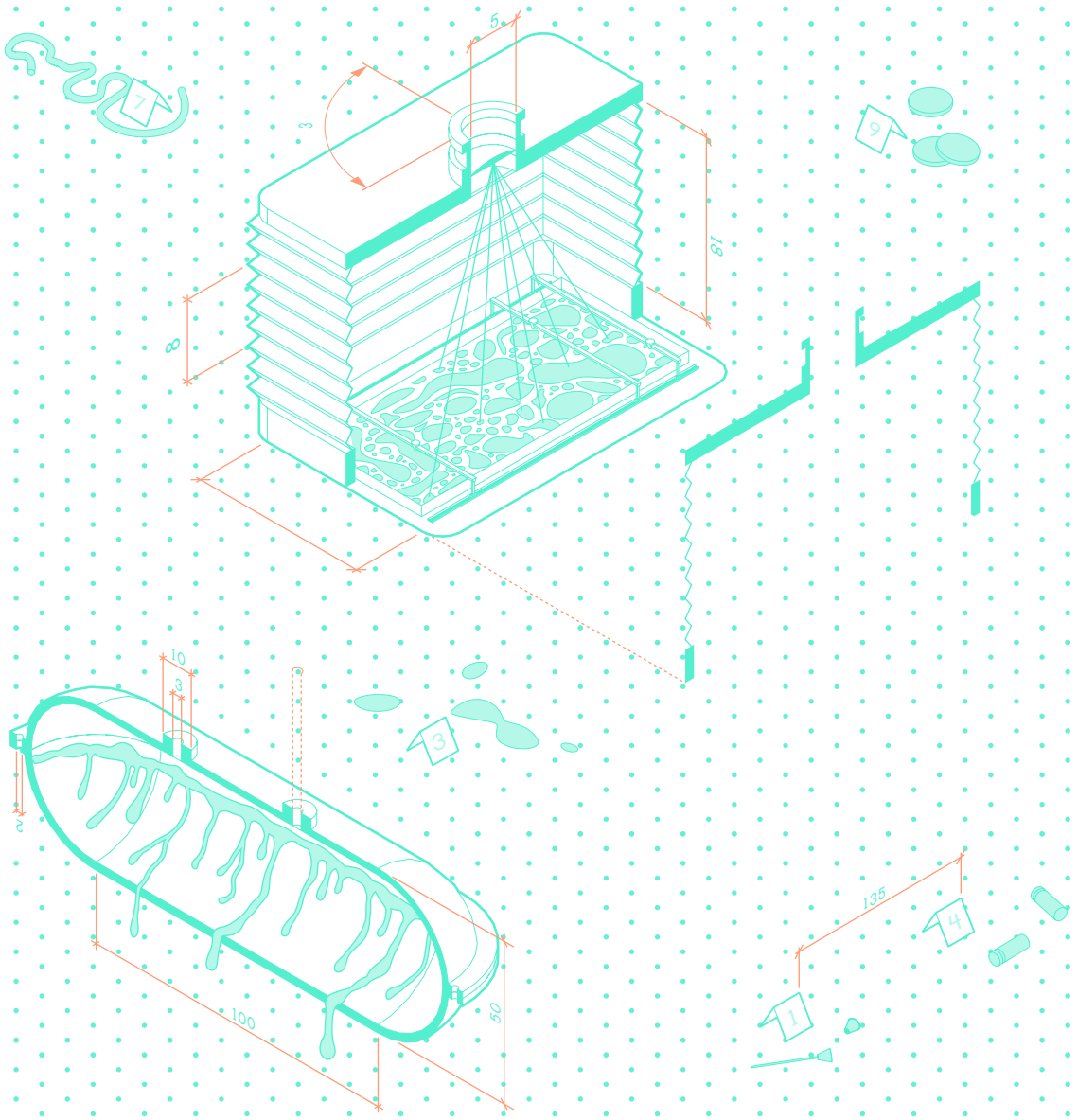
BLUEPRINTS FOR THE UNKNOWN



BLUEPRINTS FOR THE UNKNOWN

CONTENTS

INTRODUCTION

Recent advances in synthetic biology are making the design of new life forms an increasingly real possibility. Driven by an engineering approach to biology, the future scientist/designer is envisioned as an architect of life, creating living organisms from a library of standardised and replicable parts.

However, life may or may not agree with the industrial paradigm we feel comfortable with. Living organisms are unstable, random and context specific. They are subject to evolution, mutations and symbiosis. Additionally, once science gets out of the lab and into the world it becomes part of much bigger systems such as economics, politics and human beliefs – with surprising outcomes for better or worse.

This project investigates the gap between the promises of engineering biology and the complex and conflicted world we live in. Each scenario is set in a very specific context, ranging from healthcare to green politics and bonzai grooming, and probes the potential impact of biotechnology on society and culture.

SYNTHETIC BIOLOGY AS COLLECTIVE FANTASY

by Christina Agapakis

Digital illustration of a DNA in blue background [sic]
123RF Stock Photography

In 2011, Andy Ellington, a professor of biochemistry at the University of Texas wrote a typically scathing blog post on safety regulations and the growth of synthetic biology. Conversations about the need for new regulations, he argued, "continue to support a view of synthetic biology as a real-world discipline, as opposed to a collective fantasy". With hundreds of articles and blog posts breathlessly proclaiming the future potential of synthetic biology — both its promise and peril — Ellington's post provides a refreshingly new question to consider. Rather than asking if synthetic biology will save the world or destroy it, perhaps it is more useful to start with a much simpler question: does synthetic biology actually exist?

At one level the answer is easy — of course it exists, I got my PhD in synthetic biology after all! We have our own academic journals, international conferences, university departments, undergraduate majors, and expensive textbooks. Thousands of people call themselves synthetic biologists, using the term to describe very real work with very real applications. Synthetic biologists are students competing in the International Genetically Engineered Machines competition, the biotech industry, professionals starting new companies and academics redesigning the logic of living things.

But at the same time, synthetic biology is a collective fantasy — a discipline defined much better by shared dreams for the future rather than any present technique or application. Synthetic biology is oriented around the potential of what a future genetic designer might be able to do with cheap DNA synthesis and well-characterized genetic parts. In this future, synthetic biology has transformed genetic engineering into a "true engineering discipline" where living things that never existed before can be designed computationally, assembled robotically and then function as predicted, according to a rational and completely controllable logic.

The real-world work of synthetic biologists goes towards building the tools that might make this fantasy possible. But synthetic biologists also work to build the fantasy itself, to creatively imagine future scenarios and to create prototypes that help others see its potential. Building tools for future genetic engineers means imagining the world that those engineers will live in, speculating on the kind of projects that they will create and designing proofs-of-principle that can help us to better imagine that potential. Perhaps then it is useful to think of synthetic biology as a specialized form of design fiction; projects start with a simple "what if...?" and, through the design of experiments and genetic pathways, offer a glimpse of a future where such technologies might exist at scale.

Saying that synthetic biology is design fiction is not the same as saying that synthetic biology is fake or somehow fraudulent. Rather, it is saying that the work of synthetic biology extends far beyond the limited technical details of a particular genetic circuit design. Constructing design fictions involves real design of objects and prototypes, as well as narratives that work to inspire new researchers, funders and supporters. My own early work in synthetic biology began with the question: what if we could make cheap hydrogen fuel in bacteria? Such a question involves the biology of hydrogenases and electron metabolism in bacteria, but it also involves imagining a very different energy economy and transportation infrastructure to the one we have today. My gene circuits and metabolic pathways were real, as were the small quantities of hydrogen my bacteria produced, but they were also part of a story I wanted to tell about the future of energy.

Like the design fictions of critical and speculative designers, these narratives can inspire us to imagine a different world where the ways that we design, build and use technologies are different from how they are today. But unlike the work of critical and speculative designers, most synthetic biologists tell such stories to generate, sustain and promote the field. Whereas critical designers might create ambiguous and ambivalent future scenarios that challenge us to ask questions, many engineers use narratives and speculations to garner public support, gain funding and help to further realize the vision of synthetic biology.

Synthetic biologists don't focus only on utopian visions of the field, they also frequently tell more negative stories about the dangerous potential of synthetic biology. These stories of bioterror, "bioerror" and questions of social implications are important for the thoughtful and safe development of new technologies, but they also often assume a technological sophistication that does not yet exist. Speculations about the dangers of synthetic biology are also echoed and amplified by opponents of synthetic biology, who use such stories when calling for strict regulation of new research or outright moratoria on synthetic biology products. In these highly polarized debates between wholesale supporters and those who seek an end to synthetic biology, the stories and language used by both sides can be strikingly similar, focusing on what might be possible while causing significant confusion about what is actually happening in today's "real world discipline" of synthetic biology.

Both sides of the current debate about synthetic biology take for granted the present challenges and realities of engineering biology. Utopian and dystopian visions have become the dominant talking points, even though they are both extrapolated from the incorrect assumption that synthetic biology has already made biology trivially easy to engineer. In an article in New Scientist, sociologists Claire Marris and Nikolas Rose warn about the rise of such "speculative ethics" and call for us to "Get Real on Synthetic Biology". Focusing on far-future speculations, they argue,

distracts us from honest debate about what synthetic biologists actually do, what might be possible in the near term and how these actually emerging technologies might contribute to the public good with proper oversight.

Several recent examples illustrate how a focus on the "collective fantasy" of synthetic biology and a narrow definition of what synthetic biologists actually do can hamper open public debate about biotechnology. Last winter, George Church, a professor at Harvard and a leader in the field, made headlines with wild speculations taken out of context. He wrote in his book, Regenesis, about advances in genome editing that may make it possible to clone extinct species, including human ancestors. Misinterpreted quotes from the book made it seem like Church was well on his way to cloning a Neanderthal, and that all he needed now was an "extremely adventurous human female" to gestate the clone. After a public outcry, dozens of news articles and several phone calls from adventurous women willing to volunteer, Church spoke out to squash the rumors. In an interview with the Boston Herald, Church said that he wasn't actually working on cloning Neanderthals. Instead, he was simply speculating on possible far-future applications of genome editing technology to spark a debate about synthetic biology's potential. "I'm certainly not advocating it," he clarified. "I'm saying, if it is technically possible someday, we need to start talking about it today." Like many critical designers, Church was hoping to spark a debate on the desirability of this potential application of synthetic biology. The collective fantasy, however, blurs fact and speculation and makes it incredibly challenging to design for real debate.

Part of the challenge also comes from confusion about defining the term "synthetic biology" itself. Last year's successful "Glowing Plant" Kickstarter project raised nearly half a million dollars by promising backers a novel synthetic biology product: engineered bioluminescent plants. As part of the campaign, the project crafted a synthetic biology design fiction (similar to others produced in the past by iGEM students and speculative architects) of streets lined with sustainable glowing trees rather than energy-intensive lighting. Such images create a story about what synthetic biology is and what it might be able to do in the future. A profile in the New York Times described the project as using a "sophisticated form of genetic engineering called synthetic biology", and the project was supported by companies selling synthetic biology software and DNA synthesis. However, the team quickly backpedalled on the use of the term after the GMO-opposition group ETC began calling for the cancellation of their crowdfunding campaign with a "kickstopper" petition. In their response to ETC Group, the Glowing Plant team claimed that: "We are using the term 'synthetic biology' in its most general sense, the technology we are using is functionally the same as that which has been used in the creation of many other biotechnology products over the last two decades."

