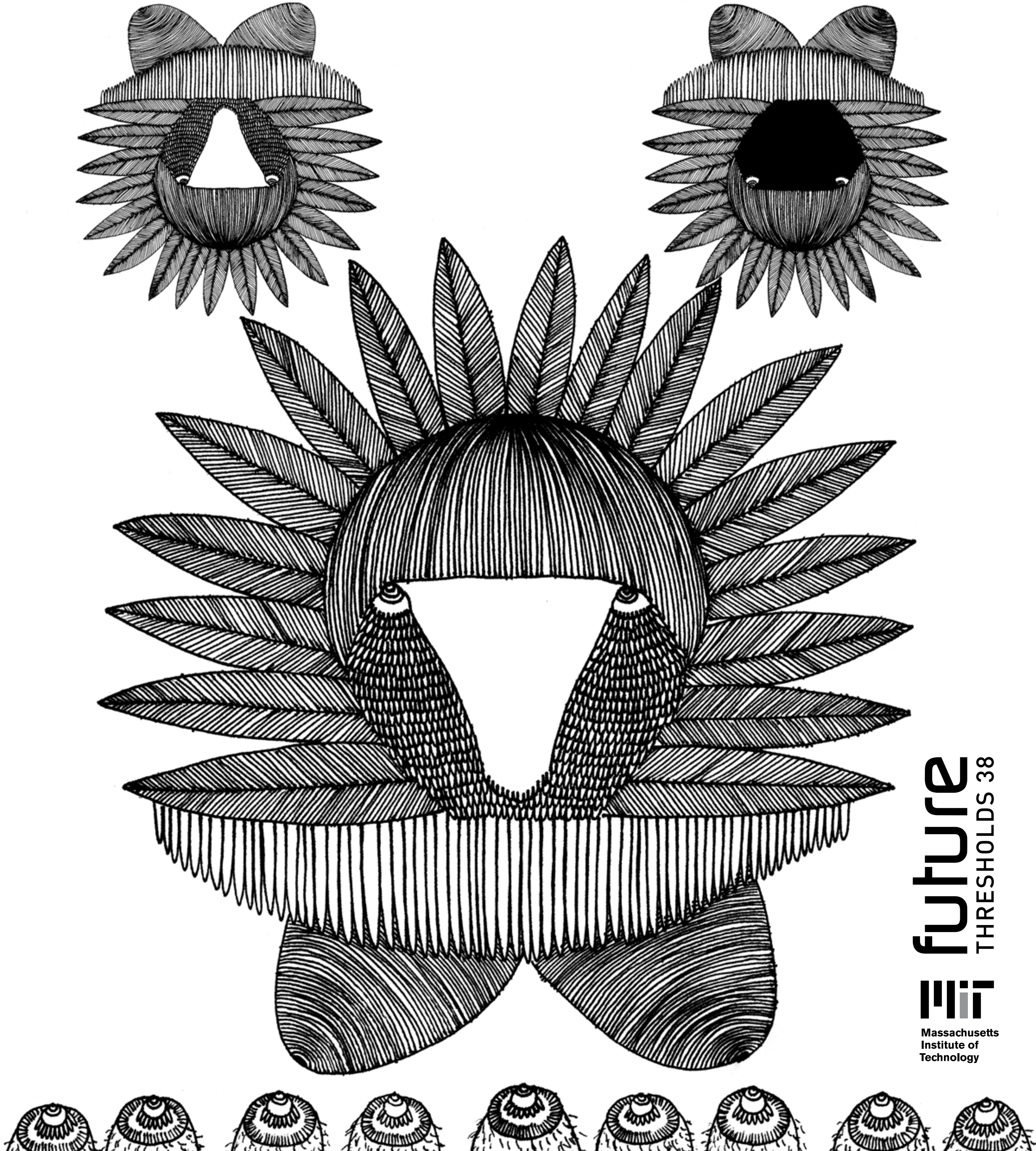


future
THRESHOLDS 38

Massachusetts
Institute of
Technology

04 The Illusions of Control
Radical Engineers and Reactionary Artists

Oron Catts and Ionat Zurr

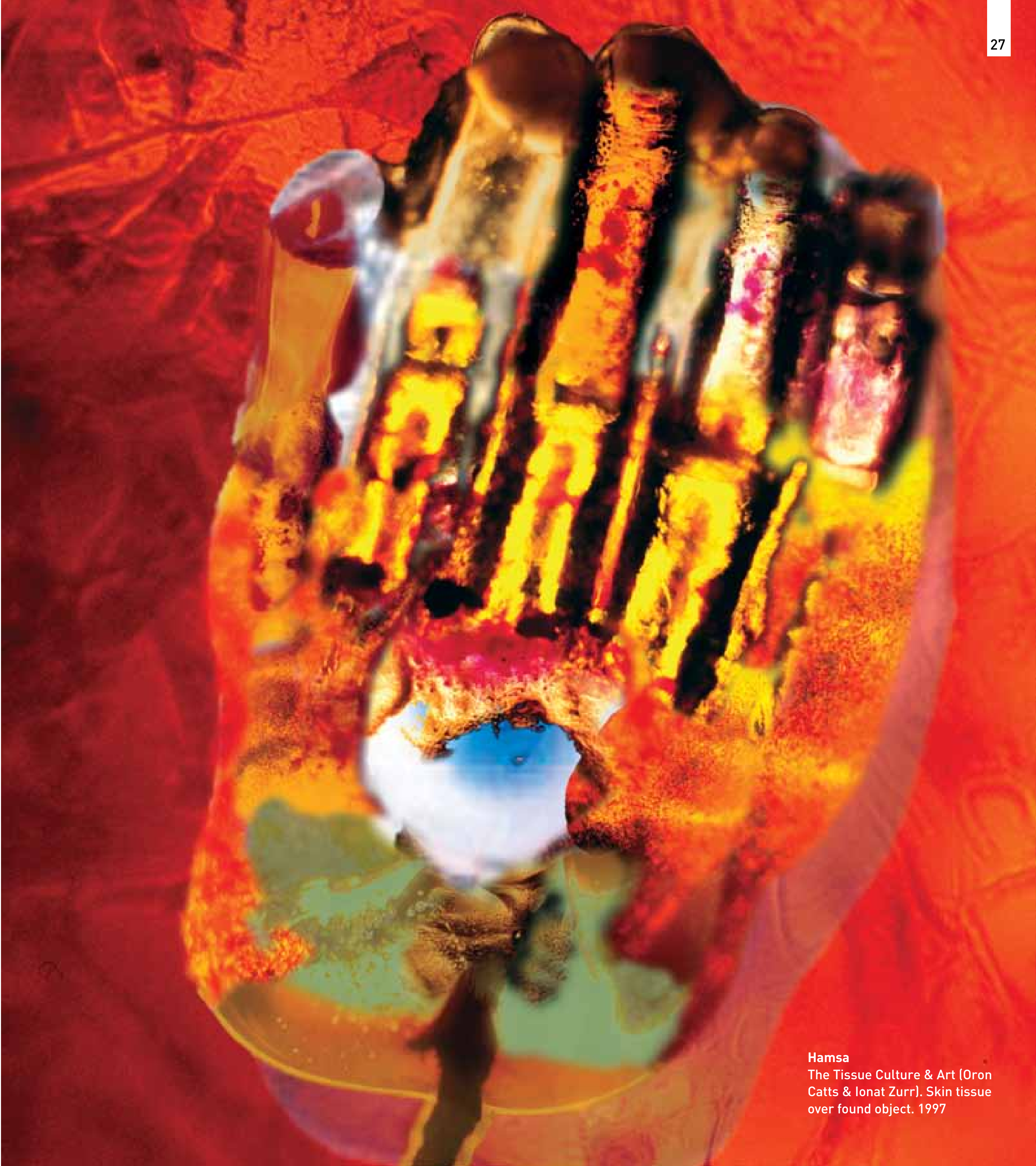
Award winning Artists, researchers and Curators, Catts and Zurr formed the internationally renowned Tissue Culture and Art Project. They have been artists in residence in the School of Anatomy and Human Biology since 1996 and were central to the establishment of SymbioticA in 2000. They are considered pioneers in the field of biological arts and are invited as keynote speakers, curate exhibitions, publish widely, and exhibit internationally.

Catts is the Co-Founder and Director of SymbioticA: the Centre of Excellence in Biological Arts at UWA and Dr Ionat Zurr, who received her PhD from the Faculty of Architecture, Landscape and Visual Arts, UWA - is researcher and SymbioticA's academic co-ordinator. SymbioticA won the inaugural Prix Ars Electronica, Golden Nica in Hybrid Art Category. They were recognised by Thames & Hudson's "60 Innovators Shaping our Creative Future" book as one of five in the category "Beyond Design", and by Icon Magazine (UK) as one of the top 20 Designers, "making the future and transforming the way we work". They were Research Fellows in Harvard Medical School (2000-2001) and Visiting Scholars at the Department of Art and Art History, Stanford University (2007).

