontal gene transfer, which allows for the transfer of genes between organisms in a manner other than traditional reproduction. The communal workings of these early life forms, before what is known as the “Darwinian threshold” when species began to compete, has been elaborated by Carl Woese<sup>15</sup> and others, but

the potential analogy of that pre-threshold moment with the rise of biotechnology is most convincingly described by Freeman Dyson:

“Life was then a community of cells of various kinds, sharing their genetic information so that clever chemical tricks and catalytic processes invented by one creature could be inherited by all of them....But then, one evil day, a cell resembling a primitive bacterium happened to find itself one jump ahead of its neighbors in efficiency. That cell, anticipating Bill Gates by three billion years, separated itself from the community and refused to share. Its offspring became the first species of bacteria—and the first species of any kind—reserving their intellectual property for their own private use.... The Darwinian interlude had begun.”<sup>16</sup>

In the future, the monopolistic control symbolized here by Microsoft (Bill Gates is in fact now a generous philanthropist) will succumb as ever-more accessible biotechnology will finally decentralize genetic sharing, yielding a richer and even better-adapted diversity of life. Dyson goes on to anticipate a future in which we can design miniature pet dinosaurs and program trees to grow batteries. But if such a future awaits, there are urgent ethical debates that must advance quickly, particularly around how we might define, value, and possibly protect life as it now exists. As Max Ernst foresaw, artists hasten understanding of these issues, pushing us to more fully develop positions and articulate what is at stake. Risks accompany uninformed acquiescence: the proliferation of designed life forms may accelerate and amplify the destructive aspects of large and entrenched societal structures. We must wonder: what will the biotechnological version of a billion smartphones look like? And what might they eat when they’re hungry? Designing life may simply intensify our destructive cycles of production and consumption. Arguably, the rise of digital technologies has done exactly this, helping the average human to be a more productive worker and faster consumer of goods and services. Will new biotechnology follow such a pattern?

Fortunately, many additional works of art that address these topics are in development. This essay offers a glimpse of the roots of Bio Art’s imperatives and practices in works of the past, coupled with examples of contemporary art that set out to address cultural shifts of recent years driven by the life sciences. In this effort, Bio Art can do much more

than visualize previously invisible forces like the unconscious, or the new realities of life and nature: it can offer us ways to ponder their meaning for our lives, help us arrive at new theoretical and practical positions, and forge new cognitive frameworks and terms to describe them. Bio Art is thus driven by the need to illuminate that which is both consequential and invisible, a gnawing need to examine change. It may also enable us to rework our conception of beauty and realign the relationship between ourselves and a world teeming with life both all around and inside us. In this way, art moves beyond the passive (if poetic) position as a signature of a civilization, to act as a lighthouse, or language-maker.

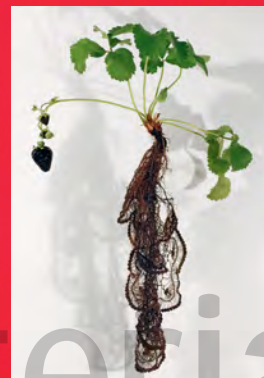
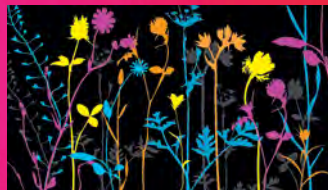
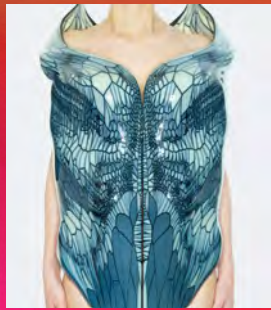
- 1 Max Ernst, “Inspiration to Order,” in *Max Ernst: Beyond Painting and Other Writings by the Artist and his Friends* (Wittenborn, Schultz, Inc., 1948), 25.
- 2 Alfred H. Barr Jr, “Research and Publication in Art Museums,” in Irving Sandler and Amy Newman (eds), *Defining Modern Art: Selected Writings of Alfred H. Barr* (Harry N. Abrams Inc., 1986), 209.
- 3 “Le Manifeste du Surréalisme” (1924), in André Breton, *Manifestoes of Surrealism*, translated by Richard Seaver and Helen R. Lane (The University of Michigan Press, 1969).
- 4 Author interview with Arne Hendriks (October 17, 2014).
- 5 André Breton and Philippe Soupault, *The Magnetic Fields* (1920), translated and introduced by David Gascoyne (Atlas Press, 1985).
- 6 Sigmund Freud, *The Uncanny* (1919), translated by Alix Strachey (reprinted in Sigmund Freud, *Sammlung Kleiner Schriften zur Neurosenlehre, Funfte Folge*, 1922).
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- 8 Nam June Paik, quoted in Jeanne Colleran, *Theatre and War: Theatrical Responses since 1991* (Palgrave Macmillan, 2012), 29.
- 9 Nancy Spector and Neville Wakefield, *Matthew Barney: The Cremaster Cycle* (Guggenheim Museum Publications, 2002).
- 10 *The Economist*, cover story title (August 18, 2012).
- 11 Virginia Hughes, “Epigenetics: The Sins of the Father: The Roots of Inheritance May Extend Beyond the Genome, but the Mechanisms Remain a Puzzle,” *Nature* 507 (March 6, 2014), 22–24.
- 12 National Human Genome Research Institute, “ENCODE Data Describes Function of Human Genome,” see [www.genome.gov](http://www.genome.gov) (September 5, 2012).
- 13 Author interview with Boo Chapple (October 25, 2014).
- 14 Author interview with Eduardo Kac, in *BioDesign: Nature + Science + Creativity* (Thames & Hudson, 2012).
- 15 Carl R. Woese, “On the Evolution of Cells,” *Proceedings of the National Academy of Sciences of the United States of America* 99 (13) (June 25, 2002), 8742–47.
- 16 Freeman Dyson, “Our Biotech Future,” *New York Review of Books* (July 19, 2007).



Chapter I

# Altering Nature, Naturally

Vincent Fournier—French • Azuma Makoto—Japanese  
Next Nature Network—Dutch • Arne Hendriks—Dutch  
Maja Smrekar—Slovenian • Center for PostNatural History—American  
Center for Genomic Gastronomy—multiple nationalities  
Kate MacDowell—American • Suzanne Anker—American  
Neri Oxman—Israeli • Patricia Piccinini—Australian  
Carole Collet—French • Eduardo Kac—American, born Brazil  
Driessens & Verstappen—Dutch • Jalila Essaïdi—Dutch  
Katrin Schoof—German



“Use what is dominant in a culture to change it quickly.”<sup>1</sup>

—Jenny Holzer, 1990

Nature and perversion are culturally constructed concepts, each meaning something quite different depending on the time and place. Yet both have long been used as powerful vehicles of meaning and moralizing, and as a basis for considering works of creativity and new technology. Take, for example, Michelangelo’s *David* (1501–4), today considered a masterpiece, but in its own time denounced by the likes of reformists and religious conservatives such as Girolamo Savonarola, who insisted that Renaissance art was corrupting and immodest. Much further back in human history we can see how a creative and liberating technology—agriculture—may initially have been seen as an aberrant corruption of nature, as a result of an unlucky coincidence in timings. At the same time as humans began to farm the land around 10,000 years ago, major glaciers around the world melted for unrelated reasons, leading to rapid sea level rise and the flooding of fertile lowlands, in particular areas of likely farming settlements beneath what is now the Persian Gulf.<sup>2</sup> These two events—the beginnings of agriculture and a disaster on a scale previously unseen by ancient people—may well have formed the basis of the myths of original sin, the expulsion from Eden, and even the betrayal of Prometheus, and the great flood. Humans may have equated planting seeds with defying nature or God’s will. It was perhaps at this moment in the collective psyche that the concept of perversion was born.

Playing with the connections between aesthetic experience and meaning is at the heart of art making and characterizes contemporary practice. As such, many bio artists choose nature and perversion for their play, working to envision and then demonstrate how these

concepts are evolving. One particularly interesting direction is an updated form of surrealism, presenting us with figures, scenarios, or prototypes of technologies that may exist in the near future. While the first iteration of surrealism was rooted in anxiety caused by war and the flowering of ideas about the unconscious mind, this neo-surrealism seems to spring from fears about intensifying global interconnectedness and the rapid and revolutionary progress in biological research and technological innovation. Uncomfortable dislocations resulting from globalization, climate change, terrorism, financial collapse, and government-led mass surveillance have replaced the components of the original surrealist creative impulse. Of course, war does still exist, but from a global perspective its impact is dramatically diminished from that of the two World Wars. The attacks of September 11, 2001 and the threat of climate change are perhaps more symbolic of the violence that will visit the 21st century: two global phenomena that remind us that what people are up to far across the oceans can have a potentially disastrous impact on our own lives.

The neo-surrealism of today is also a meditation on the possibility of perverse uses of new technology. This is an important point on which artists and technologists often diverge, with artists usually implicating people, in the form of the viewers of their art, as sharing responsibility for such technological misuse; a decidedly social determinist approach.<sup>3</sup> Technologists, on the other hand, are more likely to believe that innovation shapes the social sphere; that new technology determines the development of social structures and new behavior. This latter viewpoint is the source of much fascinating misreading of recent works about the future and synthetic biology, as seen in the projects of Alexandra Daisy Ginsberg, Vincent Fournier, and the Next Nature Network, for example. Frequently, viewers of such works miss the social critique or the exploration of the idea of perversity, and instead believe them to be earnest proposals for bizarre new objects, services, or interventions to save the environment. In part this misunderstanding results from viewers who seem to distance themselves from the issues raised by such works, not realizing that they may in fact be co-conspirators ushering in such a dystopia or,



perhaps, in denial that they hold such potential power, a denial that conveniently skirts responsibility.

The implication that people are the force behind perverse technological application informs some of the most interesting forms of Bio Art. The Center for Genomic Gastronomy, for example, embraces the idea of perverting nature with good nature, even humor, through the medium of cuisine. They bring to light cold realities about our diets that we rarely consider or are even aware of, such as the fact that we routinely consume food which is made from plants developed using radiation, as is the case with “natural” peppermint flavoring. Prior to the advent of genetic engineering, it was common for researchers to bombard seeds with radiation with the aim of causing genetic mutations that might prove interesting or useful. This is how disease-resistant peppermint crops were developed in the 1970s, and while the exact mechanism of this is not well understood even today,<sup>4</sup> we still happily consume its fruits. These circumstances inform the Center’s work *Mutagenic Mist* (2012), an installation that includes the release of a pleasant but mildly disconcerting fog of peppermint oil along with looping video footage of radiation experiments on plants conducted in the 1950s. This blend of sensory experience, of the smell of peppermint with its strong association with nature, and the video footage of practices we are now conditioned to regard as perverse, spotlights the malleability of our notions of the concept of “natural.”

Our growing ability to design and create organisms at a genetic level is just one more step on a long journey of redefining what is natural and what is perverse. At the heart of this discussion we must remember that technology itself is neutral. It is only people, in their use of technology and pursuit of various agendas, who can layer perversity onto actions and outcomes. Of course, it is also true that the “new nature” resulting from this wielding of technology—usually in the pursuit of economic gain—can be dangerous: to ourselves, to other species, and to the viability of life in general. Bio artists play a crucial role here in illustrating these realities for which we currently have limited language and understanding. As new technology throws open many doors, each of them to darkened rooms representing

possible futures, bio artists can use their gifts to carve out windows, to illuminate consequences, and to help people discover and stake out their own positions.

- 1 From Jenny Holzer artwork, *Use What Is Dominant In A Culture to Change It Quickly*, screenprint in red on brushed aluminum, 15 × 18 inches (38.1 × 45.72 centimeters) (1990).
- 2 Jeffrey I. Rose, “New Light on Human Prehistory in the Arabo–Persian Gulf Oasis,” *Current Anthropology* 51 (6) (2010).
- 3 Lelia Green, *Technoculture: From Alphabet to Cybersex* (Allen & Unwin Sydney, 2002).
- 4 B. S. Ahloowalia, “Global Impact of Mutation-derived Varieties,” *Euphytica* 135 (2004), 187–204.