This slippage in defining what counts as synthetic biology in the first place can lead to murky debates and confusion in the public discourse surrounding bioengineering projects. The Glowing Plant project was "synthetic biology" (not just genetic engineering) when it was convenient to project visions of high-tech newness to techno-utopian backers, but was not synthetic biology (only genetic engineering) when it was challenged by techno-dystopian opponents and potential regulatory oversight. This shape-shifting made it very difficult to actually debate the project's goals and rhetoric, or the proposed release of genetically modified plant seeds to their Kickstarter backers, which remains scheduled for some time later this year.

It is easy to dismiss the Glowing Plant project as simply a PR exercise rather than a relevant example of the challenges facing the public debate on new biotechnology. It is also easy, like Church did in the Herald interview, to blame the lack of nuance in such debates on clickbaity online media and sensationalist headlines, or to claim that it is poor science literacy that leads to confusion and misunderstanding in these debates. But these examples, and others where design fictions by artists and designers have been misleadingly reported as scientific facts, show how scientists and engineers, their boosters, as well as their critics all play a role in shaping the debate and the collective fantasy of synthetic biology.

Without clear and honest terminology, how are we to debate the future of technology? How might we design for a more nuanced debate? How can we "get real" on synthetic biology while still dreaming of a different future? The answer is, of course, not to stop speculating entirely, but firstly to step back and ask new questions, to understand the limits of speculation and to discuss what the speculations themselves tell us about the present realities of synthetic biology as it exists today.

The science fiction author, Ursula K. Le Guin, wrote that science fiction is not a prediction, but a thought experiment. "The purpose of a thought-experiment," she wrote in the introduction to her novel The Left Hand of Darkness, "as the term was used by Schrödinger and other physicists, is not to predict the future — indeed Schrödinger's most famous thought-experiment goes to show that the 'future,' on the quantum level, cannot be predicted — but to describe reality, the present world." Like Schrödinger's most famous thought experiment, the debates surrounding synthetic biology create a strange paradox where synthetic biology is both real and unreal at the same time. Debates about synthetic biology get caught in the quantum gap between the existing realities of the work that synthetic biologists do and the speculations on synthetic biology's future potential. To critically debate the future of synthetic biology then, we shouldn't begin our thought experiments by simply asking, "What if synthetic biology exists?" Rather, let's ask: what do the future dreams of synthetic biology tell us about the present? What does the collective fantasy tell us about biology, technology, their intersection and our role within them? Who is benefiting from these stories and what kind of future will they create? What if synthetic biology were different?

Christina Agapakis is a biological designer who blogs about biology, engineering, engineering biology and biologically inspired engineering.

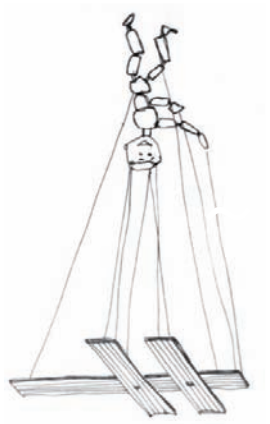
INFLUENZA PANDEMIC

by Superflux

SYNBIO TAROT READING

INFLUENZA PANDEMIC

GAIN POWER



GAIN POWER

RISE OF SYNTHBIO ACTIVISM

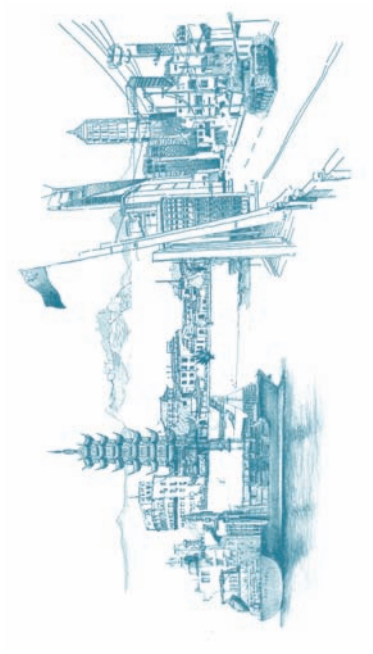
GET RICH

RISE OF A SYNTHBIO ACTIV

END TO 'WAR ON DRUGS'

END TO 'WAR ON DRUGS'

BEIJING

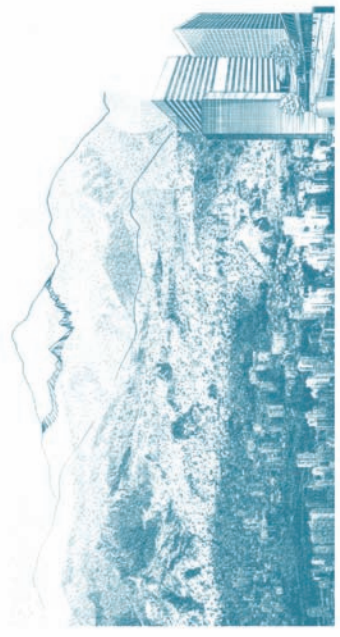


BEIJING

RISE OF COUNTERFEIT

RISE OF COUNTERFEIT

LA PAZ



LA PAZ

GET RICH

ENTREPRENEUR

cards: Superflux

The Synbio tarot card reading is a workshop tool designed to help designers and scientists explore the social, economic and political implications of synthetic biology. Developed as part of the Mutant Products workshop, the card deck is a starting point for conversations about the implications of science within a broader social, political and economic context. Taking into account a wide range of factors such as government policy, personal gain and geopolitical tensions, the game steers the players imagination away from clichés and towards complex scenarios in a playful way.

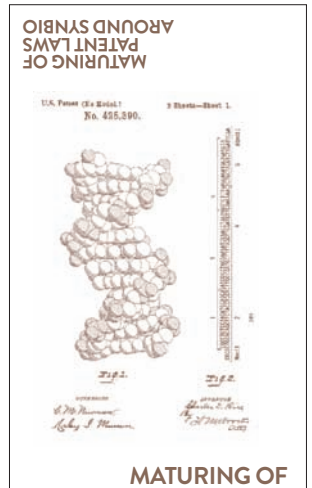
HOW THE TAROT DECK WORKS:
The tarot deck comprises six categories of card: Protagonist, Location, Synbio Condition, Year, Operating Environment and Player mission. Each category has six cards. One side of the card names a specific item, character or point, accompanied by a visual cue. The reverse side lists a couple of questions specific to the card, intended to guide thought and discussion.

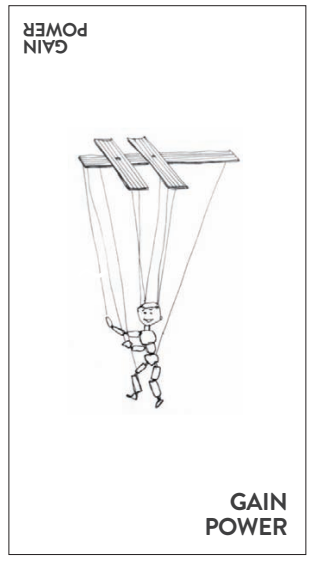
game board: Superflux

Dark Cocktails

2024 / protagonist: celebrity / Dubai, UAE / open gene directive / break-up of nation-states / mission: help humanity.

In this scenario, the cream of the world economy has come to be based on IP-protected luxury synbio products — a roster of fashionable novelties that include turtles turned into tables for cocktail parties and palm trees that produce alcoholic beverages in their coconuts. Dubai, seeking to protect its reputation as an advanced synbio producer, tasks its scientists with engineering a new kind of bacteria, a methanophage, which consumes the methane from oil. Under usual circumstances, this bacteria would be used to clean up oil slicks, but rogue elements within the Emirati state consider using this to 'destroy' the oil reserves of all other oil-producing nations. Aware of the economic (and political) risk of such a bacterium, these countries use their soft power and economic clout to push an 'open gene directive' through the apparatus of global governance, forcing Dubai to publish the genetic code behind this oil-destroying bacteria.
Because every country could synthesize it, the risks provide an effective deterrent, with no single actor daring to deploy it.





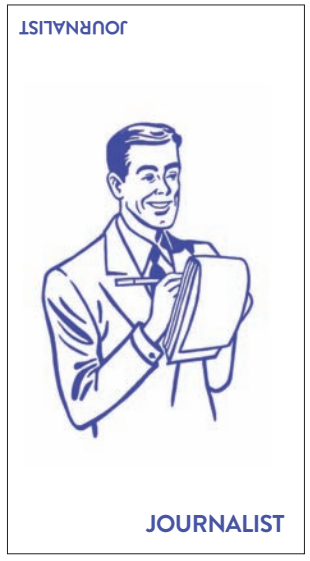
cards: Superflux

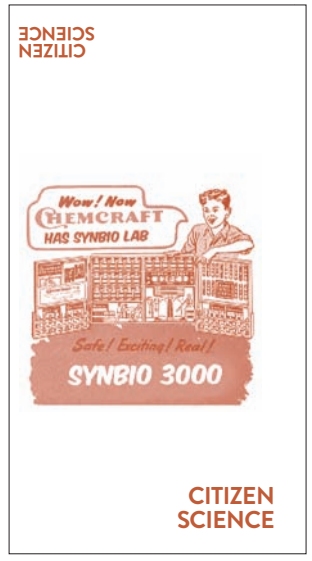
Knowledge Gambling

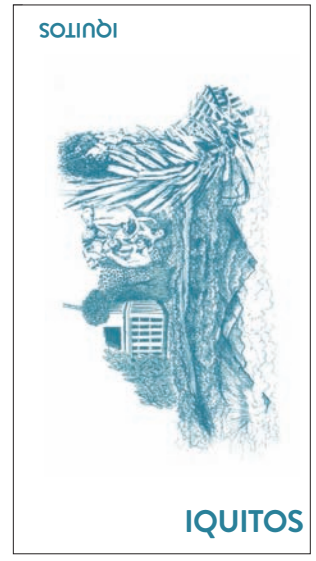
The harsh winter of 2030 triggers an international wheat blight, sending the global economy into a tailspin. Among the chaos and doom-mongering, financial uncertainty leads to new social practices and forms of economic activity. In Las Vegas, we witness a huge rise in something called 'knowledge gambling', in which participants wager their personal intellectual property (patents, biobricks, procedures) in games of chance and skill. Like any other form of gambling, the winners take all, sifting through the spoils to create new products and services.