The concept of the single engineering paradigm indicates a future in which the control of matter and life would be achieved by applying engineering principals; through nanotechnology, synthetic biology and, as some suggest, cognitive- and neuroscience. Ironically, this might seem an admission by the life sciences that the idea of the unifying theory of biology cannot be achieved and therefore a utilitarian application based approach might be the next best thing. Looking at such a future, is there anything we can learn from the past? In addition, in the light of some recent research into the 'engineering mindset,' what might an artistic mindset achieve? Can it be a counter-balance or an attempt to artistically engage with an engineering future doomed to be perceived as reactionary in one way or another? In this deliberately polemic piece of writing, we will tackle these issues.

In recent years, we have witnessed a resurgence of the application of engineering logic in the field of the life sciences. With the recent introduction of the concept of Synthetic Biology, a revolutionary rhetoric is being employed, such as 'a radical shift' and Synthetic Biology will 'revolutionize the technology of the future.' As is pointed out:

Engineers are interested in synthetic biology (or in biology in general) because the living world provides a seemingly rich yet largely unexplored medium for controlling and processing information, materials, and energy. Learning how to effectively harness the power of the living world will be a major engineering undertaking.[1]



Hamsa
The Tissue Culture & Art (Oron Catts & Ionat Zurr). Skin tissue over found object. 1997

Victimless Leather- A Prototype of Stitch-less Jacket grown in a Technoscientific 'Body'
Biodegradable polymer skin and bone cells from human and mouse. 2004

Having control over life and its processes may have always been an ambitious human endeavour. What is changing is the accumulation of scientific knowledge and technological capabilities, mounting up with increasing speed and scale of manipulation. A choreographed interplay between hype and actuality is overlaid on a public that is bombarded with information that should excite, but which is also easily forgotten. A recent recurring trope mobilized to describe our coming future is the promise of applying engineering principles to biological systems, or more generally the idea of the single engineering paradigm that engulfs nanotechnology, synthetic biology, as well as in some cases cognitive and neuro-sciences.

The idea of biology as engineering is not new. However, as the perception of the level of control possible increases, it seems that whereas previously biologists were employing their understanding of engineering to the life sciences, now it is the engineers who force-fit engineering methodologies into living systems. Therefore, two issues need to be scrutinized: the first deals with how the application of engineering logic to life will reflect on the different cultures and societies where it is going to take place. The second issue, which is more particular, is concerned with the locus of the places where radical assaults on culturally perceived norms in the 21st century are now occurring. Is it correct to assume that it is now the engineering workshops rather than the artists' studios, the philosophers' ivory towers or even the scientists' labs?

Historical reflections

The application of engineering logic to life has historical precedents. Already in 1895, H.G Wells reflected on a body as a malleable entity in his essay *The Limits of Individual Plasticity,* saying "[t]he generalization of heredity may be pushed to extreme, to an almost fanatical fatalism."[2] A year later Wells demonstrated some of these ideas and their possible consequences in his novel *The Island of Doctor Moreau.* The plasticity of life processes, through human intervention not in the fictional realm, was demonstrated quite spectacularly only three years later in 1899 when Jacob Loeb, developed what he called "artificial parthenogenesis... the artificial production of normal larvae (plutei) from the unfertilized eggs of the sea urchin."[3] In other words, Loeb demonstrated the capacity for fertilization (in a sea urchin) without the use of sperm. Loeb wrote, following his discovery, "it is in the end still possible that I find my dream realized, to see a constructive or engineering biology in place of a biology that is merely analytical."[4]

Loeb symbolized a change in the field of the biological sciences from descriptive to prescriptive, from the realm of knowledge gathering to the realm of technological application. Loeb adopted in his experimentation and biological research what he described as the "engineering standpoint."[5] What an "engineering standpoint" or "engineering mindset" *is* will be speculated upon further, but nevertheless Loeb's strong belief in control over life and his mechanistic approach to life led him to argue that "instinct" and "will" were "metaphysical concepts ... upon the same plane as the supernatural powers of theologians."[6]

The belief that instinct and will can be engineered as well as the belief that science should be pragmatic, can lead to interesting interpretations and applications. Ten years later Alexis Carrel, a surgeon, demonstrated the plasticity of the body, through the development of the technique of tissue culture—the growth of living tissue cells in-vitro—in an artificial environment. Carrel was a well-known and respected scientist who advanced the medical field in new techniques of suturing arteries and transplantation as well as tissue culture, and won the Nobel Prize for Medicine in 1912. He was also a complex and controversial figure—a person who pushed the ontological implications of his discoveries to some extreme and morally questionable places, far from its strictly bio-medical or even scientific realms into ontological and socio-political issues.