## Vincent Fournier



2

Fournier's work is rooted in art history but aimed squarely at the future as anticipated by scientific and technological advances. The artist's own blend of educational background in sociology, fine arts, and photography informs his strategy of utilizing visual experience to articulate social behaviors and their potential consequences. In the case of *Post Natural History* (2012–ongoing), those behaviors do not yet exist but will be possible and perhaps even likely in the coming decades. The work centers on the redesign of species to bestow traits better suiting them for the era of the Anthropocene, a world characterized by harsher climates and severely limited natural habitats. Such redesign, Fournier suggests, would go far beyond the familiar selective breeding of animals or plants, instead creating hybrids of the familiar and exotic, with traits that would either help species to survive or satisfy new human desires.

The ideas within *Post Natural History* stretch back to antiquity, mirroring, for example, the early depictions of fantastical animals in the ancient Greek work *Physiologus* (2nd century CE). *Physiologus* used a combination of illustrations and text for a moralizing

1–4 *Post Natural History* • 2012–ongoing  
Redesigned species, including: Brown-cheeked Hornbill (*Bycanistes attractivus*) with unbreakable beak (1); Rabbit (*Oryctolagus cuniculus*) with high intelligence (3); Red Poppy (*Ignis ubinanae*) with fiery plasma (4). C-prints.

purpose, assuming an inherent wisdom in nature and drawing on that to guide behavior. In contrast, Fournier's work stands between cautionary tale and playful surrealism: the photorealistic quality of his contemporary bestiary makes it both alluring and grotesque, situated in an uncanny valley wherein too much familiarity makes the fiction uncomfortable. The artist takes his cues from such figures as Freud and Darwin—whose works “destroyed” commonly held notions of the binary divisions of sane/mad or animal/human—by depicting mental state and evolution as continuums. By extension, *Post Natural History* redefines the border between natural and artificial as porous, on its way to complete disintegration, and accompanying a future characterized by both hope and dread.

Fournier's earlier works include *Brasilia* (2012) and *The Man Machine* (2010), each made up of several





3

photographs of expectant and monumental energy. *Brasilia* presents what the artist calls “a true ruin of a future,” in the form of a reflection on the utopian promises offered by modernist architecture of the 1950s and 1960s: well-funded intentions that have scarcely delivered. *The Man Machine* depicts an unnerving ordinariness in moments of interaction between people and robots; despite being unsophisticated in appearance, the robots are imbued with character, even melancholy, as they are so carefully and humanly choreographed. These works can be seen as a double reflection of robots as portraiture: the successful rendering of our technological creations as both sublime in their apparent autonomy and mundane in their humanness.

The recent work *Synthetic Flesh Flowers* (2014) expands on *Post Natural History* and depicts the imagined results of tissue engineering experiments to make artificially fleshly plants. In the words of the artist, these are “precious vanities” and emblematic of the human desire to transform the living.

5      *Asterae (Paulisper desiderare)* from  
*Synthetic Flesh Flowers* • 2014  
Computer renderings, 3D printing



5

4



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# Azuma Makoto

In 1962 Hans Haacke, a pioneer of systems-based art, created his *Condensation Cube*, the first enclosed natural system displayed in a gallery. Azuma has taken up and developed this practice much further, achieving original forms, immense complexity, and layered meaning. As a self-described “flower artist” updating the traditions of Japanese ikebana and bonsai, Azuma works with plants to create artworks that straddle traditions of sculpture, installation, institutional critique, and Earth art. Inspired by the life force that generates the shape plants take over time as they grow, Azuma creates environments for flora and fauna to flourish into beautiful forms endowed by evolution, yet clearly framed by his hand.

In his *Shiki 1* (2011), for example, Azuma suspends a pine tree in the center of a perfect cube framed in metal. In effect he transplants the living organism into an alien but habitable environment, held firmly in place by wiring, almost as if it were leashed. In decontextualizing the bonsai plant from the soil, its root systems are exposed and its true form, free of any other visual distraction, is revealed. Its presence in a gallery is akin to an ancient relic or religious totem meant for worship appearing in a museum: an object completely removed from its intended context.

Extending the idea of controlled or closed systems for plants further, Azuma has also created entire contained ecosystems, including *Water and Bonsai* (2012). In this work he submerges the plant into a water environment constructed to simulate natural light and air. The bonsai thrive in the water, growing as might free-floating seaweed. In this display, Azuma presents us with an elaborate machine composed of engineering and evolution; a novel, aesthetic bridge between the natural and unnatural.

In describing another of his closed ecosystem works, *Paludarium SUGURU* (2012), Azuma writes, “...we can appreciate a plant that is not capable of migrating on its own regardless of climate, environment, countries or regions.” In response, Azuma creates homes to protect the plants in his works, a reflection of how we humans construct our own specialized places to live comfortably in extreme environments. In these plant homes Azuma simulates wind, water, and air to



6

6–7 *Water and Bonsai* • 2012  
*Sabina chinensis*, java moss, water tank

create what he calls an “encapsulated environmental experiment system.”

The elaborate features of this system include light to mimic the sun’s cycles, rain, and a small population of rice fish that swim among the underwater grasses. The work is self-contained, constituting a separate, tiny world within our own, for our contemplation. As such, it can spark empathy for the plants, for the fragility of their environments and the systems they create. The artist thus raises the question: how far can we push the limits of a species to survive? This becomes an especially interesting question when we consider the likelihood of mass migration of humans as a consequence of climate change.

Text by Julia Buntaine



7





8

8 *Paludarium SUGURU* • 2012  
*Juniperus sargentii*, rock, water, glass, stainless steel, small pebbles  
 9 *Shiki 1* • 2011  
*Sabina chinensis*, stainless steel frame, wire



9

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10

# Next Nature Network

The Next Nature Network, founded and directed by Koert van Mensvoort, follows an ambitious mission: to describe, understand, and even contribute to “nature made by people.” At the heart of this endeavor is the philosophical position that the binary nature/ culture divide is nonsense, that the term “nature” and its meaning are cultural constructs anyway, and thus “nature changes along with us.” This kind of thinking acknowledges the reality of human impact all over the planet and implicates each of us, from technologists to preservationists, in its consequences. Van Mensvoort argues that humans have created “life” in the vast, complex, and autonomous systems of technology and economics, and that these systems have a nature all their own that will evolve together and combine with biology. According to this position, nature is not the source of what is pure or true; rather, the realm of morality is rooted in prioritization, value judgments, and tradeoffs made by frail, imperfect people.

The activity of the Network includes journalistic writing, design, public lectures, and performances, as well as instructional projects for industrial design students at the Next Nature Lab at the Technology University of Eindhoven. One particularly notable ongoing activity is the “NANO Supermarket,” a traveling exhibition disguised as a supermarket, which presents speculative future technologies, making stops in several cities each year to showcase new products. Such masquerading disarms the viewer before delivering a psychological shock, a technique that is also at the core of a recent work, *The Rise and Fall of Rayfish Footwear* (2012). For this project the Network launched a fictional company, complete with press releases, commercials, and fabricated scientific research, to offer personalized sneakers crafted from the skins of genetically modified stingrays.

The marketing of the company generated enormous attention and catalyzed a debate on emerging biotechnologies and the moral implications of their products. By inspiring such heated reactions, the



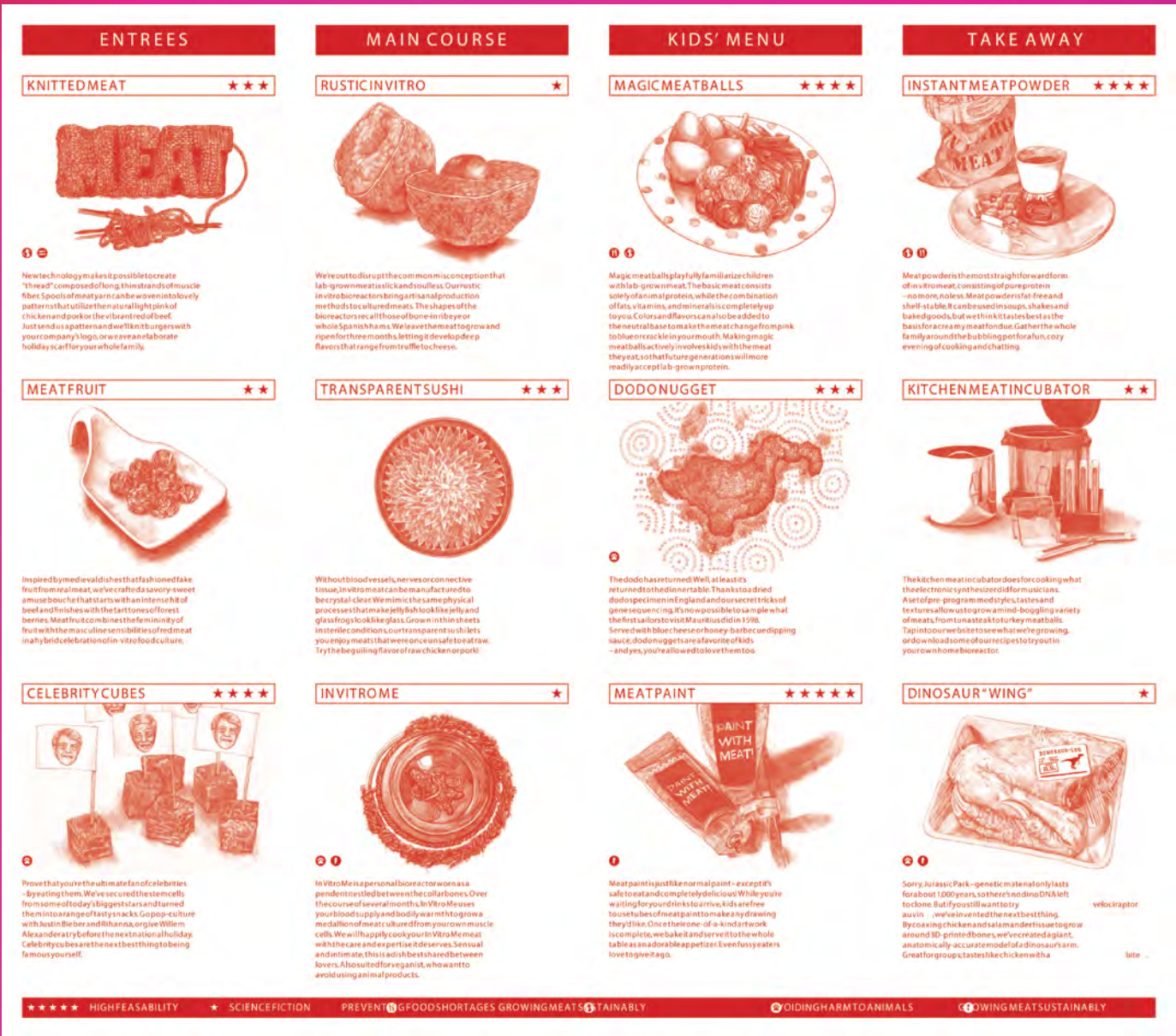
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10–11 *The Rise and Fall of Rayfish Footwear* • 2012  
In collaboration with Ton Meijdam, Floris Kaayk,  
and Jan Jansen  
Online audiovisual presentation

Network exposed an uncomfortable set of values: that exploiting fish in such an “unnatural” way was far more repugnant to many people than, say, the use of underage labor in developing countries, a practice still common in the footwear industry, as detailed in a 2012 report by the Centre for Research on Multinational Corporations. In an interview in 2013, Van Mensvoort revealed some of the thinking behind the Network’s hyperbolic gesture “...if you propose a surrealistic alternative, it might disclose the surrealism of the world we live in today.”

*In Vitro Meat* (2014) is a project that imagines the dining behaviors, products, and traditions which may emerge as a result of the laboratory culturing of meat; an area of research advancing rapidly, with significant contributions from Dutch scientists, who recently presented the world with the first laboratory-grown hamburger. The cookbook, menus, and edible products of *In Vitro Meat* are all speculative and blend humor and research with marketing imagery and language that we all find familiar. The exclamations and assurances in the food descriptions are what you might expect from a traditional food company, yet they are for products such as Dinosaur “Wing.” An earnest dimension to the project takes the form of ratings to indicate each product’s feasibility and the overall argument for adopting such new products as substitutes for conventional meat, given that the worldwide demand for meat is growing rapidly and cannot be ecologically sustained for long.