Cocaine Cows

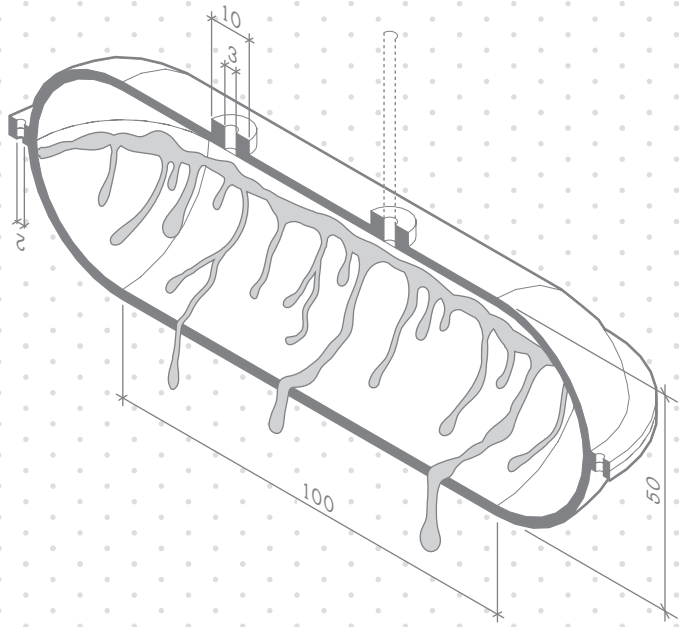
In 2024, a journalist, Tintin, stumbles onto evidence proving that RNOSA (the Royal Nation of South America) is responsible for cocaine pollution in waters off the Florida coast. Researching near Iquitos, in Peru, he finds that some Peruvian cows have been given endemic gut bacteria that can process cocoa leaves, allowing them to produce cocaine in their excrement – much of which is dumped into the sea. These revelations trigger a wave of interest from citizen scientists enthused by the notion of extracting cocaine from affected sea water, but also ratchets up diplomatic tensions between RNOSA and the United States.

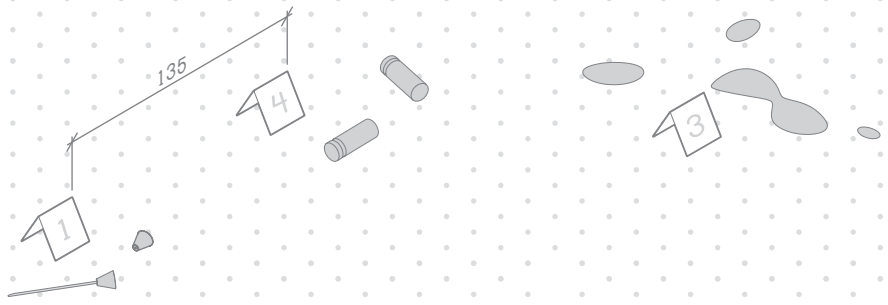


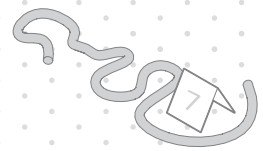




cards: Superflux

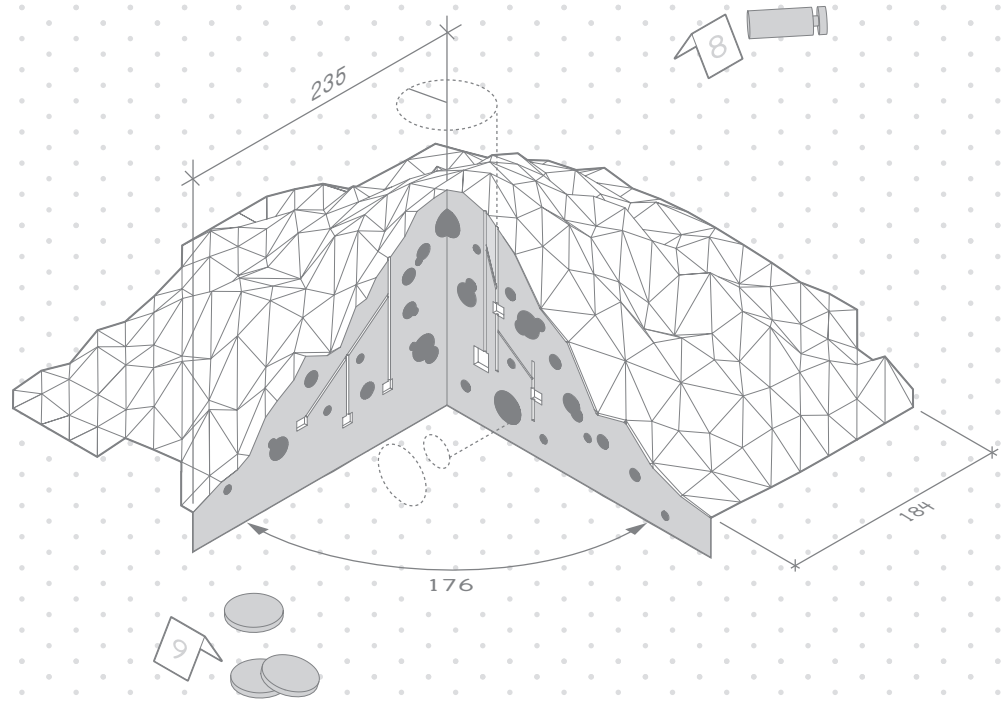






MUTANT PRODUCTS

What is the business plan when products are living and evolving? What does the license agreement, warranty or supply-chain look like?



DYNAMIC GENETICS VS MANN

by Superflux

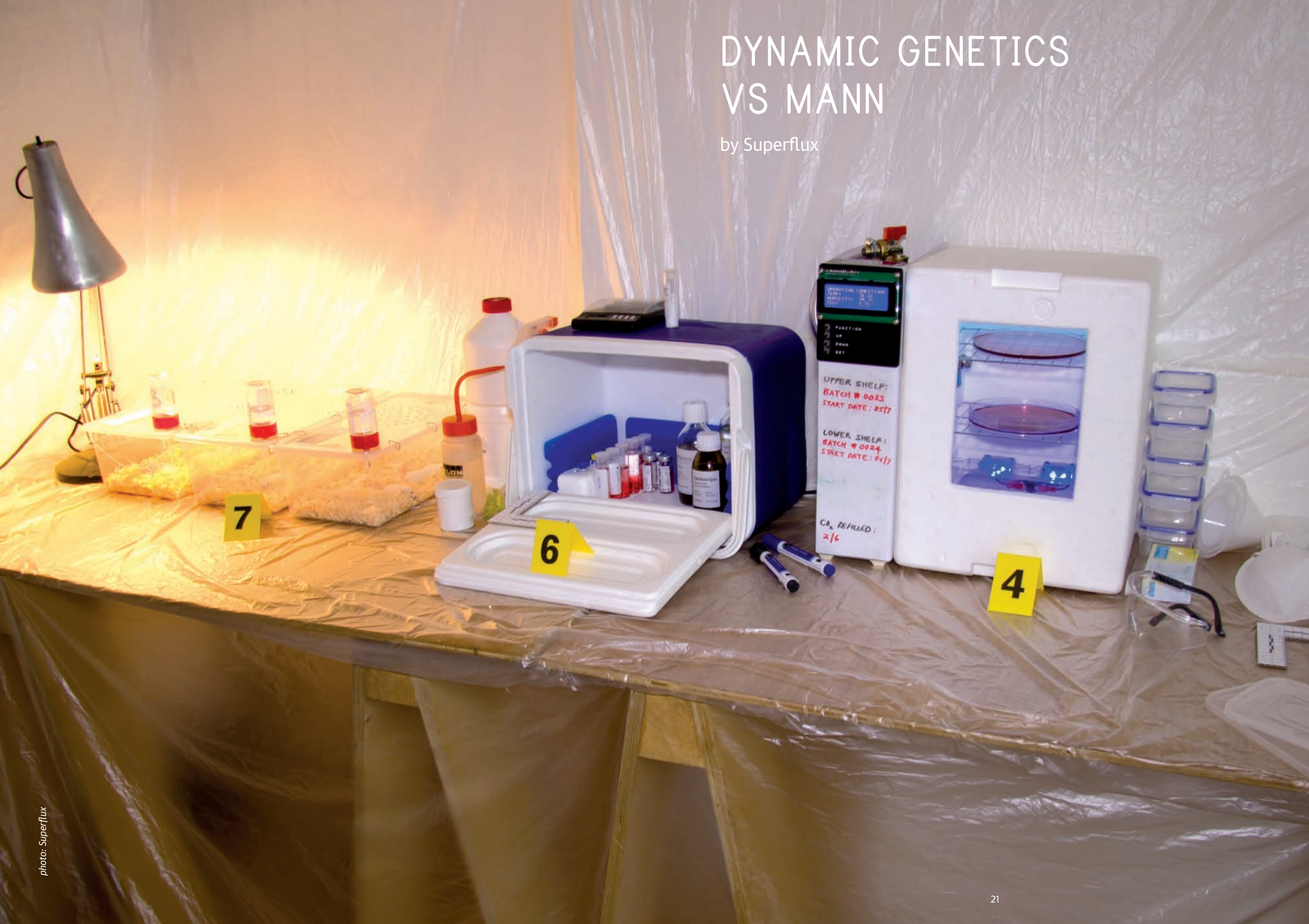


photo: Superflux

From tissue biopsy samples to an improvised CO2 incubator used in the manufacture of counterfeit genetic therapies, 'Dynamic Genetics vs. Mann' presents a body of evidence from a fictional court case. Unfolding as a rich narrative, this new project from Superflux explores a world where designed and patented genetic material enters the human body through illicit means. History has shown that political and economic forces exert as great an influence on the development and application of technology as the aspirations of scientists and engineers. 'Dynamic Genetics vs. Mann' explores the technological trajectory of synthetic biology, extrapolating from current social, economic and political trends so as to locate the technology within a broader cultural landscape. This project imagines a world in which synthetic biology and gene therapy have moved from the lab to the marketplace. In this world, the responsibilities of the state have shifted from healthcare to the provision of health insurance. By calculating the likely impact of specific gene combinations, insurance rates are adjusted on a person-by-person basis, ensuring that individual 'contributions' more accurately reflect the potential costs associated with the individual's genome.

What new legal and economic models might emerge under these conditions? How will intellectual property be applied and policed when designed genetic material makes its way into people's bodies and their lives? Who are the winners and losers in such a world?

top:
EVIDENCE: DG-0237-008
CLASS: DIGITAL, DEMONSTRATIVE
Photograph of the identified victim, Dynamic Genetics, London headquarters.

bottom:
EVIDENCE: DG-0237-010
CLASS: DIGITAL, CORROBORATING
Covert surveillance photograph from inside the crime scene that appears to show the defendant receiving unlicensed gene therapy.

The Exhibit

The primary plot of 'Dynamic Genetics vs. Mann' reveals the increasing vulnerability of protagonist, Arnold Mann, an 'ordinary citizen' whose insurance contributions spike dramatically after a regulatory spit test from the NHI (National Health Insurance) reveals elevated risks across a range of chronic health conditions in his genetic profile. Caught between an inflated health levy and the staggering cost of private treatment, a desperate Arnold turns to a black market clinic for a gene upgrade. This treatment will reduce his health insurance bill at the cost of permanently modifying his DNA with patented, but unlicensed therapy.

The collection of evidence presented in the exhibition, including an interrogation video, alongside other corroboratory, forensic, scientific, digital and material evidences, make a strong case against Mann, who is accused by Dynamic Genetics, a major corporation in the genetic therapy industry, of illegally possessing their proprietary DNA. Items including tissue biopsy samples, covert surveillance photographs, a genetic search warrant, 'found' documents, newspaper clippings and an improvised CO2 incubator, are presented by G5P, a private security agency hired by Dynamic Genetics to carry out the investigation.

Visitors to the work are encouraged to explore the body of evidence, piecing together this foreboding story that questions the ethical and economic implications of the new forms of genetic technology that are quietly transforming our world.