Carrel was so convinced in humans' abilities to control life through the sciences that he believed that his experiments in engineering a "body" in which to grow cells would eventually lead to the ability to resurrect through techno-scientific methods.[7] This is manifest in this somewhat surreal conversation extract:

"What would be my responsibility if I bring people back to life?" Carrel asked...

"Responsibility for what?" The lawyer asked.

"For those I bring back", said Carrel. "Food and Lodging and all that. If I bring them back an old man too old to work. Or, in the case of a young man, suppose something happens and he isn't able to do anything for himself. Am I liable for his support?"[8]

In the 1930s, the *surgeon* (Carrel) joined forces with *the mechanic,* the famous aviator Charles Lindbergh, to devise the Organ Perfusion Pump, a mechanical pump for circulating nutrient fluid around large organs kept alive outside of their host body. Carrel's affiliation with Lindbergh, the great American hero, extended to a shared ideology of eugenics, which Carrel outlined in his 1938 publication *Man, the Unknown:*

Those who have murdered, robbed, ... kidnapped children, despoiled the poor of their savings, misled the public in important matters, should be humanely and economically disposed of in small euthanasic institutions supplied with proper gases. A similar treatment could be advantageously applied to the insane, guilty of criminal acts.[9]

It can be argued that the application of mechanical/engineering logic to the living body preceded the same line of thinking that led Carrel to treat human societies as objects to be engineered. These engineered objects can be fixed by removing faulty parts. "Eugenics," Carrel wrote in the last chapter of *Man, the Unknown,* "is indispensable for the perpetuation of the strong. A great race must propagate its best elements."[10] The book, a worldwide best-seller translated into nineteen languages, brought Carrel international attention.

It took more than eighty years to discover that cells can be grown in three dimensions to form a functional tissue. This development came from the collaborative work of a surgeon, Dr Joseph P. Vacanti, and a material scientist, Dr Robert Langer, in the early 1990s. They developed a system that used specially designed degradable polymers that act as a scaffold for the developing tissue.

Tissue engineering (TE) was developed as a surgical solution for a body fixing/reconstructing 'problem.' In modern medicine, the system imagined to fix the body is a mechanical one, using mechanical, non-living apparatuses to replace failing body organs, such as metal or plastic bits to replace joints, a pump for a heart and an external filtering machine to replace a failing kidney (a dialysis machine). Until the late 1980s the notion of the cyborg—a human body enhanced by mechanical means—was the dominant mental picture both in the sciences and in the arts. The conceptual shift with the advent of tissue engineering was to look at and treat the body as a regenerative site, to use the body's own tissue to repair itself. This would not only avoid the problem of rejection of foreign materials and foreign cells (from other bodies) but also, in Eugene Thacker's words, tissue engineering "... is able to produce a vision of the regenerative body, a body always potentially in excess of itself"[11]—a body that is not dependent on artificial means to fix itself, but is an endless resource. In that respect, TE can be perceived as a 'natural' almost non-technological technique (although TE is a highly technological application within the biotech industry). Tellingly, although the technique is perceived as 'natural' and dominated by a biological approach, it was named Tissue 'Engineering.'

This trend of adding the term engineering to biological fields is not exclusive to TE. It can be argued that in order to legitimize the shift from descriptive to prescriptive approach, as well as to enhance the 'technological' aspects, biologists started to refer to their work as engineering (such as in Genetic Engineering, Tissue Engineering, Cell Engineering etc.). The opposite is occurring however with the recent movement of 'real' engineers into the biological field. These engineers coined the term Synthetic 'Biology' to legitimize their approach.

Synthetic Biology is becoming the catch phrase for contemporary attempts to apply engineering logic to life, and as such, it covers a wide range of approaches ranging from re-branding genetic engineering to the creation of synthetic life forms. Driven mainly by engineers, Synthetic Biology in Europe and North America is going through an image construction exercise that is interesting to follow. A worrying trend is that engineers, who are used to a system of certifications and approvals, tend to favor restrictive approaches in regard to access to these new techniques. At the very same time they favor engineering logic over scientific biological knowledge, valuing the language of control and simplicity over the scientific language of uncertainty and complexity.

..."If we think of a cell as a computer, it's much more complex than the computers we're used to."

For this reason, some scientists say, it might be difficult ever to make biological engineering as predictable as bridge construction.