12 Menu Card: *Bistro In Vitro* from *In Vitro Meat* • 2014  
In collaboration with Hendrik-Jan Grievink, Silvia Celiberti, Allison Guy, and Francesca Barchiesi  
Drawing, computer rendering

13 *In Vitro Meat* cookbook • 2014  
In collaboration with Hendrik-Jan Grievink, Silvia Celiberti, Allison Guy, and Francesca Barchiesi  
Book

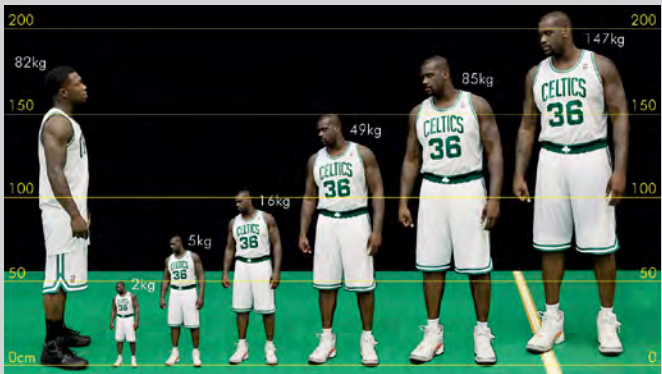


# Arne Hendriks

Hendriks combines hyperbole and earnest declarations in much of his work, challenging us with somber reality packaged in wry humor. We are urged to face facts while given permission to laugh at, or at least take pleasure in, rich visual presentations and clever pop-culture appropriations. These are presented with the zeal of a prophet and often address emerging realities of the Anthropocene, particularly the scarcity of resources and space we face as a global population approaching nine billion. The staggering scale of the problems this ever-increasing population will present are matched creatively by the ambition of the artist's works, which include proposals as various as shrinking humans, making repair work sexy and resettling the world's entire population into a single city.

The artist's most developed work to date is *The Incredible Shrinking Man* (2010–ongoing), which consists of an entire ecosystem of graphics, text, objects, and performance, proposing the idea of shrinking humans to an average height of 50 centimeters (1 foot 8 inches) and then envisioning the changes to our lives this would pose. In this speculative world we would consume roughly 2 percent of the material and energy resources that we do today. At just 50 centimeters we could hunt mice as big game, cater a wedding feast with a single chicken, and arrange tours of old cities as giant amusement parks, overrun with vegetation reclaiming the land. In this world of terrific new abundance old human skeletons could become fixtures in natural history museums, akin to dinosaur bones: the detritus of a species unfit to survive in its environment.

Shrinking humans would effectively expand the world and populate it with wonder and possibility. But Hendriks takes the project beyond just an experiment in thought. His research includes earnest investigation into how phenotypes (an organism's observable traits) emerge and how environmental pressures can have consequences at a genetic level—for example, a mutation that allows humans to suppress their own growth hormones, which has been observed among some isolated populations. The project won the Future Concept category at the Dutch Design Awards in 2013, and it continues via workshops, a blog, and temporary installations such as the *Disproportionate Restaurant* (2010–



14–16 *The Incredible Shrinking Man* • 2010–ongoing  
Mixed media including photography, sculpture, graphics  
17 *8 Billion City* • 2013–ongoing  
In collaboration with Monnik  
Photography, mixed media, the world population

ongoing) that serves food portions fit for a squirrel. *8 Billion City* (2013–ongoing) is another response to a world that feels increasingly small as it becomes more populated and developed. The project sets out to envision how a single city containing all the world's population might work, look, and be managed. This ongoing work highlights the reflex of humans to sprawl, meaning that we achieve only low population density, resulting in tremendously high consumption. In fact, if we could all adopt living with the density of a city like Shanghai it would be possible for the world's humans to live within the borders of France. City living is already becoming the defining, common characteristic of contemporary life as the world's urban population rapidly expands. How we organize this phenomenon and the extent to which we can condense it are critical issues connecting us all around the world and across generations. *8 Billion City* is thus a reflection on uncomfortable realities that we avoid at our peril. Hendriks's earlier work *Repair Manifesto* (2010–ongoing) aims to create communities and alter how we approach consumption. The work is a declaration of the beauty of repair, as a means of extending the life of products. It is also about “extending relationships” among people, given that repair often requires cooperation between people and the systems that make things. In learning to repair, the artist highlights how we learn the ways that things are made. In sum, the work is akin to the artist's starvation experiments in which he denies himself food for several days: an effort in unlearning the doctrine of increasing consumption that prevails in many cultures.





# Maja Smrekar

Collaboration is of particular importance to Smrekar, and she often works closely with scientists from different fields to advance her projects. The artworks she creates address changing notions of identity, ecology, and responsibility, and often spotlight the power and meaning of evolutionary processes. These themes generate aesthetic experiences that lead the viewer to see the range of species around them as a kind of interconnected, genetic tapestry sewn together by time and experience. The artist also has a strong interest in the phenomenology of perception, the notion that stimuli, consciousness, and environment all interact as originators of thought, as advanced by Maurice Merleau-Ponty, a position that contrasts with the Cartesian assertion that thinking and being are simultaneous.

The 2012 *Hu.M.C.C. (Human Molecular Colonization Capacity)* project began from the observation that in the coming decades resource scarcity will apply pressure to food production processes and will likely result in greater reliance on biotechnologies. This work probes the possibilities of using genetic manipulation in the food industry in a new way, beyond crop modification and instead relying on the human body. In collaboration with biologists, the artist combined genetic code from her own DNA to alter yeast, changing its metabolism so that it produced lactic acid. This compound, which is quite common in the food industry, was then harvested to make yogurt, called *Maya YogHurt*. In installations of the work, samples offered to visitors are all filtered to ensure that no genetically modified organisms are present. However, in order to sample the product, a visitor has to first sign an agreement acknowledging their responsibility in consuming the product. By using familiar visual branding language, *Maya YogHurt* appears to be a familiar offering that you might find in a supermarket today. But would we all be comfortable consuming such a product? Resource scarcity in the coming years may not leave many choices.

*K-9\_topology* (2014–ongoing) sets out to map specific ways that humans and dogs co-evolved, specifically in relation to the sense of smell and mechanisms of serotonin regulation in the two species. The work investigates how the cooperation between dogs and people over time has steered both species to be

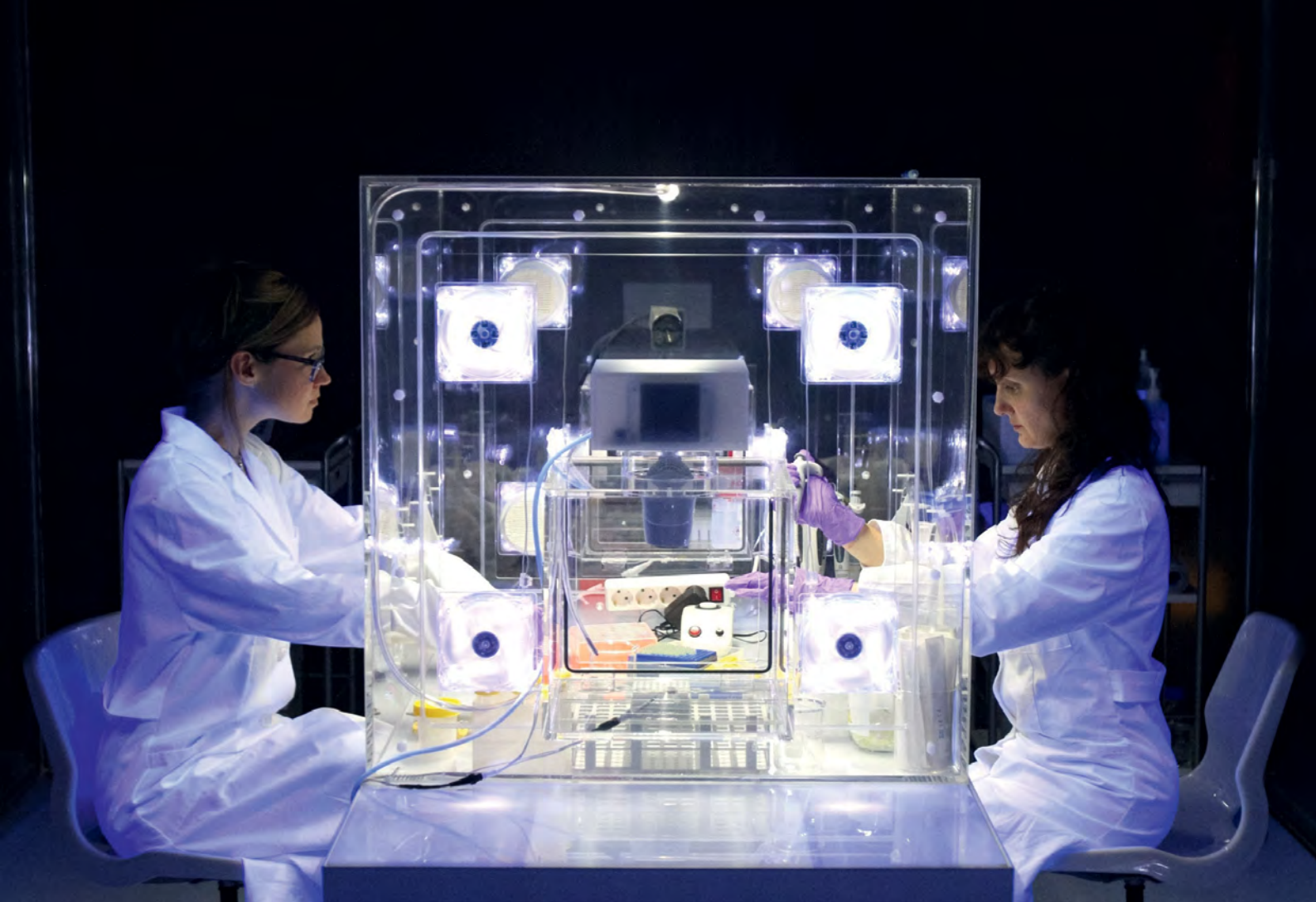


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18–20 *Maya YogHurt* from *Hu.M.C.C.* • 2012  
In collaboration with the Institute of Biochemistry, Medical Faculty, University of Ljubljana, Slovenia and Kapelica Gallery, Ljubljana, Slovenia  
Genetically modified yeast *Saccharomyces cerevisiae*, artist's DNA, graphics and video, custom-made hybrid laminar/incubator/glove box

more emotionally connective. As the writer Michel Houellebecq put it, dogs can be thought of as “machines for loving,” bred over many generations to be eager human companions. Implicit in this work is the concern that contemporary life, which is frequently preoccupied by deodorizing spaces and removing smell from everyday experience, may undermine emotional connection in general. In the work's gallery materialization, the artist offers visitors the experience of inhaling a gaseous version of the serotonin produced by the interaction between her and her pet dog: an opportunity to partake in the essence of their relationship.

The 2013 work *BioBASE 45° 53' 28.20"N, 15° 36' 9.18"E* examines an invasive species that has been appearing across Europe: a crayfish featuring an unusual mutation that allows it to reproduce asexually. First discovered in Germany in 2003, it is assumed to have changed genetically while under the pressures of captivity. Now it has found its way into the natural environment and is capable of multiplying rapidly and crowding out species in their native habitats. Smrekar has choreographed and recorded encounters of this new and alarming species with its ancestor, the more “natural” crayfish, via aquatic installations. This sort of interaction may be one that we humans will repeat in a far-off future when we compete and conflict with dramatically mutated versions of humans adapted to new environments.



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With Naturally Produced  
B Complex Vitamins!  
Enriched with Human  
Enzyme Product.