EVIDENCE: DG-0237-006
CLASS: DOCUMENTARY
Letter from Revenue & Customs addressed to the defendant detailing the rise in his NHI contribution.

348200:3900429 03221:034_031

Revenue & Customs

NHI Contributions
Information and Payment Reminder

348200:3900429 03221:034_031

MR A MANN
55 LOWER CLAPTON ROAD
LONDON
N16 3XY

Issued by
REVENUE & CUSTOMS
CUSTOMER OPERATIONS
NHI32445
PO BOX 730A
NEWCASTLE UPON TYNE
NE98 3YX

Phone number	Date of Issue
0845 3000 291	13 DEC 2022
Tax reference	**National insurance number**
345/G0890	JN 14 22 09 D

7418907210001819

Dear Sir

I am writing to inform you that your quarterly National Health Insurance contribution is due by 31st January 2023. Furthermore please be advised that your contributions bracket has been updated in line with recent changes to our contributions classification system. Your new contributions bracket is: UT6

More information about our updated contributions classification system can be found on the reverse. Information about why you have been assigned bracket UT6 and how it effects your contributions can be found below. Please remember that we charge penalties for late payments. Penalties start at £500 and can rise to £5000 plus 20% of any unpaid contributions.

Your payable amount for this quarter is: £1531.80
Your total payable amount for this year is: £6127.20

N.B. You may have noticed a 46% increase in your contributions this year, please be advised that is not a mistake. This is owing to a 2% rise across all contributions brackets as a short term measure in order to pay for much needed upgrades in administrative infrastructure. The remaining 46% increase is due to your NHI Genetic Profile, placing you in contributions bracket UT6 as would have been explained to you at your DNA Mapping consultation.

Should you wish to query your contributions increase please do not contact Revenue & Customs directly. Instead call the NHI helpline, visit: www.nhi.gov/dnamapping/mychoices or arrange a follow up consultation with your assigned clinician.

CT211 FYJ

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Payslip Revenue & Customs **bank giro credit**

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Reference	Credit Account No	Amount due
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CHEQUE ACCEPTABLE

For official use

For official use

Cashier's stamp and initials

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HEAD OFFICE COLLECTION A/C
REVENUE & CUSTOMS

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photo: Kristof Vrancken / Z33

DNA STORIES

by Christina Agapakis

This is me

What if personalized medicine never happens? What if the promised therapies tailored to our unique genomes just never materialize? Although it seems inevitable, there is no guarantee that we will be able to match treatments to individuals precisely. For complex diseases with many associated genes interacting in changing environments, the statistical power to make therapeutic predictions currently remains elusive. What if we sequence the genome of every single person on earth and the data is still not big enough?

In such a future, will we still believe in genomic promises? Perhaps, unable to let go of the hope that our genes can predict our future health, we continue will to demand access to our largely uninformative genetic code. Unable to find strong associations for complex and chronic diseases but still desperate for determinism, we might look for answers not only in the genes of our own cells but the genes of our microbial symbionts.

This hope might remain a part of medical rituals, a statistical placebo for the post-genomic check-up. The doctor takes samples of your secretions and sends them to a genome sequencing company; the costs are barely a blip on otherwise ballooning medical bills. You talk about your fears of aging, cancer, neurodegenerative diseases, antibiotic resistant bacteria. You discuss your parents' and grandparents' medical history. Your blood pressure, cholesterol and blood sugar are measured. Risks are calculated. You should probably lose some weight, eat more vegetables, walk more. You should smoke less, eat less processed food, less sugar. You should take better care of yourself. You probably should have done this anyway. You go home with a reassuring list of percentages that put a number on the fundamental uncertainty about your future.

The sequencing company analyzes your DNA, bills your insurance company and stores your data in the cloud. Your demographic information and health records are linked to your unique set of sequence variations. Associations are identified, risk percentages are modified. Sequences are patented. Progress (money) is made.

You continue to be anxious about privacy. You think, "If a company is telling me that my DNA data is me, then why should that company have so much access to me?" We are told that, in our dangerous world, we must give up some privacy for increased safety. For increased health we must give up some of our expectations about genetic privacy.

"Crimes of a Genetic Nature"

DNA is good for telling stories about the future: DNA as machomolecule, in control of our genetic destiny; DNA as code, programmable, controllable, readable, re-writable. Like other data-driven futures, DNA-based stories are stories about probability, risk and control: risk of developing certain medical conditions and the control that DNA has over our biological characteristics; risk that genetic information will be used to discriminate against us, risk that our DNA will be used to control what we are and what we can be.

Superflux is good at telling stories about the future, stories that help us connect with the abstractions of probabilities and the weirdness of our unevenly distributed futures. With Dynamic Genetics vs. Mann, Superflux tells a story about DNA, risk and control, not with percentages and promises but through the carefully crafted evidence of a fictional patent infringement trial.

The story is set in Britain in the near future, when the UK's National Health Service (NHS) has been privatized and transformed into National Health Insurance (NHI). The trial's defendant, Arnold Mann, faced with unmanageable NHI premiums due to undetermined genetic risk factors, turns to black market gene therapy, replacing his risky genes with healthy sequences patented by the fictional biotech giant, Dynamic Genetics. With these new genes, his insurance costs are decreased, but he is prosecuted for the DNA sequences that he now holds in his cells, sequences that he didn't pay the right people for.

At first glance, DG vs. Mann seems to be a very familiar kind of future, especially for people who don't live in the UK and don't have an NHS. For many Americans, a story about an insurance company trying to use anything and everything to screw you over is not an unfamiliar fiction but an everyday fact of life. The idea that an insurance company could one day use your DNA sequences to justify increasing your premiums or deny you coverage is such a pervasive story in the American debates about gene sequencing that it was codified into law and outlawed by the 2008 Genetic Information Nondiscrimination Act. If anything, DG vs. Mann might give its first shock of weirdness with the notion that it could be weird for such corporate shenanigans to exist in the first place. Imagine a future where Americans think that privatized insurance is a frightening and ridiculous scenario!

This is one way that design fiction could begin to help us "bypass the established narratives about the present and future", challenge us to see the present world from a new perspective and teach us to challenge our assumptions about what is and what might be possible–both technologically and politically. Design fictions show technologies at the edge of speculation and reality, inviting us to imagine, question and debate the applications and implications of new science and technology in a cultural context. Exploring genetic technologies in relation to government programs, the business of health care and the ongoing debates about piracy and intellectual property allows for discussion not just about the function of the technology itself, but its inextricable relationships with power, politics, economics and society.

Fictions give life to these complex relationships and give us a vocabulary to debate the kind of future we want (think of how often Gattaca used to come up in conversations about DNA sequencing). But while such stories are good at challenging our assumptions about how a technology might be used, rarely do they challenge the deeper assumptions about technological power and control.

What does the world look like when we bypass the established narratives of DNA as the master of our readable and rewritable future? What if DG vs. Mann is actually a story about genetic indeterminacy?

"Good Source of 6 Vitamins & Minerals"

The DNA evidence in DG vs. Mann is not humanly readable. Strips of paper with tiny, indecipherable As, Ts, Cs and Gs highlight the regions of Arnold Mann's genome that are infringing on Dynamic Genetic's patents. Looking at these strips, we don't know what diseases he was at risk for, how much of a burden he would one day be on the insurance pool, or even if the pirated gene therapy has actually changed his odds of developing the disease.

It's possible that Mann's risky sequences are part of the relatively small set of gene variants that are known to directly cause devastating diseases. But if Mann is an otherwise healthy adult, it is much more likely that the NHI actuaries are looking for common gene variants that have been statistically associated with very common and very expensive diseases: type II diabetes, cancers and cardiovascular disease.

What does it mean if you have, for example, a diabetes-associated sequence in your genome? In terms of real world health outcomes, the small changes in risk associated with any one such variant probably don't mean much, especially compared to the big effects that environment and diet can have.

Indeed, it's harder to imagine what these numbers might mean for your health than what they could mean for your health insurance. These associations provide an "objective" justification for what the insurance company wanted to do all along: get more money. As long as people still believe that DNA is in control of our biological destiny, these associations don't actually have to be biologically meaningful in order to have a big effect.

What does it mean then to use gene therapy to change these risky gene sequences? Considering that for most health outcomes, zip code is a better predictor than genetic code, probably not much, but if an insurance company can use DNA sequences to justify charging more, then altering gene sequences isn't necessarily about being healthier but simply appearing healthier to the risk calculators. The new variants are the genetic equivalent of sugary breakfast pastries fortified with vitamins and minerals, an unknown risk with a quantifiable veneer of "healthiness".

Unlike Pop-Tarts, however, when it comes to deciding who gets affordable insurance coverage, such genetic spoofing might ironically be enough to translate into better health in the real world, where access to health care is much more important than DNA. For Arnold Mann, the potential dangers —medical and legal — of undergoing back-alley gene therapy is worth the risk in order to get affordable insurance. People have done weirder things for health care.

"Unproblematic effectivity"

Polarized debates about the desirability of a new technology and its potential implications often oscillate between cheerful utopia and horrific dystopia. We discuss the promises and perils, the risks and rewards — opposite ends of a speculative spectrum. The real future, of course, is not simply one side or the other, happening instead somewhere in the messy inbetweens, neither world-saving nor civilization-destroying.

But whether proposing utopia or dystopia, both sides of such debates grant technologies with an unexamined power to solve or create problems, what anthropologist Georgina Born calls an"unproblematic effectivity". For debates about the future of biotechnologies, the power of DNA always remains at the center. When speculating about the future of a technology, it is worth asking: what if it just doesn't work that way?

Stories about the future can open up new possibilities, new avenues for debate, breaking free from the "half-pipe of doom" between utopia and dystopia. We can imagine more complex, weird, ambivalent futures — stories where technological promises come unraveled, their technical underpinnings explored, their cultural appeal examined.

We want to know the future. We want to know that in the future we will be able to know more than we do now. We want our futures populated with competent scientists, always in control, able to fully understand and accurately predict. We want DNA to be able to justify inequalities in health; we want DNA to give us answers, to tell our future.

DNA is obviously an important molecule, but too many of our social problems and technological dreams rely on the false promise of genetic determinism. DNA is not all-powerful. Data is not enough. Health is biological, but also social, political, economic. Biology is complex. Biology is messy. For better health, we need less sequencing and more support. For better technological promises, we need less control and messier futures.

This essay was first published on the Superflux Blog as a guest post by Christina Agapakis.

Christina Agapakis is a biological designer who blogs about biology, engineering, engineering biology and biologically inspired engineering.

photo: Studio Nand

THE PHOSPHATE STANDARD

by Studio Nand

Phosphate is one of the key elements in biological life. It is required for a wide range of different functions, such as the construction of DNA and RNA molecules and the activation of the cell's energy cycle. The introduction of synthetic biology on a large scale will require huge amounts of this inorganic chemical. Its highest quality is derived from Guano, the poo of specific sea birds.

The Phosphate Standard is a speculation at the intersection of economics and synthetic biology and a re-enactment of the history of the world's smallest republic, the republic of Nauru. Located in Micronesia in the South Pacific, the story of the island could have been an entirely fictitious myth of technological progress and capitalism: the phosphate rock island boasted the highest per-capita income enjoyed by any sovereign state in the world during the late 1960s until the phosphate reserves were exhausted and it became a so-called rogue state, being discussed as a site for nuclear waste dump.