"There is no such thing as a standard component, because even a standard component works differently depending on the

environment," Professor Arnold of Caltech said. "The expectation that you can type in a sequence and can predict what a circuit will do is far from reality and always will be."[12]

To follow the difference in conceptual approaches: for the engineer, genetic engineering as performed by biologists may seem just randomly shuffling genes; for the synthetic biologist (read engineer) with the 'engineer mindset,' the approach and aims are different.

Engineering mindset

In a recent paper that received quite wide coverage, scholars Gambetta and Steffenhertog demonstrated that "among violent Islamists, engineers with a degree, individuals with an engineering education are three to four times more frequent than we would expect given the share of engineers among university students in Islamic countries."[13] After eliminating other plausible possibilities such as network links and/or technical skills, they conclude that an 'engineering mindset' as well as current social conditions in Islamic countries as the most plausible explanation of their findings.[14]

What is this 'engineering mindset'?

Firstly we should highlight, as emphasised by the authors of the paper cited above, that the 'engineering mindset' is not unique to Muslim extremists. On the contrary, it is a mindset which characterizes extremist thinking in general, engulfing all religions as well as secularism. Secondly, this 'mindset' can be described generally as one of the fundamental views of the world: the either/or, right/wrong attitude. Furthermore,

[t]he concept includes an assumption, which has been raised in psychological research, that engineering as a field of study and a profession tends to attract people who seek certainty, and their approach to the world is largely mechanistic. So they are characterized by a greater intolerance of uncertainty—a quality that is evident among extremists, both religious and secular.[15]

Reactionary artists

If in recent years the engineering mindset is being introduced into life science laboratories, so too the artistic mindset has invaded these laboratories, such as in the case of SymbioticA—the Centre of Excellence in Biological Arts in the School of Anatomy and Human Biology at The University of Western Australia. The scientific laboratory, where artists (and engineers) are placed cannot be viewed in isolation but is positioned within a larger system of a capitalist culture that calls for new products and a profit driven agenda.

Critiquing these technologies and refusing to take part in their developments may seem to suggest a call to halt them and return to a previous state—a reactionary perspective. Entering the places where these technologies are being developed and using them to create artworks that have the potential (even against the artist's will) to become cogs in the future propaganda machine is also reactionary in the Marxist sense—reactionary by serving the capitalist hegemony.

So how then can artists destabilize the system?

Through our experience over the last fifteen years or so working in the arts and life sciences, we have witnessed the peak and hype of the genome revolution and its associated central dogma, as well as its slow demise. We have also experienced the periodic re-marketing of the field of tissue engineering through cultural amnesia, and so we cannot provide a clear and definite answer. We suggest that it is the ambiguity and irony of the artistic expression which may be most effective in functioning as a counter-balance to the 'engineering mindset' that is again penetrating the life sciences.

Saying that, if misread, art that engages with the above developments can be perceived as simply reactionary in both senses described above. Yet we want to believe that artistic expressions that are more subtle and complex will be appreciated and understood by all (possibly even by some engineers).

A future dominated by the single engineering paradigm might be upon us; now is the time to figure out strategies of resistance to some of the more fundamentalist (or shall we say radical?) elements of it. One way is to open up the very same tools that serve this future to others, including artists. This is less scary than leaving such tools in the hands of the engineers... ŧ

Editorial Policy:

thresholds is published biannually in spring and fall by the Department of Architecture at the Massachusetts Institute of Technology. Opinions in thresholds are those of the authors alone and do not necessarily represent the views of the editors, the Department of Architecture, nor MIT.

Correspondence
thresholds
Massachusetts Institute of Technology
Department of Architecture, Room 7-337
77 Massachusetts Avenue
Cambridge, Massachusetts 02139, USA

thresh@mit.edu
architecture.mit.edu/thresholds/

ISSN 1091-711X
PSB 10-06-0288

Printed by Puritan Press—Hollis, New Hampshire
Text set in DIN.
Design by Vassia Alaykova
Cover illustration by Lucy Cheung

Special thanks to:

Mark Jarzombek for his advice and advocacy; Sarah Hirschman for her incredible dedication to the thresholds spirit; Adam Fulton Johnson for his support and feedback.

thresholds is indebted for the tireless support of Rebecca Chamberlain,
Jack Valleli, Minerva Tirado, Michael Ames, and Puritan Press, Inc.

Non-Profit Organization
US Postage Paid
Cambridge, MA
Permit No.: 54016

MASSACHUSETTS INSTITUTE OF TECHNOLOGY
DEPARTMENT OF ARCHITECTURE, ROOM 7-337
77 MASSACHUSETTS AVENUE, CAMBRIDGE, MA 02139