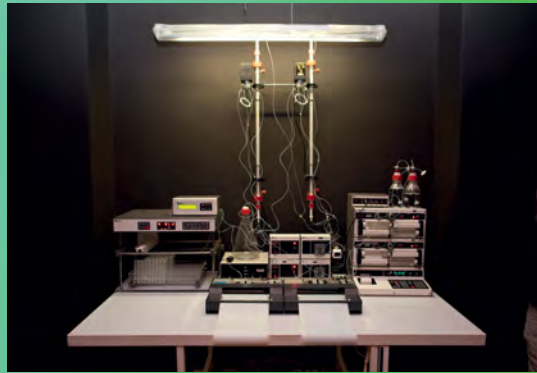
GENOME

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- 21–23 *K-9\_topology* • 2014–ongoing  
In collaboration with University of Ljubljana, Slovenia, departments of Forestry and Renewable Forest Resources, Wildlife Ecology Research Group, Institute of Biochemistry and Medical Faculty, Marko Žavbi, B. Eng. First installation at Kapelica Gallery, Ljubljana.  
Graphics, video, gaseous serotonin extracted from platelets of the artist and her dog
- 24 *BioBASE: 45° 53' 28.20"N, 15° 36' 9.18"E* • 2013  
In collaboration with the Department for Freshwater and Land Ecosystems at the National Institute of Biology in Ljubljana, Slovenia and Zavod Aksioma, Ljubljana, Slovenia  
Artificial aquatic environments, *Cherax quadricarinatus*, *Astacus astacus*

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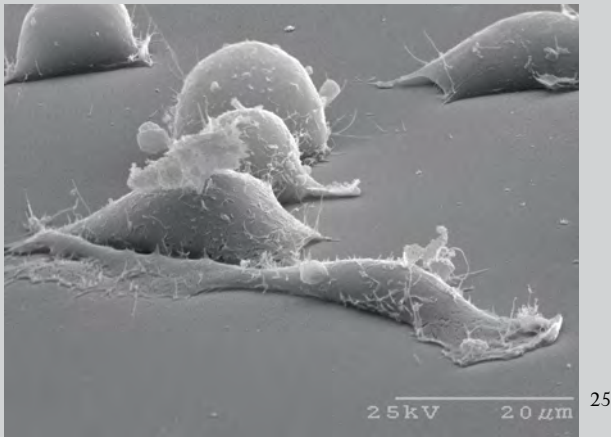
# Center for PostNatural History

“...to acquire, interpret and provide access to a collection of living, preserved and documented organisms of postnatural origin.”

So reads the mission statement of the Center for PostNatural History, founded by Richard Pell in 2008. Pell is an artist who also teaches art at Carnegie Mellon University in Pittsburgh and who is motivated by what is absent from museums of natural history and zoos: biology altered by people. This is a rich and consequential thread of human history by any measure, and Pell makes the case for it powerfully by presenting the organisms in a standard museum format, using exhibition techniques and language. One of the goals of the Center is to invite viewers to examine their beliefs about activities such as selective breeding and genetic modification, and to consider how they are related. Essentially, the Center makes the case that the story of postnature began long ago, with the first developments of agriculture and the domestication of dogs. This is not to say that transgenic organisms should be unthinkingly embraced or that rapidly proliferating genetically modified crops are nothing to worry about; rather, the Center elevates these living products of deliberate human design to the status of artifacts worthy of study.

The specimens preserved and presented by the Center for PostNatural History include organisms from little-known milestones such as the irradiated screwworm project, undertaken by the United States government in the 1950s. The project successfully eradicated *Cochliomyia hominivorax*, a species that naturally thrived in warmer climates, inconveniently feeding on the flesh of ranchers' livestock. The program bred millions of the worms and then used radiation to sterilize the males. Their subsequent release across huge tracts of the United States effectively halted the species' reproductive cycle, with the sterile males crowding out their vastly outnumbered virile brothers.

Another recent effort to deliberately steer natural selection toward a more anthropocentric outcome involves mosquitoes. As the Center documents, efforts are underway to spread a new, transgenic species of mosquito altered so that it is unable to spread the



malaria virus to humans. Several teams of scientists have demonstrated that it is possible to breed such a mosquito, a specimen of which is preserved by the Center. This is a cultural artifact of significant potential consequence, given that up to 500,000 people die each year from malaria. Again, the goal of the Center in acquiring this specimen is carefully worded so that it doesn't advocate for the deployment of such living technology but rather helps us recognize the extent of its importance. Just as the mosquito can be a vector of disease, transgenic technology can be seen as a vehicle communicating our societal priorities.

The Center also preserves representations or specimens of transgenic goats, zebrafish, mice, corn, and other organisms. Its exhibitions have dealt with subjects such as techniques to prevent the reproduction of genetically modified species, and the design of the Svalbard Global Seed Vault (SGSV)—a “Noah's Ark” intended to protect biodiversity in the event of global catastrophe. The Center has exhibited widely, from New York to Berlin to Amsterdam, and actively promotes a more informed and nuanced discussion of the anthropocentric realities of the nature all around us.



25 HeLa cells from Lindstedt Lab at Carnegie Mellon University  
Cancerous cells harvested from Henrietta Lacks in 1951,  
cultured indefinitely for research  
Transmission electron microscopy

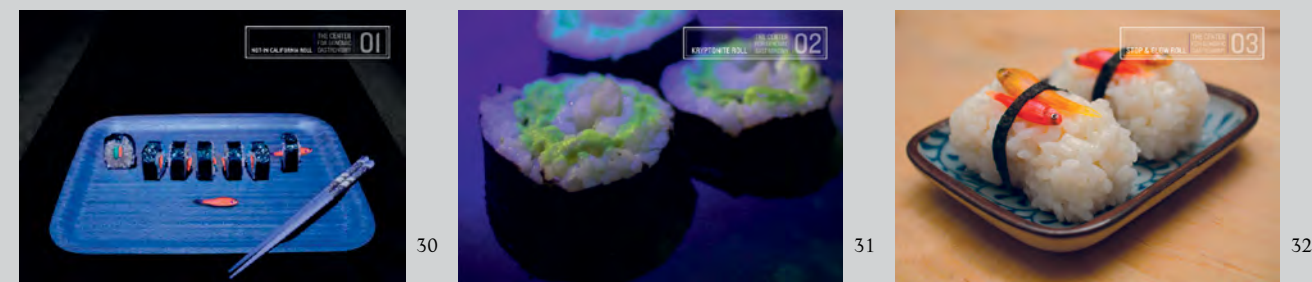
26 Gigapan portrait of Center for PostNatural History  
Photograph

27–29 Artifacts of human design:  
Domesticated dog skull from the collection of Berlin  
Museum für Naturkunde  
Transgenic mosquito from James Lab at UC Irvine  
C57Bl6 mouse from Jackson Laboratories





# Center for Genomic Gastronomy



The projects of the artist-led think tank known as the Center for Genomic Gastronomy range from cooking performances and museum exhibitions to the design of speculative products relating to food production and consumption. For its founders Zach Denfeld and Katherine Kramer, and their many collaborators, food is a platform that can be used to address a multitude of issues in an engaging and accessible way. Central to the topics they address in their work is the concept of the Anthropocene. Their treatment of the subject is critical but seasoned with humor; it confesses our sins but jeers at our prejudices and hints at a hopeful future. Their works can therefore be seen as a roast (a mocking toast) to our culture.

The *Glowing Sushi* project (2011) exemplifies this sort of send up: it (literally) highlights the ubiquity of genetically modified organisms in the food industry. It does so by using “GloFish®,” which have been modified to be fluorescent and are intended only to be decorative, in a raw fish dish. A subtext of the work is the unfortunate invisibility of food sources in contemporary life and the hypocrisy we are susceptible to when we develop reflexes to dismiss particular ideas or practices. The title of one work within the project resonates powerfully: *Not-In-California Roll*.

*Disaster Pharming* (2013) presents a bio-prospector’s toolkit. The idea behind the work is historically rooted in both the acts of explorers looking for exotic plants and animals and the experiments, which began in the 1950s, in bombarding seeds with radiation to see how they might change. *Disaster Pharming* suggests there may exist commercially useful plants, species that have stumbled upon a genetic variation thanks to a

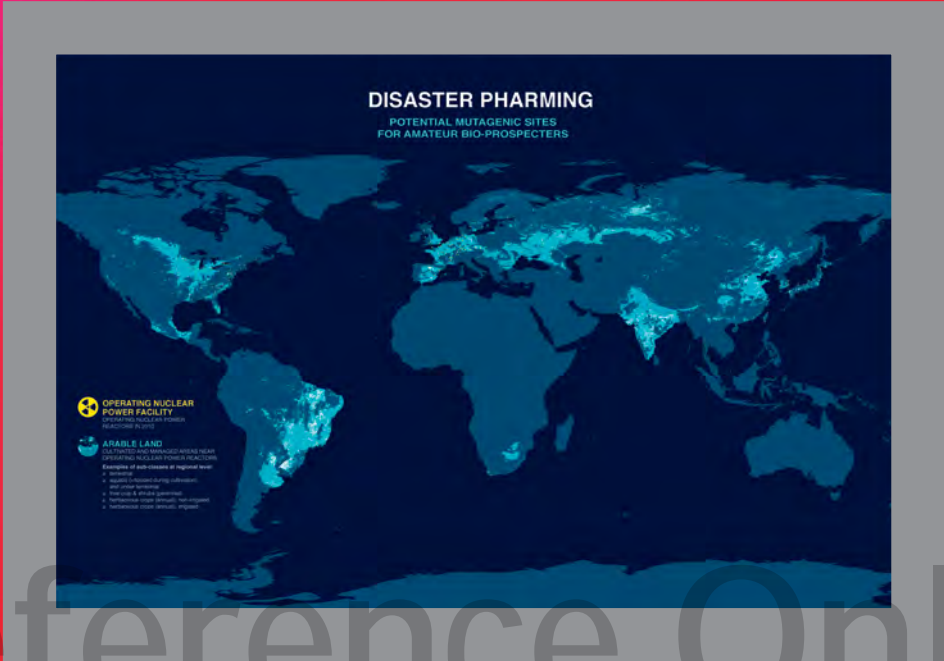
radioactive or toxic environment poisoned by humans. The toolkit’s presentation includes a call to action which makes sly use of traditional marketing language: “Let the radiation do the work, while you reap the benefits.”

Taking this idea still further, *Cobalt 60 Sauce* (2013) features in its recipe five radiation-bred ingredients: Rio Red Grapefruit, Milns Golden Promise Barley, Todd’s Mitcham Peppermint, Calrose 76 Rice, and soy. This work plays on our lingering, and often irrational, fear of nuclear technology and underlines two points that the Center’s artists frequently make: that “we’ve always been biohackers” and “breeding is just very slow programming.” Mutagenic species can be found around the world and are a testament to the outdated beliefs many of us hold about what is natural or perverse.

The *De-Extinction Deli* (2013) is a playful speculation based on recent experiments to resurrect species that have been lost. In presenting the possibility of animals like the Pyrenean ibex (a wild goat) on a food menu, the artists pose an uncomfortable and pitch-perfect criticism: would efforts to bring back lost species just end up enabling a novel form of consumption? Perhaps we should reflect more on why extinction is happening instead of applying our efforts to the merely symbolic act of defeating it in a laboratory.

30–32 *Glowing Sushi* • 2011  
GloFish®, rice, seaweed

33–34 *Disaster Pharming* • 2013  
Photography, mixed media







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35–36 Cobalt 60 Sauce • 2013  
BBQ sauce made with radiation-bred plant ingredients, mixed media

37–38 De-Extinction Deli • 2013  
Mixed media and performance



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# Kate MacDowell

MacDowell works primarily in porcelain, a material that is simultaneously delicate and durable when treated with care. It can also be precisely textured, allowing for expressive detail and wide variation in light and shade effects. The artist often builds a solid form and then hollows out negative spaces or, with smaller works, builds miniscule segments at a time, lengthening MacDowell's exposure to the material and forms.

A frequent starting point for the artist's work is the observation that people yearn for union with a natural world from which they feel divorced, but this desire conflicts with the realities of the relationship. Specifically, the increasingly visible and consequential harm humans visit on the environment and other species belies our romantic urge to feel united with the beautiful intricacies and mysteries of the natural world. The artist explores this notion using myth, humor, art history, and popular culture references, including recognizable symbols of genetic engineering.