The Phosphate Standard imagines a new world around an economic shift towards phosphate, extrapolating from current mechanisms of globalization and economics.

---------- NAURU ----------
---21 square kilometres of rock in the Pacific Ocean.----------
----------Smallest republic in the world (~9.000 inhabitants).---------
----
-------Stopover for migration birds for thousands of years: seen as the main explanation for where the phosphate is coming from: Guano – a mixture of bird poop and skeletons mixed with the corals and soil of the island.---------------
----
----------"Nauru is an island of shit. It looks like shit; it smells like shit but when you have a sense for business, you can earn a lot of money with this island very quickly" - Chambost, Eduard, international financial consultant, 2005.----------
----------The phosphate mining begins in 1907; the British pacific phosphate commission mines and exports the mineral. Nauru gets 2% of the profit. Australia imports the phosphate to boost its agriculture. Food is exported back to Nauru.----------
----
----------31.01.1968 The Nauruan, Hammer DeRoburt, who studied at the Gordon Institute of Technology, Australia, leads Nauru to independence.----------
----

----------The Nauru Phosphate Commission makes Nauru one of the richest sovereign states of the world with its own Air Line (Air Nauru), its own bank (Bank of Nauru) and its own fleet (Nauru Pacific Line).----------
----
--Nauruans don't need to work anymore; everyone gets 65 cent per phosphate barrel. There are no taxes, electricity, cleaning of toilets. Golf and medical treatment are free.----------
----

----------Some families had up to 67 luxury cars for the island's 30 kilometres of street.----------
----
------In 1982, Hammer DeRoburt is knighted by Queen Elizabeth II for the economic success of the island. He dies in 1992 of diabetes.----------
----
-------Nauru invests in foreign countries, building a luxury hotel on Honolulu (Nauru Tower) and exporting a musical to London which only ran for one month becoming the biggest flop in London's Musical history. (The story is about Leonardo Da Vinci falling in love with Mona Lisa.)----------
----------In the 1990s, 80% of the island's surface is removed and there are almost no trees anymore.----------
----------Rene Harris becomes the new president. His first action is to take out a loan of AUS$268 Million from General Electric.----------
----

---------The founded Nauru Agency Corporation is housing over 4,000 shell banks. For AUS$25,000 one can open one's own bank.----------
----
----------Nauru becomes blacklisted by Colin Powell.---

---------In 2001, Australia deports 500 Afghani refugees to Nauru, paying the island for them.----------
----
----------In 2004, the constructed refugee camps are overcrowded with over 1,200 refugees.----------
------At the end of 2005, all refugees are sent back except Muhammad Faisal and Mohammed Sagar (Microbiologist), guarded by 150 employees.----------
----
----------The only solution is a second mining: a second layer of phosphate will be mined which will last for about 30 years.--
----

White Capped Albatros

Black Footed Albatros

Black Petrel

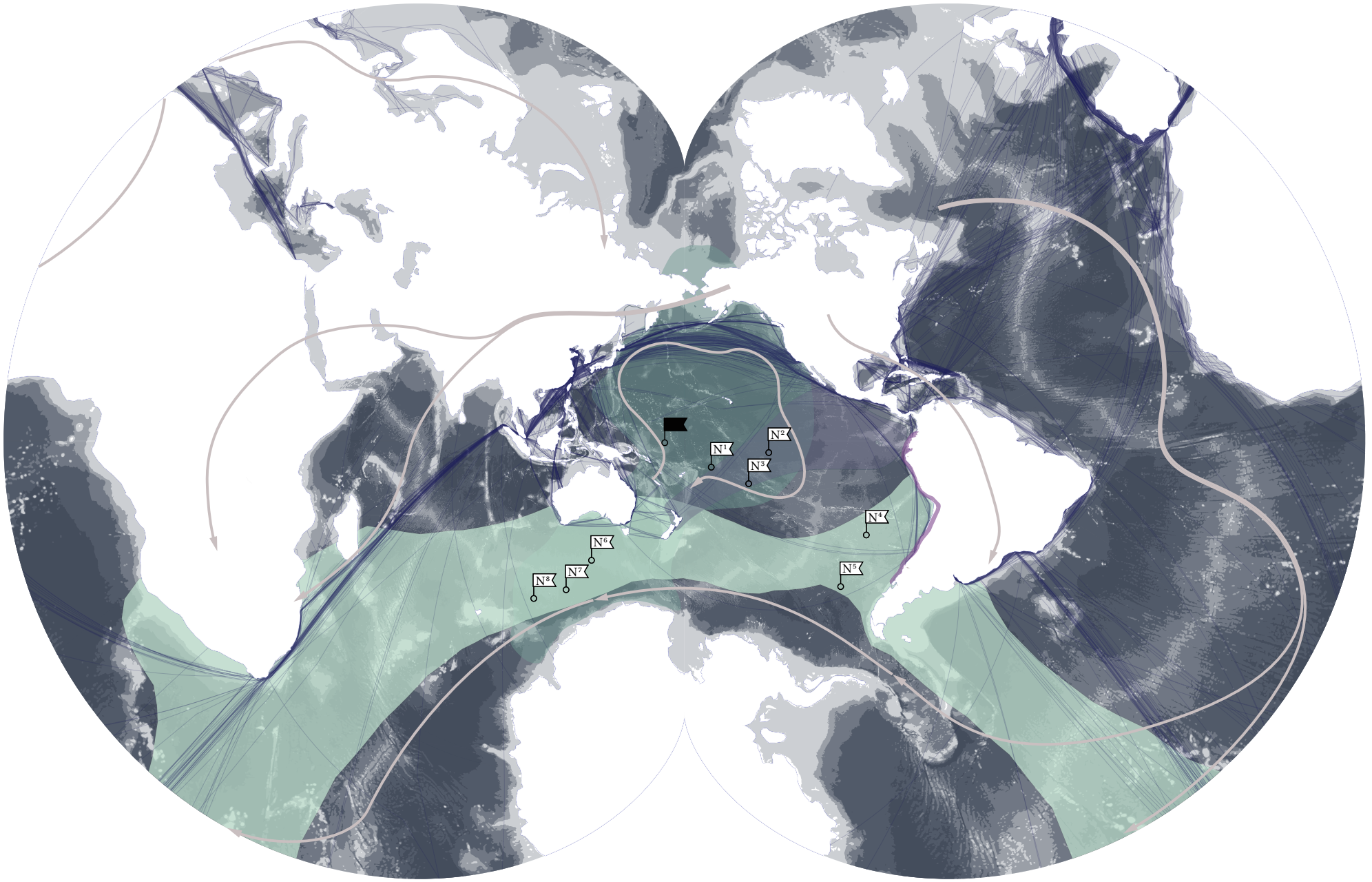
Guano Cormorant

Main Vessel Routes 2013

Nauru

Nauru Blueprints

The artificial islands are positioned at places with the highest bird ratio and the fewest vessel routes ensuring the collection of bird feces.



Bird data provided by:
Bird species distribution maps of the world. (2012)
BirdLife International,Cambridge, UK and NatureServe, Arlington, USA.

Naurutica. Mythemes.

White light, aww white light it lighten up my eyes
White light, don't you know it fills me up with surprise
White light, aww white heat tickle me down to my toes
White light, aww white light I tell you now goodness knows, now work it
White Light / White Heat, Velvet Underground

Empires are built on washy ground. The heart of darkness is to be reached on waterways, over oceans, into rivers, a hut every 150 kms on the riverbanks. See the man in a white suit and hat drawing numbers into lists and books, connecting goods and people with signs on papers, installing traffic and communication over an unsure, watery scape. Some territories consist of more water than land, strewn rocks in rippled seas, singular like solid waves. In 1899 it takes 60 days to cross German-New-Guinea, even on a Phosphor-Helium screw steamer like the Reich's new pride, The Samoa, from the Salomon Islands via the Bismarck Archipelago and the Karolinen Islands all the way up to the Mariannen. To reach Nauru from Hamburg, it takes 6 weeks — 35 days less, if you take the Transsib and conditions are good. The Jaluit Society runs all ships and holds all rights on pearling and, of course, on the Phosphorus Mirabilis, the starry-eyed, bird shit, wind and water salted philosopher's stone gleaming on Nauru's black coastal rock strewn like an exploded lighthouse. Contesting with heavenly constellations for the fate of all those chemical generations and modernities to come and go, here, I sit. The hunks and chunks of the El Iksir, with many names, dip my face in white light so artificial no one would believe its natural grounds. Scintillating Azoth of all prima materia, of immortality and unfathomable wealth — this is phosphor. The heart of darkness gleams in the dark.

Have you ever had a closer look at the flags of the colonies of the German Reich? Well, if you have, you would have seen the Prussian eagle, proud and violent Aar of ancient Germanic lore turning into the paradise bird of international capitalism, inelegantly mimicking the most vast British dreams of market, sea and power. Head down, no claws, wings bent to embrace the soft and warm-feathered southern side of the globe like Queen Vic's girdle, voluptuously mirroring its black and red sharp-taloned Northern original. A German knight invented the globe. Martin Behaim's dream of the world becoming a ball is bird's territory these days. Any dream is bird's territory these days. Above the 2 birds on our flag is a crown with miraculously gleaming stones, forming yet more birds, shitting out a luminous cross. The German farmer died the very day he hit the sea. I am the harvester and I shall tell you about the chemistry of the world: birds — follow the birds. I will follow the birds — from Greece to Nauru, from the Argonauts to the unworldly mines of international capitalism. A myth can only be told in the language of a myth. Like song and melody, mythologies conserve what is

and preserve what has not yet come. I shall tell you of a continuity beyond the binaries of past and future. Like Cantor, the mathematician of phosphor, or Leibniz, its poet, or Hennig Brand, whose body brought it to shining light, solution is a chemical term.

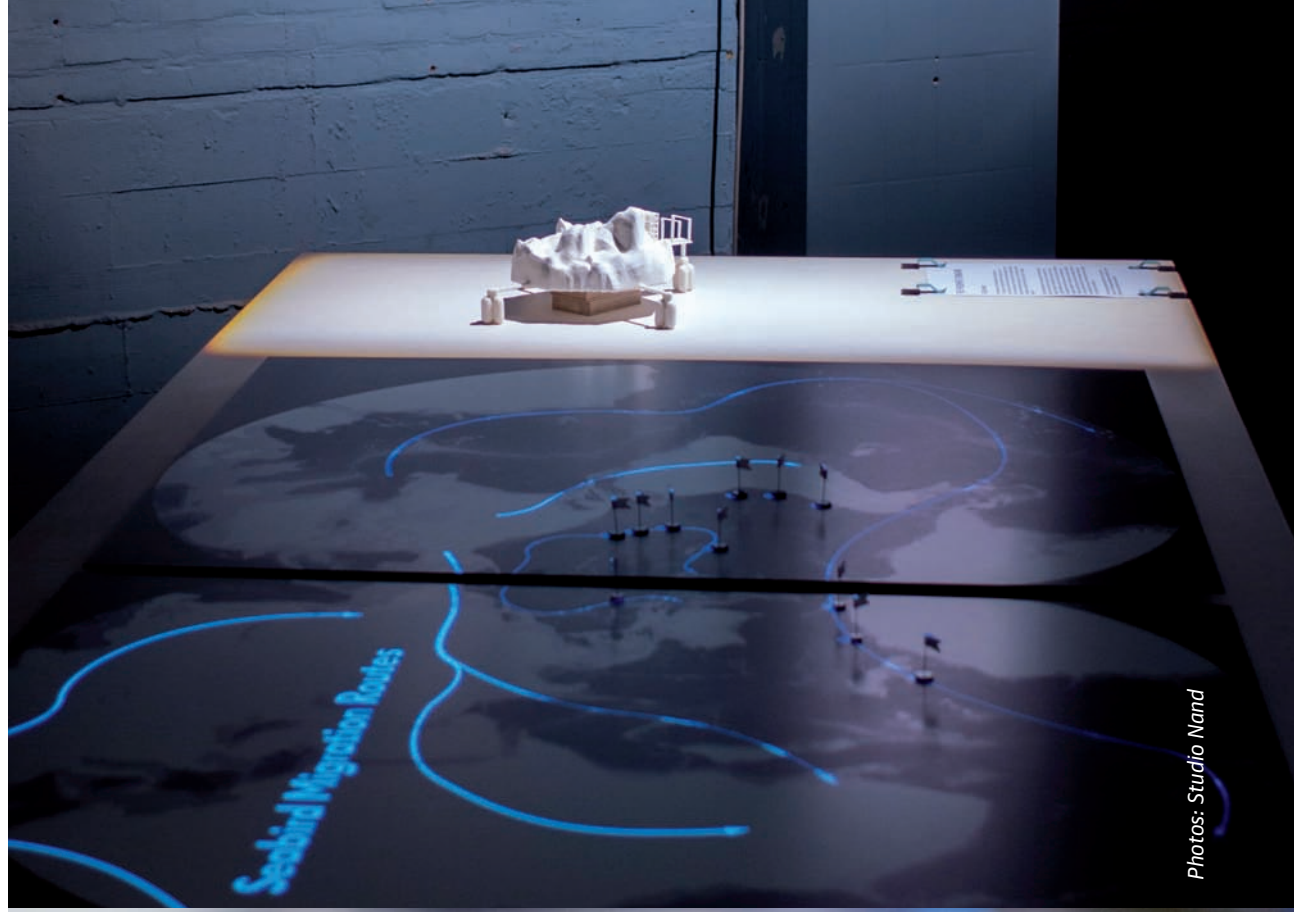
On March 16th 1656, my great-great grandfather's great-great-grandfather pissed on a piece of cloth. Again and again distilling the more yellow fluid until it glowed white. Phosphorus Mirabilis, the gleaming miracle, dissolves all differences of culture and nature, inside and outside, money and body, life and things. Hennig Brand does not know he has distilled our chemical future past. He stands in a very brown room — deep brown like the still-life of Robert Boyle's dim laboratory at the rear wall of Brand's laboratory, portraying the ethereal mystery of a vacuum pump against the hardened, vapor and color-soaked wood of a candle-lit room. Behind Boyle's back, a painting shows another dim lab, portraying some other scientific revelation, multiplying the situation like the 2 open doors of one of Brandt's lover's mirror cabinets, inscribing the repetitive, simulational logic of modern experimentation with thick chemical oils on canvas. The researcher and the table in the image face the observer full frontal, exhibiting the nihilo ex creatio in the slender form of a dead, white pigeon dropping its suffocated head down the tube as one of its feathers would fall if dropped in airless space. This is building nothing out of something. You may never see a door or a window in laboratory portraits. Experiments install their own rigid time and space, like grandparents' living-rooms (without the ticking clock - and no ancient gallery, but just as brown). The cloth in front of my ancestor is slightly stained from failed experiments. He wiggles his butt, both fists behind his pelvis, pushing it forward, one foot rubs a little closer to the table than the other. He unzips. His shirt sticking out of his fly like a little flag, he concaves his back and presses hard on his glans, holding his fleshy bit between thumb and index finger. He drips. His left foot is bent outwards, pointing at the heavy back left leg of the sturdy brown wooden table the cloth is pinned to. His right foot crooked inward so far that the lines of his toes, if followed, would meet only a couple of centimeters further, to mingle under the table like forbidden romance or straying cats. He is drunk (alcohol in his urine helps the process). He wobbles and aims. Drips again. He laughs. He can't reach the cylinders and glass tubes Robert Boyle is using in the painting on the wall behind him. He breaks the illusion of a consequent experimental time-space in a predisposed setting and puts his bets on chance. He thinks of himself as an alchemist. From my ancestor's lab to the advent of late-modern synthetic biology, the promise of phosphor has always been two-fold: eternal life and infinite wealth — the philosopher's stone, curing any disease, giving life and turning material into gold. Synchronizing the innermost circulation with the outmost circulation, I often wonder, whether the notion of circulation was taken from the body and brought into the world, or whether it was taken from the outside world of finance and goods in the rise of colonialism and extended into

the body. Both concepts were born in my ancestor's life time.
Given the fact that an organism is (according to 17th century medical standards) either alive and circulating or dead and cut-open, it seems more likely that knowledge of the human body as a closed circuit of fluids mimicked the flows of words, coins, people and things — and not the other way round. Either way, the discovery of phosphor is unthinkable without the circulation of life and money, back then and now: life and money; inside and out; bodies and things; nature and culture. There is no difference — like the islands which the birds shit on these days, or the people that carry the phosphor currency standard in the fleshy pockets of their DNA.

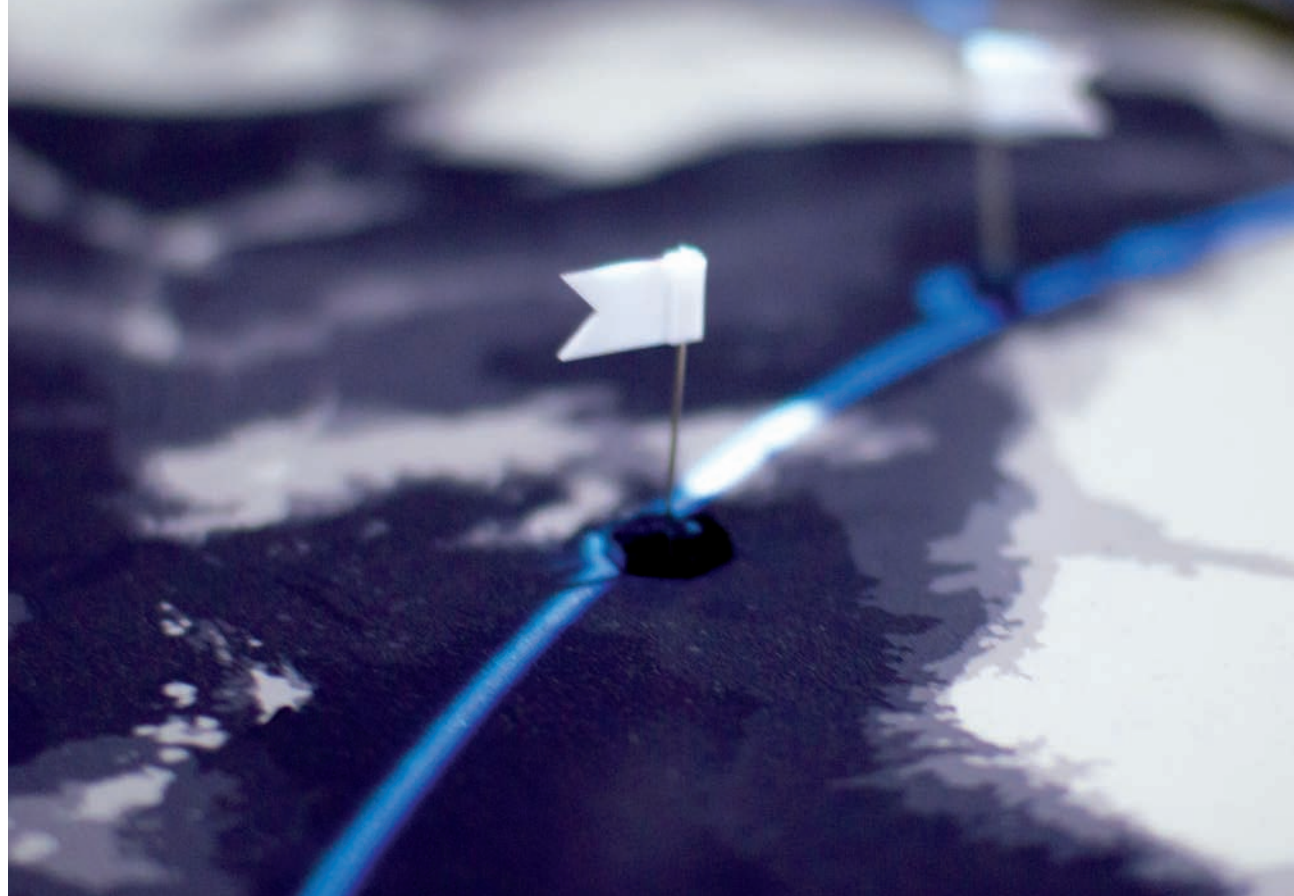
The next day, Leibniz came to our house to write a poem on my family's piss.

Phosphorus Mirabilis
(G.F.W Leibniz 1678 - a rough translation)

The fiery gown that is Medea's gift,
Hindered more simply from burning it is,
Lying calmly hiding its force,
one hardly feels the warmth at its source.
Its life is shown in its gleaming alone,
An emblem for the happiness of soul.



Photos: Studio Nand



THE NEW WEATHERMEN

by David Benqué

Photo: David Benqué

In the face of impending climate crises, environmentalists are becoming increasingly polarised in their ideas and beliefs. Bio-Conservatives argue for a curbing of consumption, a return to Nature and are suspicious of new technologies. Techno-Progressives on the other hand adopt an optimistic trust in progress, and promise to solve problems with newer and better technologies. However, a number of emerging factors suggest possible alternatives for the relationship between environmentalism and science. Among these are the DIYBIO or Biopunk movements and the campaign for open access to science, as well as efficient, headless and cell-based networks of activists such as Anonymous.

This project explores relationships between ideology and science and how an alternative to current options might manifest itself. The New Weathermen is a fictional group of activists who embrace Synthetic Biology to push for radical environmental change. Challenging the borders between activism and crime, their actions aim to disrupt the status quo and propagate an ambitious vision for the greater good. Deliberately radical and ambiguous, they provide a starting point for discussion about our existing beliefs and ideologies.

The project consists of a series of test rigs, small scale experiments that reflect much bigger, radical and slightly deluded ambitions.

THE NEW WEATHERMEN MANIFESTO

For a new symbiotic world order

For immediate release,

We the Weathermen have listened for too long, it is time for action. Politicians, journalists and “green” activists keep on telling us which way the wind blows. In the Anthropocene, the only question is; which way do we want the wind to blow?

If it is to survive, Homo Sapiens must recognise and celebrate Symbiosis. From our guts to the bottom of the ocean, from intercourse to welfare, give-and-take is the rule. Like Toxoplasmosis, we are going to re-wire your brains, in order to un-tangle the ideological mess you are in.