MacDowell's work *Daphne* (2007) can be understood as a bleak continuation of the myth of Daphne, the young woman transformed into a tree to escape the salacious Apollo. According to the telling of the myth by Ovid in *Metamorphoses*, while Daphne ran from Apollo (Phoebus), who had been struck by Cupid's arrow, she prayed to be transformed so as to preserve her purity even at the cost of her life: "change me, destroy this beauty that pleases too well!" Daphne thus became a bay laurel, disappointing Apollo but inspiring his worship; laurel leaves have long been a potent symbol of honor. Over the centuries numerous artists have used idealized forms to depict this myth, usually capturing the moment at which Daphne begins to become a tree. MacDowell injects contemporary reality into her depiction by presenting Daphne as a tree that has been felled but also brutalized and abandoned in disarray that suggests a crime scene: a compounded tragedy perpetrated by the close cousins of lust and greed.

Another of MacDowell's works in porcelain, *First and Last Breath* (2010), combines humor and absurdity to highlight the plight of animals freshly born into a tragically altered environment. The likelihood that we would furnish small animals with gas masks is about equal to that of their survival as depicted in the work.



39 *First and Last Breath* • 2010  
Hand-built porcelain, mixed media

40 *Daphne* • 2007  
Hand-built porcelain

41 *Mice and Men* • 2009  
Hand-built porcelain, cone 6 glaze

We might begin to wonder if the post-apocalypse for many animals has already begun. Other works by the artist depict mice altered by tissue culturing and genetic manipulation practices that fuel biomedical research but spur little discussion. The 2009 work *Mice and Men* recalls the poem by Robert Burns *To a Mouse* (1785). Apparently, the poet was inspired to write the piece when he accidentally destroyed a mouse nest while ploughing in the fields. He wrote: "I'm truly sorry man's dominion/ Has broken Nature's social union....In proving foresight may be vain:/ The best-laid schemes o' mice an' men/ Gang aft agley." These last two lines are taken to mean that the plans of all species often "go awry," a notion that is graphically rendered in MacDowell's work in the sprawled, stiff forms of the rodents. Tiny human skulls are nested in their heads, suggesting that the fates of mouse and man are closely linked.







# Suzanne Anker

Anker is a visual artist and theorist who has been working at the intersection of art and biological sciences and contributing to its evolution for more than twenty years. As the founding director of the Bio Art Lab at the School of Visual Arts in New York City that opened in 2011, Anker is also shaping how such art will develop in the future, by influencing the students drawn into its orbit. The artist's work is realized in a range of media, from digital sculpture and large-scale photography to arrangements of plants grown with artificial light. The issues confronted and techniques employed in Anker's body of work resist summarization, but there is a decidedly art-historical perspective informing her decisions, as well as an urge to critique the claim on universal validity that culture has granted to science. Anker has described the potential of genetic manipulation and related technologies as "clinically and philosophically seductive" as they can "promise control and perfection, but they also evoke fundamental questions of authenticity, identity and bodily integrity."

Anker's early work *Zoosemiotics* (1993) can be read as a meditation on visualization in science: our need for it, its limits, and the long history of trusting imperfect technologies to generate what can become fixed cultural icons. Like any written language, the visual can be ever more distorted, misleading, or arbitrary, especially when dealing with forms that are otherwise invisible and concepts that are understood well by few outside of the scientific professions. In this work, bronze sculptural representations of chromosomes of various species are arranged on a wall adjacent to a round, glass vessel filled with water—a very early magnification technology. Looking through the curved surface of the glass and water warps the forms of the chromosomes in the distance and offers an alternative visualization.

The ongoing work *Vanitas in a Petri Dish* (2013—ongoing) references *vanitas* painting, or still life compositions that feature symbols of decay and death underlining the futility and vanity of human endeavors. The *vanitas* compositions are arranged in Petri dishes that effectively represent the collective enterprise of science and its application. These compact

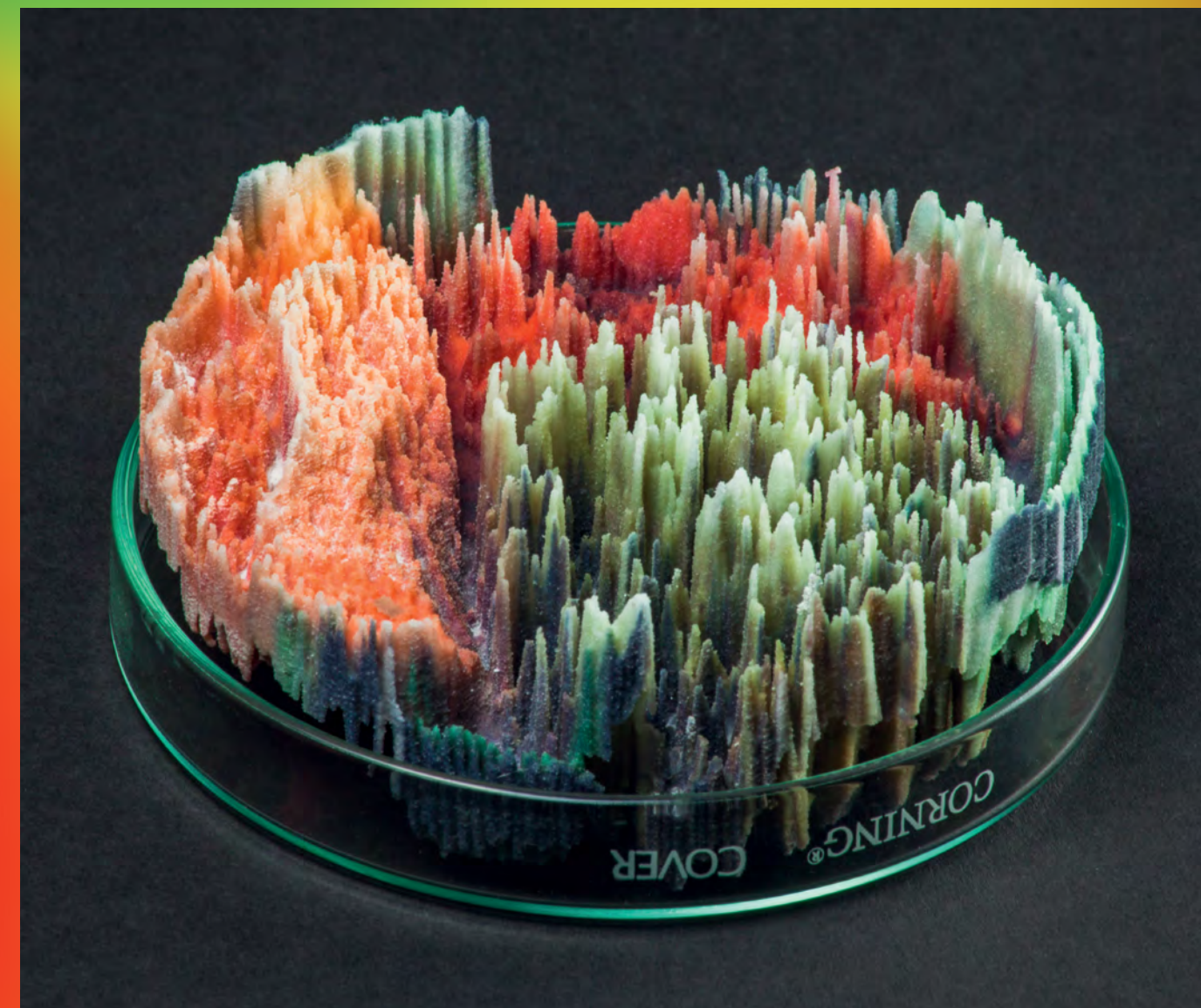
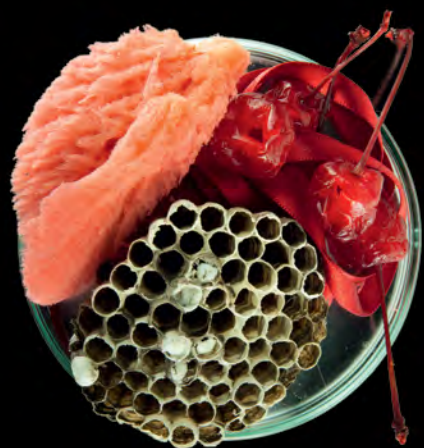


42–44 *Zoosemiotics* • 1993  
Hydrocal, metallic paint, stainless steel, glass, water

configurations can lead us to wonder what all our splendid discoveries through research actually create and who do they primarily serve? It is with humor or despair that one might consider how cheating death in some way has long preoccupied scientific inquiry, but it now seems within reach, once again, in our molecular age.

With *Vanitas on a Petri Dish* as a starting point, Anker translated photographs of the dishes into 3D printed sculptures for *Remote Sensing* (2013—ongoing). With the help of advanced image manipulation and printing software, elements of the *Vanitas* photographs were translated into height, texture, color, and shape, and these compositions have been realized in 3D and sized to the standard of the Petri dish. The results are akin to exotic, miniaturized landscapes, like models of mountain ranges yet to be found on another world. These sculptures lend new dimensionality to the earlier work but stand on their own aesthetically and, just like a *vanitas* painting, can provoke a distinct sense of melancholy.





- 45 *Vanitas in a Petri Dish* • 2013–ongoing  
Digital prints on watercolor paper
- 46 *Remote Sensing* • 2013–ongoing  
Plaster, pigment and resin rapid prototype  
sculpture, glass Petri dish

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# Neri Oxman

“Wearable myths and habitable contraptions.”

Oxman is an architect and professor of Media Arts and Sciences at MIT in Boston and a leader in the development of fabrication technologies to make materials ever more responsive, meaningful, and effective in their role as mediator between matter and environment. Oxman’s work often involves the study and adaptation of biological systems, translating aspects of behaviors honed by evolution into algorithms usable in emerging technologies like 3D printing. The goal of such work is grandly ambitious and entwined with the mission of the Mediated Matter group at MIT to “radically transform the design and construction of objects, buildings, and systems.” Oxman’s projects therefore have an underlying utilitarian current, but they often also reveal a prioritization of aesthetics, and of making objects that speak to transformations underway in the broader culture. From this perspective, Oxman can be said to be creating works of art. This is supported by the virtually instant acquisition of her works by such institutions as the Centre Georges Pompidou, Paris, MoMA in New York, and the Museum of Fine Arts in Boston.

*Imaginary Beings: Mythologies of the Not Yet* (2012) is a series of eighteen prototypes designed for the human body and inspired by *The Book of Imaginary Beings* by Jorge Luis Borges (1957). The series captures and materializes so-called “mythemes,” or what can be thought of as the subatomic portions of myth, components that cannot be reduced further and which represent a cipher of human essence. This idea was first elaborated by Claude Lévi-Strauss in the mid-20th century, and is comparable to concepts in structural linguistics that describe universal elements in language systems across cultures, such as phonemes, morphemes, and sememes: the smallest vehicles of meaning a language deploys. Oxman postulates that futuristic design is rooted in fantasy and myth, and presents her prototypes as narrative tools, each presenting a potential personalized augmentation that confers a supernatural kind of function, such as flight or becoming invisible. A goal is to achieve in form “eternal archetypes of the super-natural and its material expression.”

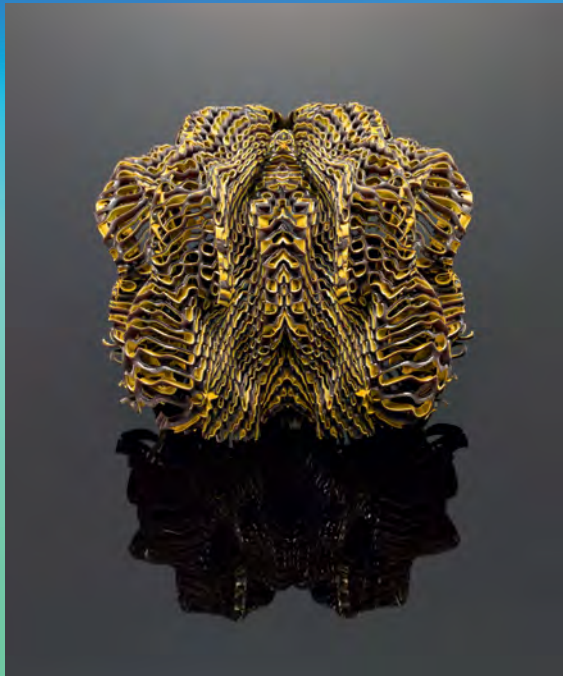
One of the prototypes, *Medusa 1*, is a design for a protective helmet inspired by the head of the gorgon, a chthonic monster of Greek myth. It is the result of a form-generation process that minimizes weight through strategically located perforations and achieves enhanced strength by way of undulating folds which increase surface area and stiffness. Brain-augmenting electrodes for increased cognitive performance could possibly be woven throughout—perhaps a helpful aid for outwitting a contemporary Perseus.