We set forth the principles for a new symbiotic world order, which is the guiding force behind our actions.

Parasite Lost
Parasitic behaviour will not be tolerated.

Eden Gone
There is no untouched Nature to goback to. Only forward.

Caution is for Preys
Abort the precautionary principle.

Bio Commons
Abolish intellectual property.

Species Galore
Conserve all species and genomes. Create as many new ones as possible.

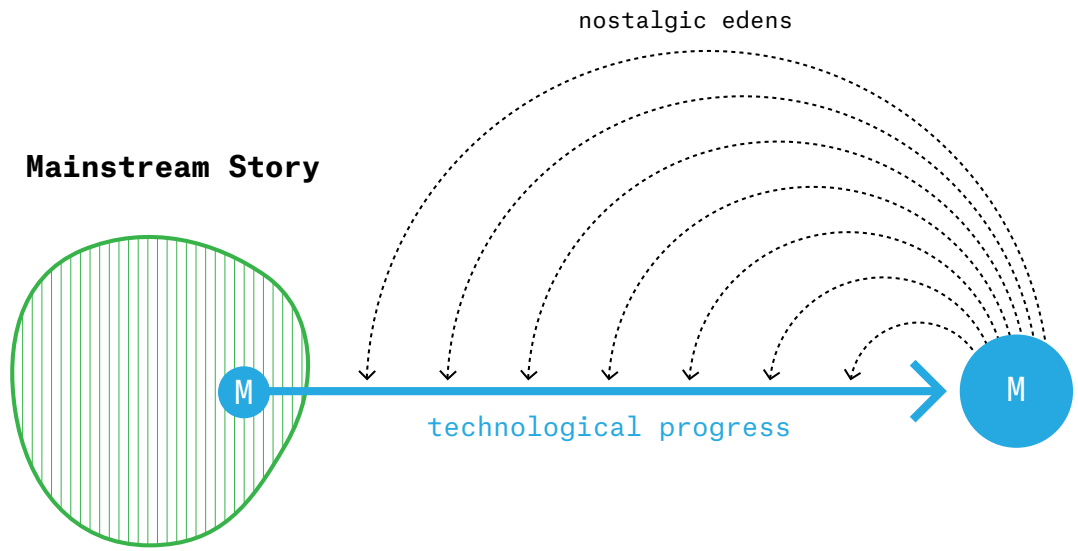
IF YOU LIKE

NATURE

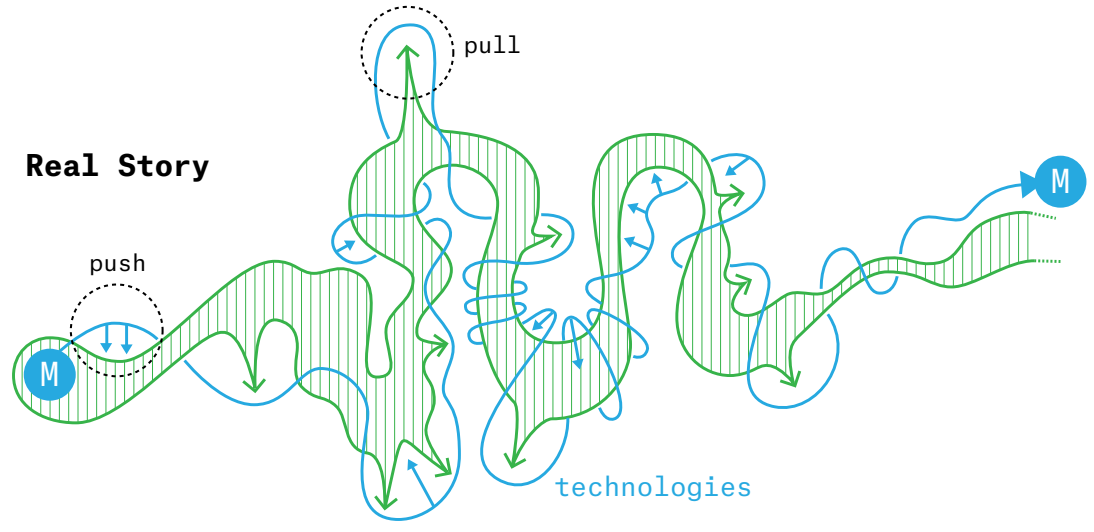
SO MUCH

WHY DON'T YOU GO

LIVE THERE?



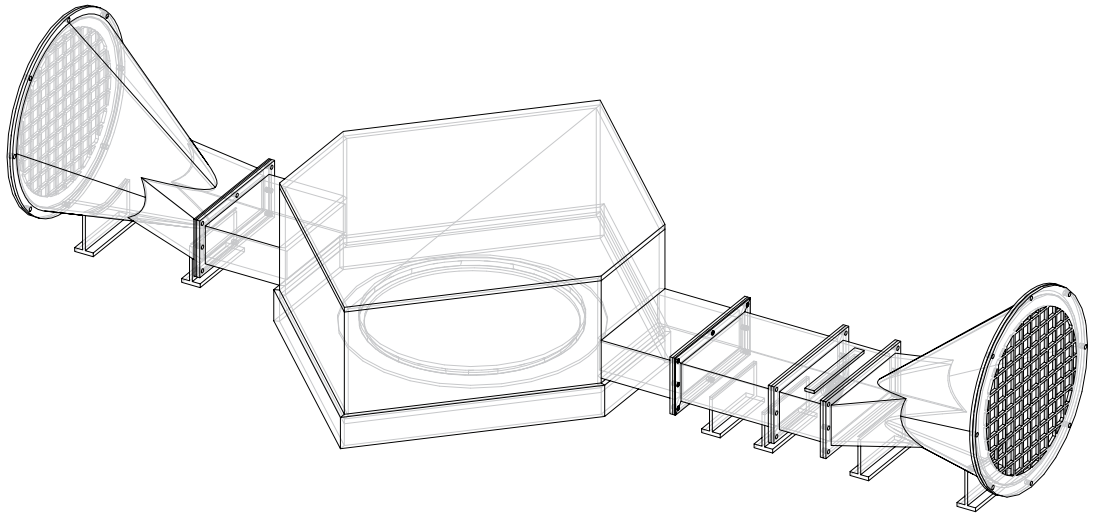
Man vs Nature

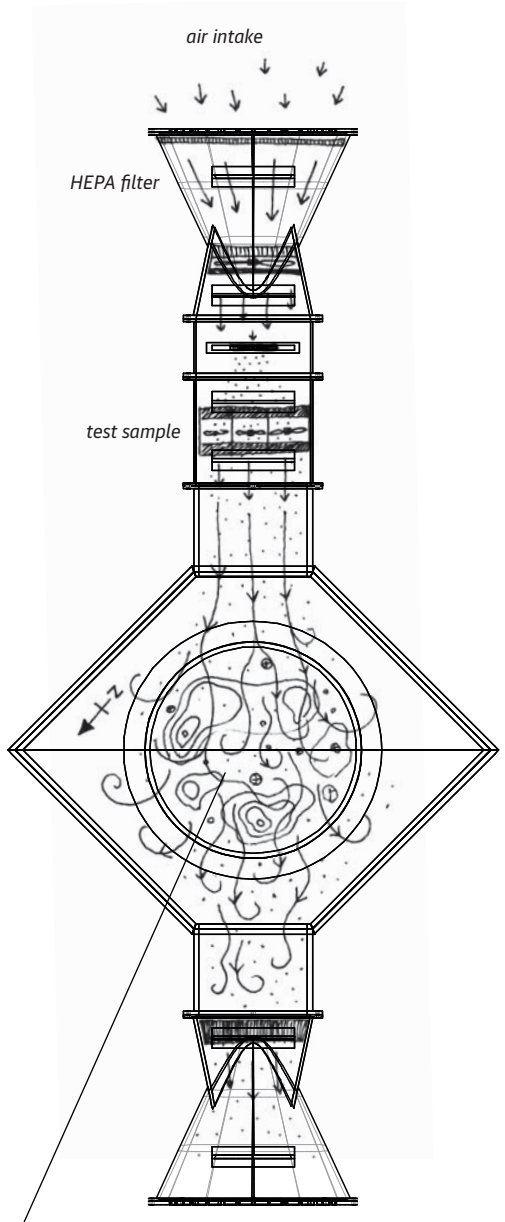


#PIRATE POLLEN ©lub

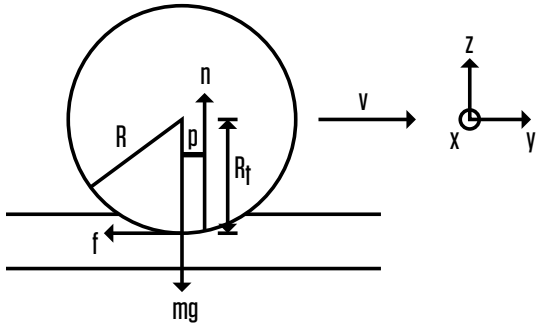
Many golf courses and suburban houses use genetically modified grass in order to grow stronger, greener and prettier lawns. Suburban genetics is a juicy market for biotech companies and the subject of patents and copyrights, which the Weathermen oppose. While traditional green activists — such as the Anarchist Golfing Association — would simply break into greenhouses to kill experimental crops, the Weathermen believe that the answer to Big Biotech is not No Biotech but Open Source Biotech.

Using a wind tunnel to test propagation, two plans are devised.
The first one involves Homology Directed Repair to remove the copyrighted gene in the grass and disable the herbicide resistance it expresses. When the golf course is sprayed, the herbicide kills weeds and grass alike, leaving golfers with only rough soil to play on.
The second option is to propagate an open source grass species which out-competes the copyrighted one in terms of growth rate and sturdiness. The new species disrupts the green's flatness and makes it much harder to play.