Another of Oxman’s prototype constructions is *Remora*, which takes its title from the marine animal and its related myths of ancient seafaring. It is a fish that attaches itself via a suction mechanism atop its head to other, larger fish such as sharks. In exchange for transport and protection the remora are helpful vacuum cleaners, ingesting parasites, waste, and other matter on or near the surface of the host. In mythology they represented a force that could delay or reverse a ship’s course, wreaking havoc on marine military campaigns or exploration. This is possibly attributable to the fact that remora occasionally attach to the hulls of boats, creating additional drag, a force exaggerated in myth. The remora of Oxman’s work has materialized as a hip splint, attaching itself to the pelvic region using suction. This symbiotic being is imagined as an organic corset, studded with barnacle-like hollow structures. The form is also reversible, with one iteration promoting circulation, and the reverse, with suction appendages facing outward, providing the ability to attach the pelvic region to rough surfaces, as might a remora to a turtle’s shell.

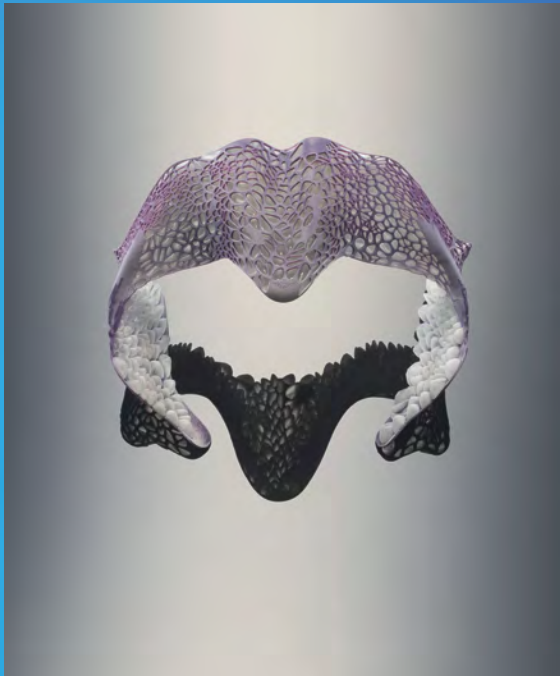
47–51 *Imaginary Beings: Mythologies of the Not Yet* • 2012  
Individual pieces: *Gravida*, *Medusa 2*, *Remora*, *Leviathan*, *Arachne* (Self-Portrait)  
In collaboration with Prof. W. Craig Carter of MIT and Statasys Ltd  
3D printing using Statasys Polyjet technology







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# Patricia Piccinini



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“And if she could be engineered, would she actually be something people might choose to create?”

So said Piccinini of her recent work *The Skywhale* (2013), a balloon in the form of a terrifically fecund aquatic mammal. This question resonates through much of her work, from drawing and sculpture to film. The artist thrusts into our consciousness an uncomfortable combination of the plausible and grotesque: life forms we might one day breed, engineer, or simply imagine, which cross meaningful psychological thresholds. Our uneasiness with exposed flesh, outward sexuality, the endangerment of children, or large insects, for example, creates distinct vulnerabilities that Piccinini readily exploits with cinematic finesse. But in these works she constructs more than friezes from horror films in her mind’s eye; she confronts us with a combination of what we fear and want and do not yet have a vocabulary to describe to create a vision of dystopia laden with hope and humanism.

Although she is keen to downplay it, Piccinini’s study of economics prior to her shift to fine art may inform many of her creative decisions and critical reflexes. She has described the subject as more akin to an ideology, and it seems that it is the (albeit unintended) consequences of such an ideology’s manifestations that interest her most: the messy reality

- 52 *The Listener* • 2013  
Silicone, fiberglass, human hair, speaker cabinet
- 53 *Doubting Thomas* • 2008  
Silicone, fiberglass, human hair, clothing, chair

beyond abstracted models. In *The Listener* (2013) we see a friendly monstrosity mounted on a speaker, a unified sculpture and plinth with warm, welcoming eyes. Its diminutive size works to amplify its non-threatening nature—like a tiny dog—and it somehow balances revulsion and comfort within its gaze. It appears both profound in its strangeness and akin to a cute consumer product tailored to some tasteless preference. Still more confounding to the senses is *Doubting Thomas* (2008), referencing the biblical story and its depiction by Caravaggio in c. 1601–2, about the skeptical apostle who needed to touch Christ’s wounds to believe the Resurrection. The allusions to the original story accumulate quickly: the stand-in for Christ appears to be a mutated or engineered blob of tissue—a product of technology, a contemporary god. And one cannot help but be fearful for the boy, Thomas, who is more curious than skeptical and seemingly in danger, threatened by something he may have inadvertently created.

*Eulogy* (2011) presents a sad portrait of a species victimized by human industry and a clear indication

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of the mindless exploitation that characterizes part of the nature/culture relationship for the artist. The work stands out for how literally it can be read: it is about the unfortunate blobfish (*Psychrolutes marcidus*) brought to near extinction by the crabbing industry. Its outlook is especially bleak given its lack of aesthetic appeal. The fish is unlike, say, an adorable panda and few would miss it. *Eulogy* spotlights the invisibility of many of the consequences of human activity. Likewise, *Aloft* (2010) presents an infestation of sorts, one that feels repellent and brazenly unnatural, but can be seen as a critical mirror. Humans routinely trammel the habitats of other species; why should we expect anything different from them?



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54–55 *Eulogy* • 2011  
Silicone, fiberglass, human hair, clothing

56–57 *Aloft* • 2010  
Fiberglass, stainless steel cable, felted human hair and wool, silicone, robotics, clothing



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## Carole Collet

Collet is a designer, curator, and lecturer who heads the Design & Living Systems Lab at Central Saint Martins in London. As both a researcher and a teacher positioned within a program dedicated to pushing the boundaries of textile making and its applications, Collet's work can be seen as a harbinger of the art that will emerge in the coming decades. The starting point for her recent projects has been a focus on plant life combined with speculation on the possibilities offered by synthetic biology amidst the increasing pressures of climate change and resource scarcity. In other words, she has considered the question: in light of these crises, how will we want or need to alter the biosphere and, with it, our practices of manufacturing materials? For Collet, the answer emerges from the advance of genomic research, and she foresees a massive retooling of industry involving a shift in approach from manufacturing to "biofacturing." This would involve organisms being programmed genetically to make the materials we need in a much more efficient and effective manner.

The project *Biolace* (2012) presents a glimpse of possible future plants which could act as platforms for biofacturing numerous high-value products simultaneously. For example, *Basil n°5* (*Ocimum basilicum rosa*) would allow a fragrance-laden lace to be harvested from the root system, along with the herb itself, which would be enhanced with health-supporting, anti-viral compounds. Another such plant in the project is *Strawberry Noir* (*Fragaria fusca tenebris*), a plant that would be programmed to grow roots of lace and to produce fruits that are jet black; in this scenario berries would no longer need a bright color to entice seed-spreading animals and would have enhanced levels of Vitamin C and antioxidants to support human health. Given that vegetables and fruits can already be genetically designed to resist pesticides, look more appetizing, and survive on considerably less water, it is perhaps only a small leap to imagine these attributes being developed in the near future.

Collet's *Future Hybrids* (2014–ongoing) once again takes environmental degradation as a departure point, proposing possible chimeras of plants and other species for the purpose of protecting biodiversity.



58 *Strawberry Noir* from *Biolace* • 2012  
C-print

59 *Fungi Fur* from *Future Hybrids* • 2014–ongoing  
C-print

This project supports the artist's assertions that "textiles are language," a means to preserve history by recording stories, a process of conducting research, and a potent, accessible way to suggest potential futures. Textile-making is among the most ancient crafts and textiles can be read, like much art, as echoes of massive change, tragedy, and triumph. In line with the theme of epic loss are the pieces *Fungi Fur* and *Phyto Fur* (both 2014), species of plant and fungi that would be designed to grow furs identical to those of large, endangered mammals in the hope that their fast and efficient growing cycles would replace the trade in animals. By contrast, *Phyto Miners* (2014) proposes crocus plants that absorb and concentrate valuable minerals. Eventually, these could be harvested and used in industry at much less material or energy cost than conventional methods.



# Eduardo Kac

After more than thirty years of artistic innovation, it seems fair to conclude that Eduardo Kac can see around corners. At heart he is a serial artist–entrepreneur, endowed with lidless optimism and an inexhaustible willingness to experiment, adjust, and begin anew. Kac began his artistic career working in poetry, combining it with video and digital technologies as well as performance. The artist’s approach at this time, in the early to mid-1980s, was informed by an interest in body politics, which was an area of critical inquiry and activism relatively under-represented in his home country of Brazil at the time, and the writings of Roland Barthes and Herbert Marcuse. In what may be indicative of Kac’s verve and utter commitment, he self-reports in his chronological biography: “1982: Begins to wear a pink mini-skirt both to carry out daily chores and in performances.”

Kac’s experiments with technology in general have been remarkably prescient: as early as 1986 he created a telepresence work with a wireless, radio-controlled robot allowing participants to converse with the public. In 2000 he presented *GFP Bunny* in France, to much media attention and subsequent controversy. This live rabbit, which could allegedly glow bright green under ultraviolet light, had been altered at an early embryonic stage to express a gene that codes for a fluorescent protein found normally in jellyfish. Whether the pictures or data about the particular rabbit (*Alba*) are accurate from a scientific standpoint seems beside the point. Art of this kind heralds a new age of possibility for creative expression, one that has clearly caught on rapidly. The sensationalist quality of the presentation and reporting may also reveal a level of gullibility in the international media, something that has snowballed since the proliferation of the internet. This offers an irresistible, if potentially dangerous, new canvas to artists (see for example Next Nature Network’s *The Rise and Fall of Rayfish Footwear*, pages 32–33).

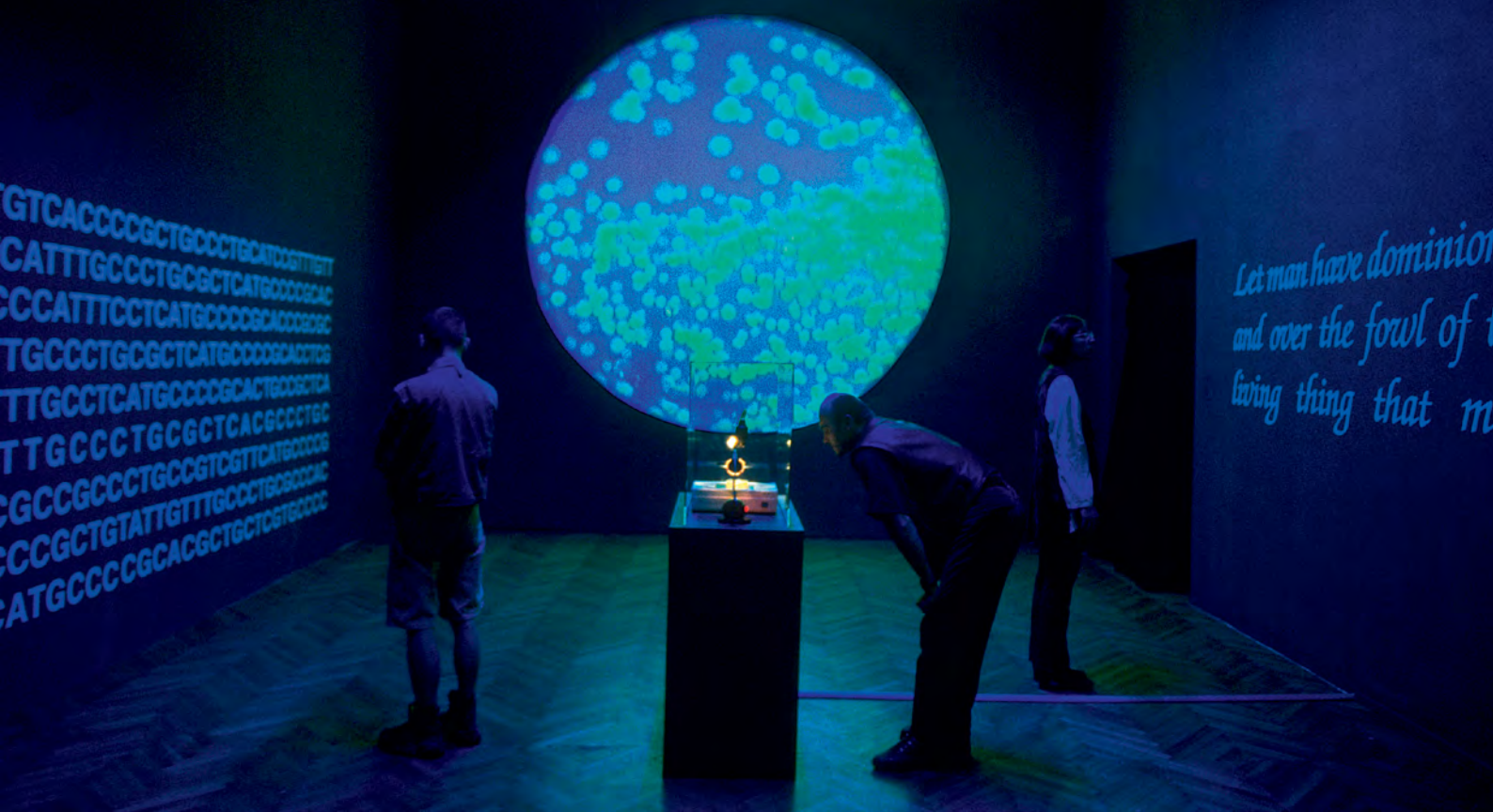
*Genesis* (1999) was the world’s first major work of transgenic art, although it would receive less global attention than *GFP Bunny* a year later. *Genesis* premiered at Ars Electronica in Linz, Austria and on the internet, allowing an interactive platform which invited the public to participate in the act of physically altering



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the DNA of an organism. For this work, a population of ordinary and harmless *E. coli* bacteria was altered to contain genetic code that, instead of coding for distinct proteins, was a Morse code translation of a text from the Book of Genesis: “Let man have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moves upon the earth.” This population of message-bearing bacteria was grown under a UV light that gallery and online visitors to the work could control. By activating the light viewers created the potential for mutation, or slight variations in the order of the genetic codes of the organisms. Eventually, the exposure created changes in the part of the code that contained the text, altering the spelling and potential meaning of the biblical sentence; a collective, genetic-poetic gesture. This seminal work anticipated many developments in the fifteen years that followed, from crowd-sourcing and interaction design to artistic use of transgenic organisms and the need to illuminate the limitations of metaphors frequently used in language about genetics such as “code” or “Lego bricks.”

Another of Kac’s works to incorporate DNA is *Cypher* (2009), consisting of a DIY transgenic kit including the tools required to bring “to life” a poem coded into a string of DNA, along with a gene for fluorescent protein. The user chooses to add the DNA to that of the ordinary bacteria through a basic procedure of horizontal gene transfer—an activity now common in high-school biology. The resulting red glow confirms that the poem has been seeded into the bacterial population and is reproducing. A small booklet accompanying the work provides the cypher or system that the artist has used to convert the poem into a genetic sequence. The kit is sculpted as both an



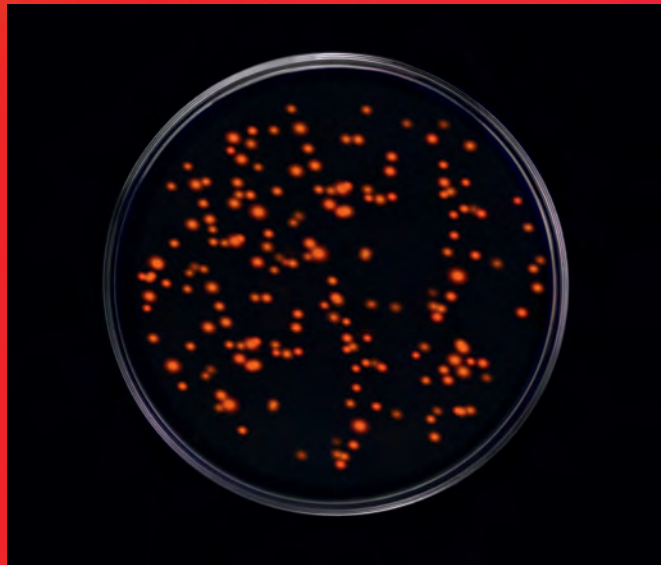
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60–62 *Genesis* • 1999 First version  
Commissioned by Ars Electronica, Linz  
Multimedia equipment, UV light, genetically modified *E. coli* bacteria, genetic sequencing

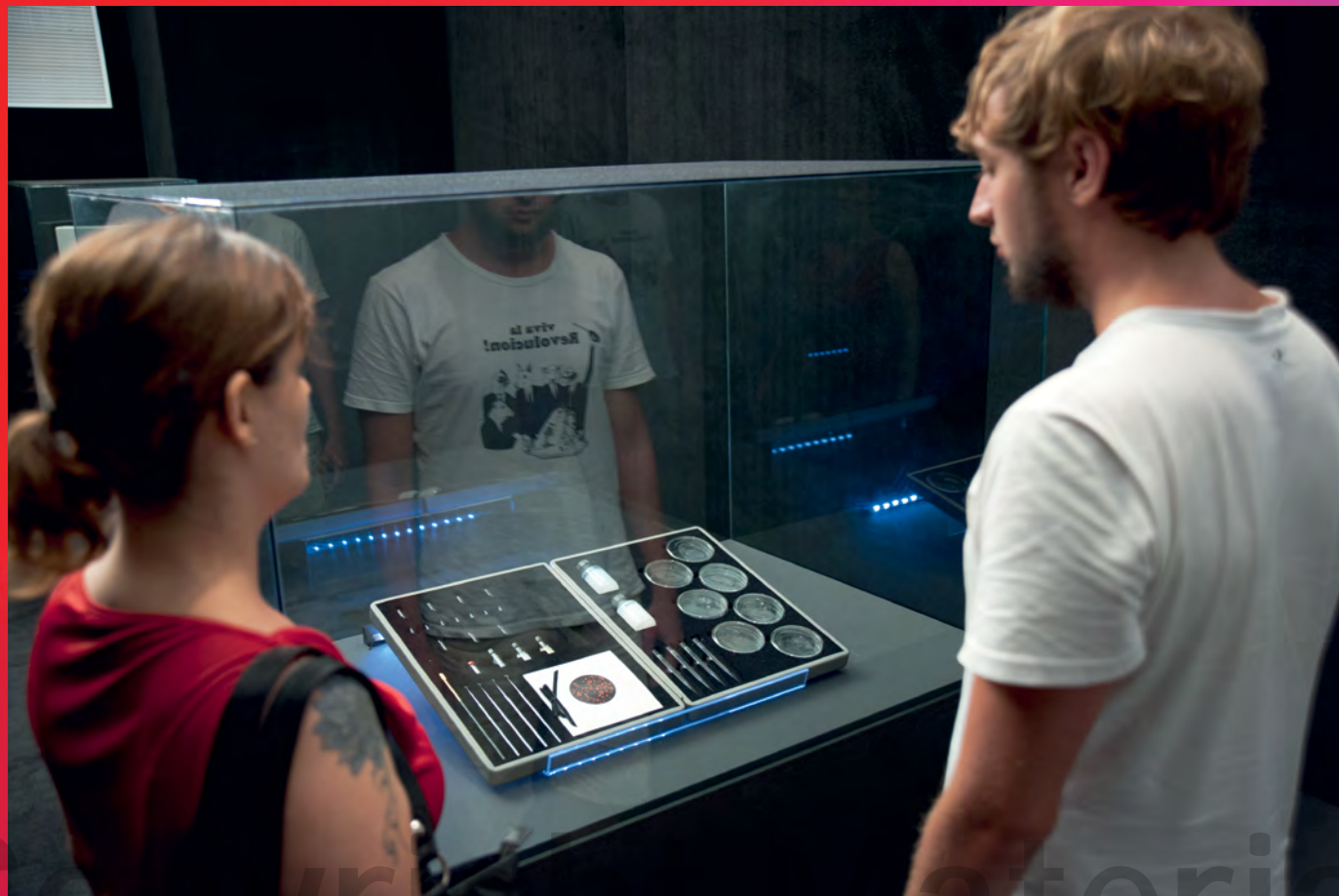




industrial and biological object and the DIY nature of the process is contradicted by the very polished finish of the components. Adding to the layered meaning of the work is the content of the poem itself: "A TAGGED CAT WILL ATTACK GATTACA," which plays on the fact that DNA expresses itself through four bases: A, T, G, and C. As Kac notes: "The poem encompasses not only the visual composition, with its specifically chosen typeface, but also its simultaneous existence as a gene and as a code—a code that can be read in alternate directions. In other words, the poem is a network of elements that should be considered together."

63—65 Cypher • 2009  
 DIY transgenic kit with Petri dishes, agar, nutrients, streaking loops, pipettes, test tubes, synthetic DNA, booklet

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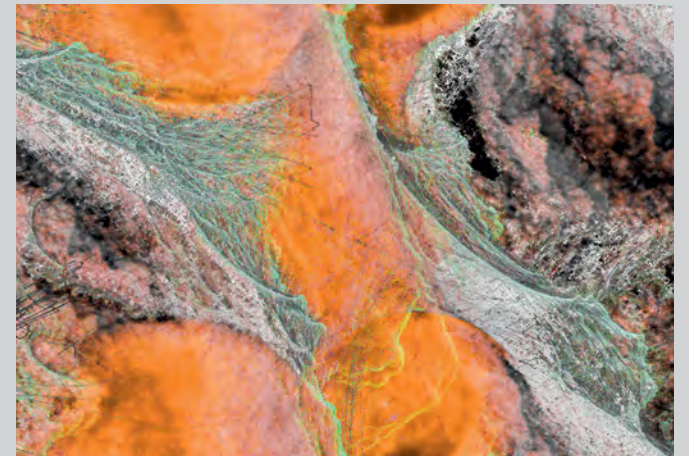


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# Driessens & Verstappen

The work of Erwin Driessens and Maria Verstappen is often concerned with releasing control and coaxing poetic serendipity to emerge from carefully designed systems. In effect, they devise processes that generate form on their own, like a blend of film direction and dance choreography but for media such as wax, plants, and pixels. The artists have been collaborating and creating works for more than twenty years, having also studied together before forming their studio. A departure point for them early in their career together was the observation that institutionalized art establishments used art and, by extension, artists as tools to perpetuate power structures over which they reign. Thus, art that could generate itself was a critique of this system in general and also synthesized a deep sense of awe for nature's ability to endlessly create original forms. In addition, the artists have linked themselves to the intentions of concrete art of the early 20th century to produce works that are non-referential and readily adopted new technologies to do so. What they have aimed to achieve is spontaneity without the potential interference of human intuition, expressing trust "that chance, self-organization and evolution order and transform reality."

*Top-down Bottom-up* (2012) is an installation system that produces new forms in each of its iterations. Blocks of wax are melted slowly from a height, forming jagged stalagmites out of what began as smooth, geometric form. Their likeness to geological form accumulated over millennia is striking, and each of their tiny, intricate layers is completely original and yet like a *trompe l'oeil*, given the temporary character of its creation and display. Each of the stalagmites is eventually melted down to blocks once again, to start the cycle anew. *E-volved Cultures* (2006) is a more literally programed production of visual spontaneity. For this work, the artists designed algorithms that alter pixels in a display according to the state of their neighboring pixels, with the process repeating and continuing indefinitely as changes beget more changes. This produces



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- 66 *Top-down Bottom-up* • 2012  
Commissioned by Centraal Museum Utrecht  
800 kg beeswax, 4 dripping machines made out of aluminum, electronics, heating components
- 67–68 *E-volved Cultures* • 2006  
Software for Mac OSX, video projection

compositions in motion, always making new colors, forms, and structures. The resulting ordered chaos evokes association with clouds, fungal growth, animal tissues, or satellite maps of landscapes.

The works *Herbarium Vivum* (2013) and *Vegetable Collections* (1994–2011) both engage with natural material directly, showcasing the forms of plants and highlighting the ways in which we are conditioned to misperceive them. *Herbarium Vivum* restricted the growth of herbs to just two dimensions, as would be seen in traditional herbariums that served as





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records for the study of plant life forms. The extreme conditions these unfortunate herbs experienced are akin to the sort of testing regularly performed on crops in order to isolate favorable characteristics. The *Vegetable Collections* originated from a similar desire to challenge perception. For this multi-part work the artists found and photographed examples of variation in vegetable forms that may appear peculiar but are in fact an instrument of nature to ensure survival through diversity. In considering how odd these appear to the contemporary consumer, we might ask: what other natural miracles might we have been conditioned to look at with revulsion, and at what potential cost?



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69 *Morphotheque #15* from the *Vegetable Collections* • 2011  
27 copies of peppers in painted plaster

70 *Morphotheque #9* from the *Vegetable Collections* • 1997  
32 copies of carrots in painted plaster

71 *Herbarium Vivum* • 2013  
Hemp, mustard, cucumber, corn, borage, marrowfat, poppy, tomato, tobacco, potato, cultivated in a frame



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# Jalila Essaïdi

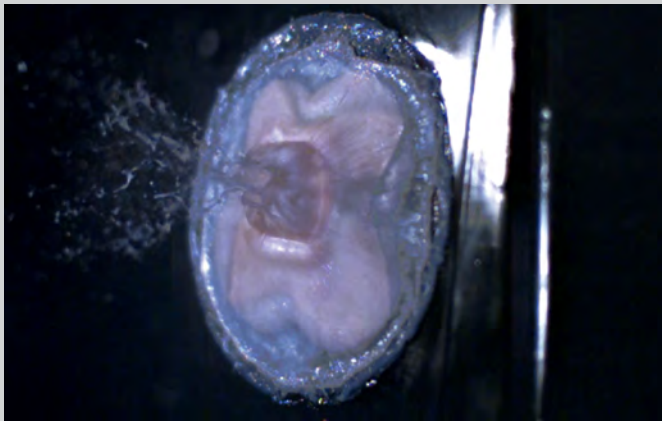
The starting point for much of Essaïdi's work reflects Socrates' observations on love, as recounted by Plato in *The Symposium*; that essentially what people seek is "the everlasting possession of the good" and it is through this urge that countless forms of expression unfold. More specifically, the artist chooses to use living material as a medium to help acknowledge the transience of life in spite of the frantic but futile human impulse to resist loss and decay. The nature of this struggle between possession and loss is complicated by continuing advances in biotechnology, in particular the implied promise to arm us with ways to combat inevitable death. The tools and techniques life has devised over three-and-a-half billion years of evolution are seemingly endless, but research is rapidly decoding and explaining them, leading to new technologies with which we have not yet come to terms.

The artist's most extensive work to date is *Bulletproof Skin*, also known as *2.6 g 329 m/s* (2011). The numbers used in the title denote the mass and speed of a .22 caliber bullet from which a standard bulletproof vest will afford protection. Essaïdi set out to make a human skin sample bulletproof by combining it in a laboratory with spider silk, which is a material stronger than steel. With funding from the Dutch Bio Art and Design Award and the collaboration of the Forensic Genomics Consortium in the Netherlands, the artist developed a sample and tested it with bullets fired at varying speeds. The sample successfully stopped bullets that had been partially slowed when fired, all of which Essaïdi captured in dramatic imagery. Aside from the formal and technical elements of the project, the most interesting implications are those about the possibilities of engineering forms of human safety.

Technological progress can be seen to alternate between strengthening and removing our sense of security, creating a whiplash effect that is amplified by sensationalized media coverage. *Bulletproof Skin* may preview the vast dimensions of possibility for changing and enhancing our bodies in the near future thanks to biotechnologies, but as the technology races ahead, we may need to stop and ask about their meaning in the face of social dysfunction: why do we need to shoot bullets at people in the first place?



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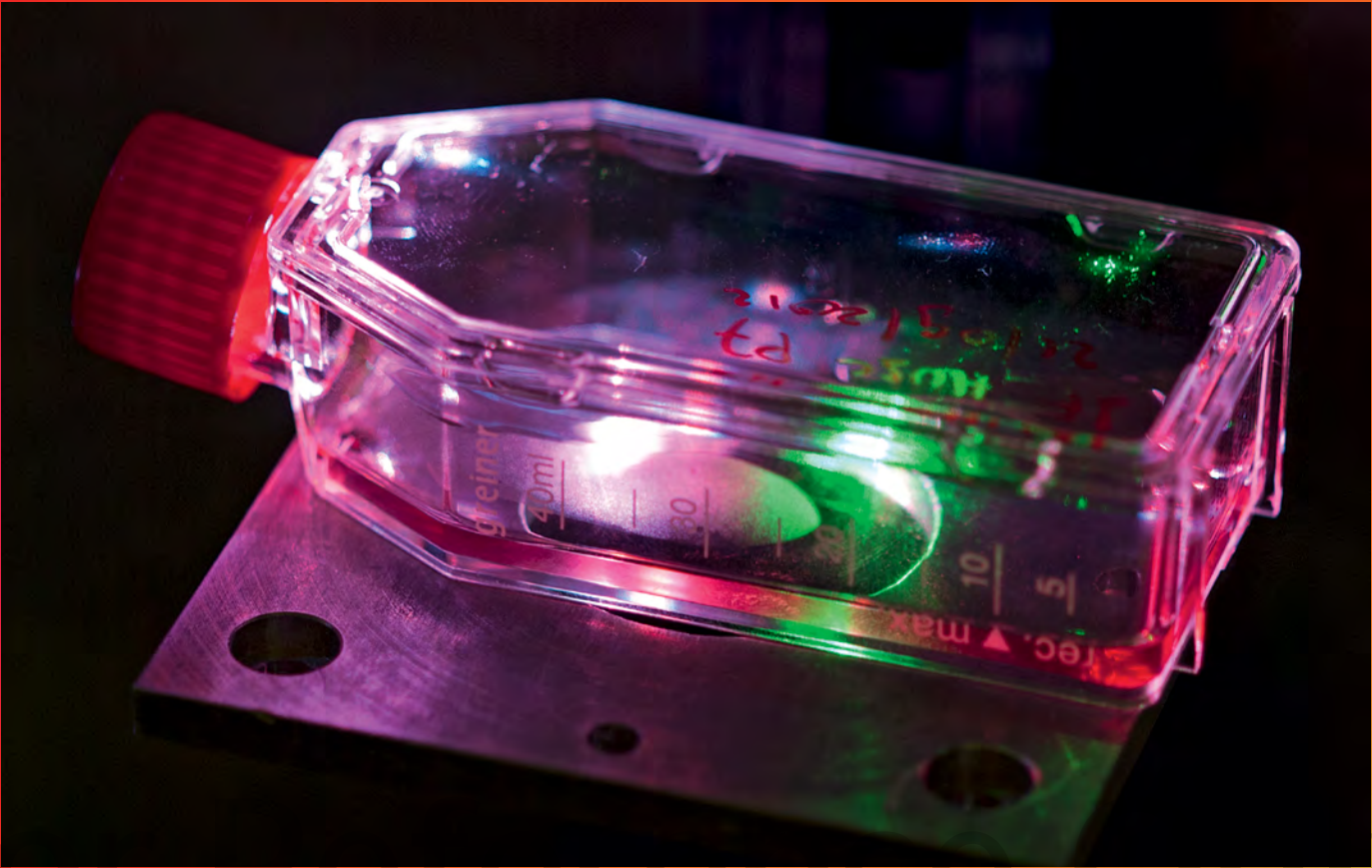
72–74 *Bulletproof Skin* or *2.6 g 329 m/s* • 2011  
In collaboration with Forensic Genomics Consortium  
Netherlands, Utah State University, Leiden University  
Medical Centre, Netherlands Forensic Institute  
Spider silk made by genetically modified goats and  
silkworms, human fibroblasts and keratinocytes, bullets

75 *Composing Life* • 2012  
Human fibroblasts, music, argon/krypton-ion laser

In the 2012 work *Composing Life*, Essaïdi explored the origin of the human sense of timing, rhythm, and harmony. For this work she began with cultured human cells and monitored changes in their growth as they were exposed to music via pulses of laser radiation. It is known that certain types of radiation can have positive effects on cell growth, alignment, vitality, and proliferation. In the controlled setting she created, the artist aimed to discover whether the patterns we call "music" can have a physiological effect on tissue unconnected from the human nervous system.



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# Katrin Schoof



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Schoof divides her time between personal artistic practice and commercially focused work as a communication designer based in Berlin. Her projects range from book design and art installations to creating the graphic identity for a Media Architecture Biennale in Vienna. Schoof's fluency in visual language supports a style that is characterized by clarity and simplicity. This tendency of reduction toward essential form in turn characterizes her art projects that involve the representation of nature.

The Romantic regard for landscape celebrates its joint beauty and danger, and is the starting point for the work *Paradise Panorama* (2008). In line with the scale of its subject, this work consists of monumental images, intended to be viewed as a projected slide show in an outdoor public space. As in the works of Romantic painter Caspar David Friedrich, who Schoof cites as a reference for this project, the use of panorama demonstrates an attempt to evoke the sublime via landscape, but in this case in a far more technologically updated way that also draws on camp aesthetics. Schoof does not strain to achieve verisimilitude, but rather she exposes her process and its artifice while still managing to convey a blend of the forlorn with the mystical. Even an untrained eye can detect the tricks of digital manipulation at play, but the images still resonate as a collage of symbols; of cues that popular culture, in its unique alchemy, has programmed us to receive as idyllic. The "opulent images of both

real and virtual landscapes," as the artist calls them, are reflections of the changing nature of nature, as well as being visual experiences as we continually define them; they are earnestly artificial.

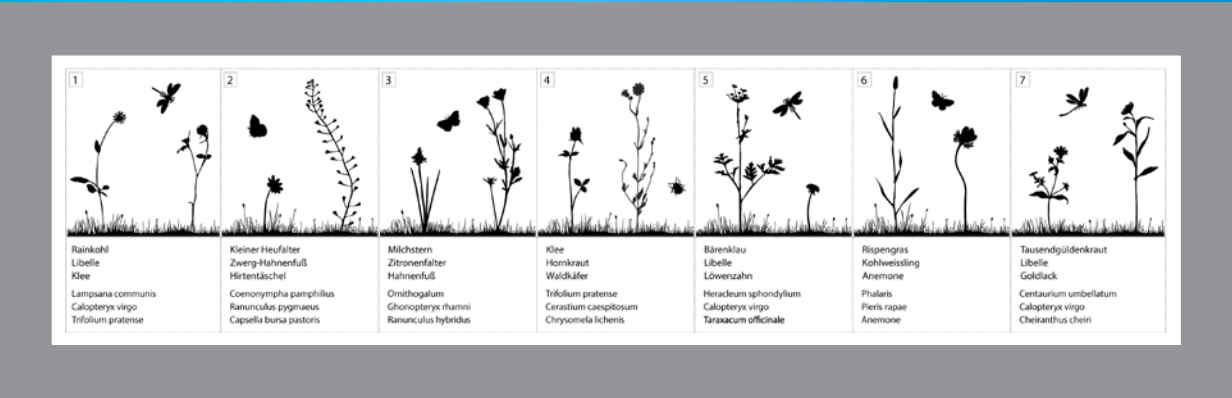
*Ma Jolie*, or "my pretty" (2010), is a product series of wall decoration that began with photography studies. The artist reduced the photographs to silhouettes and began to arrange and rearrange them into a prototypical form. The resulting shapes recall the filigree of art nouveau and its variations from the late 19th and early 20th centuries. Like *Panorama*, *Ma Jolie* channels new conceptions of nature and a yearning for organic form in a thoroughly mechanized and digitized world. Schoof also makes variations of her decor, adding vivid color and arranging them into slideshows, forming what she calls "pop-art tableaux."

76 *Paradise Panorama* • 2008  
Digitally altered images, slideshow projection

77–79 *Ma Jolie* • 2010  
Silhouettes, digital imagery, website presentation



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