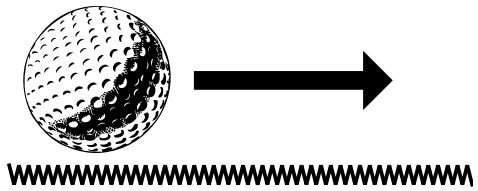




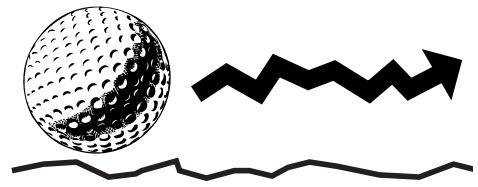
Agar landscape cast



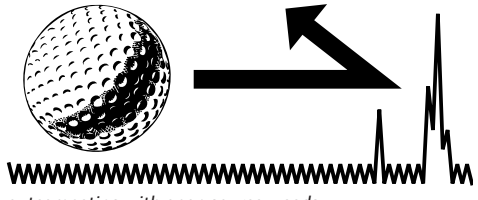
Forces acting on a golf ball rolling on a level green



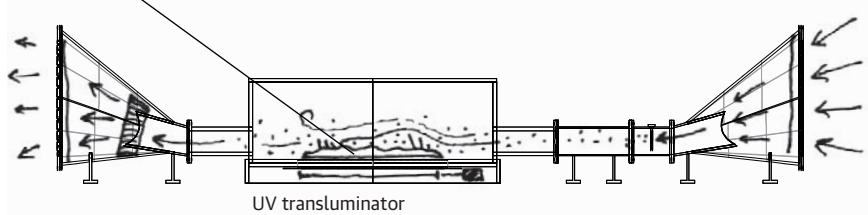
©opyrighted herbicide resistance



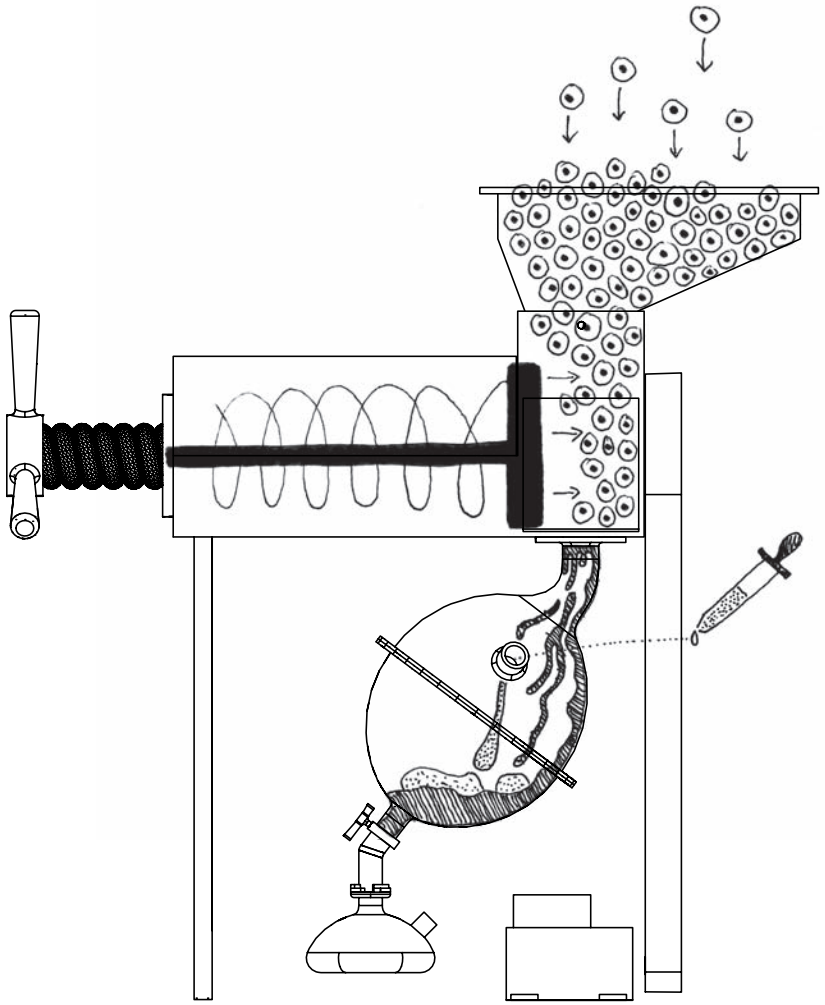
no herbicide resistance



outcompeting with open source weeds



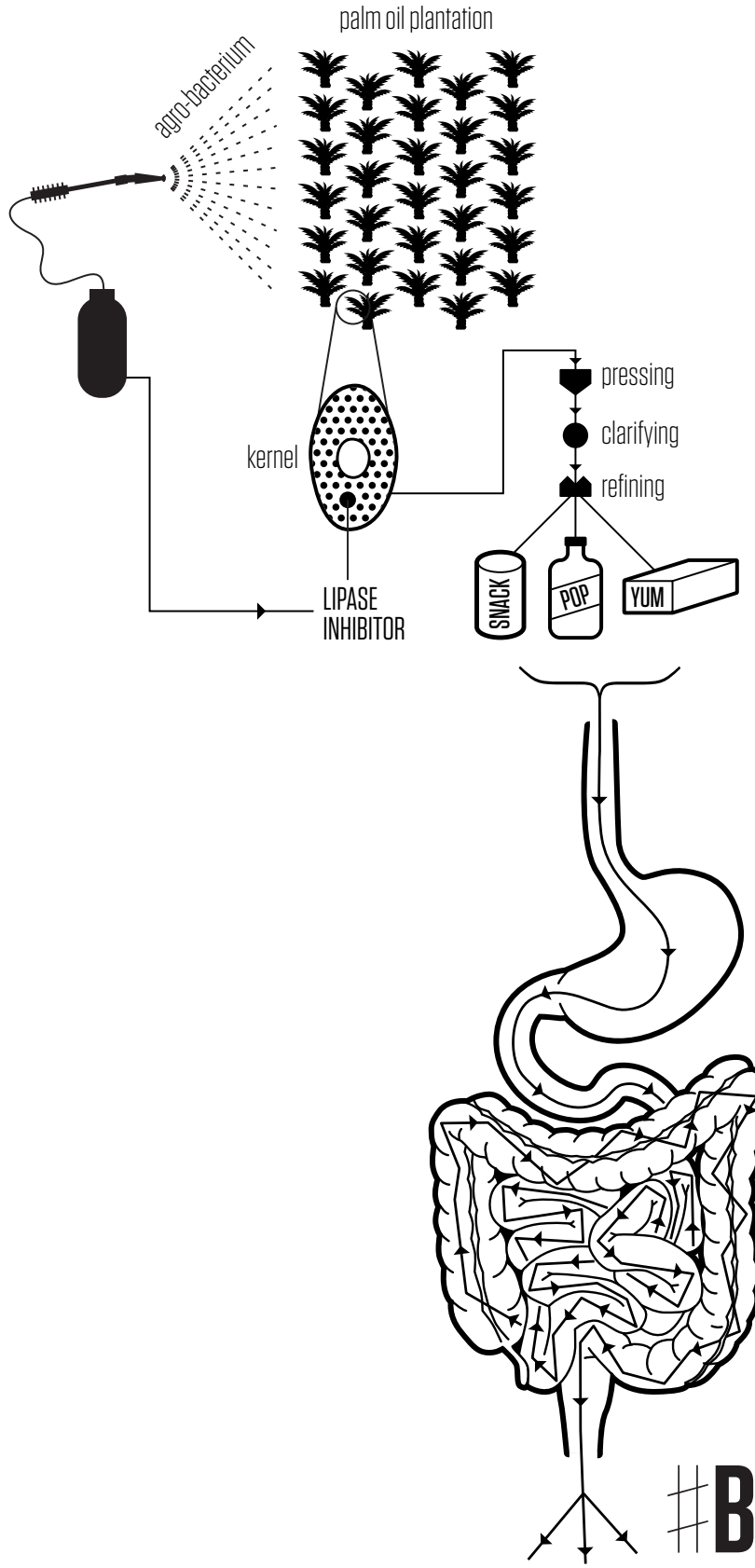
UV transluminator



#PALMOPS #BIOLULZ

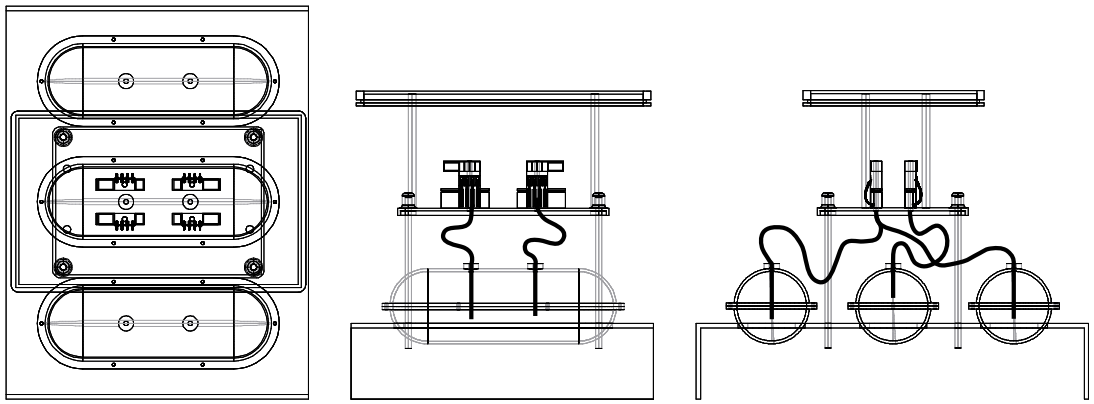
Massive palm oil plantations in southeast Asia are widely criticised by green activists groups because they take over rainforests, peat lands and biodiversity. Palm oil is increasingly attractive to the food industry, especially as an alternative to trans fats which are now subject to labelling regulations.

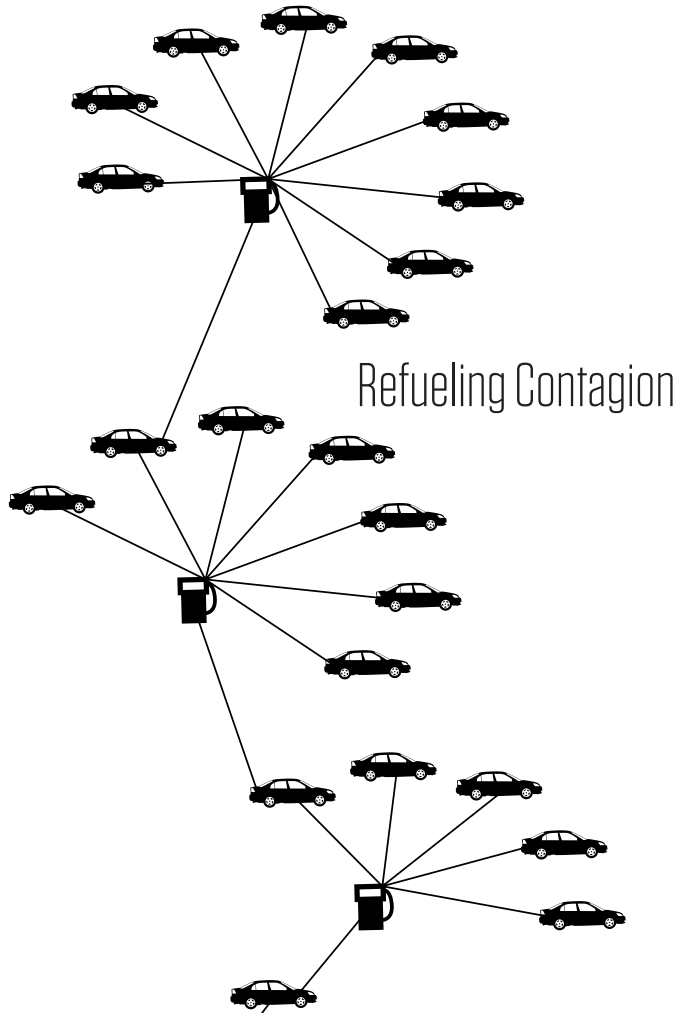
To shift the public's opinion of this ubiquitous foodstuff, the Weathermen take to radical methods. By way of agrobacterium and guerilla spraying operations, they modify the palms to produce lipase inhibitors which keep the body from digesting oil. Anyone consuming this modified oil is unable to process it, causing sickness and all sorts of #BIOLULZ side effects. The oil press device is used to test the transformation by pressing small batches of oil and testing for the absence of glycerol. This tactic builds on existing treatments for alcoholism, where Coprine—a compound found in the ink-cap mushroom—produces instant and violent hangovers in patients who drink while on the drug.

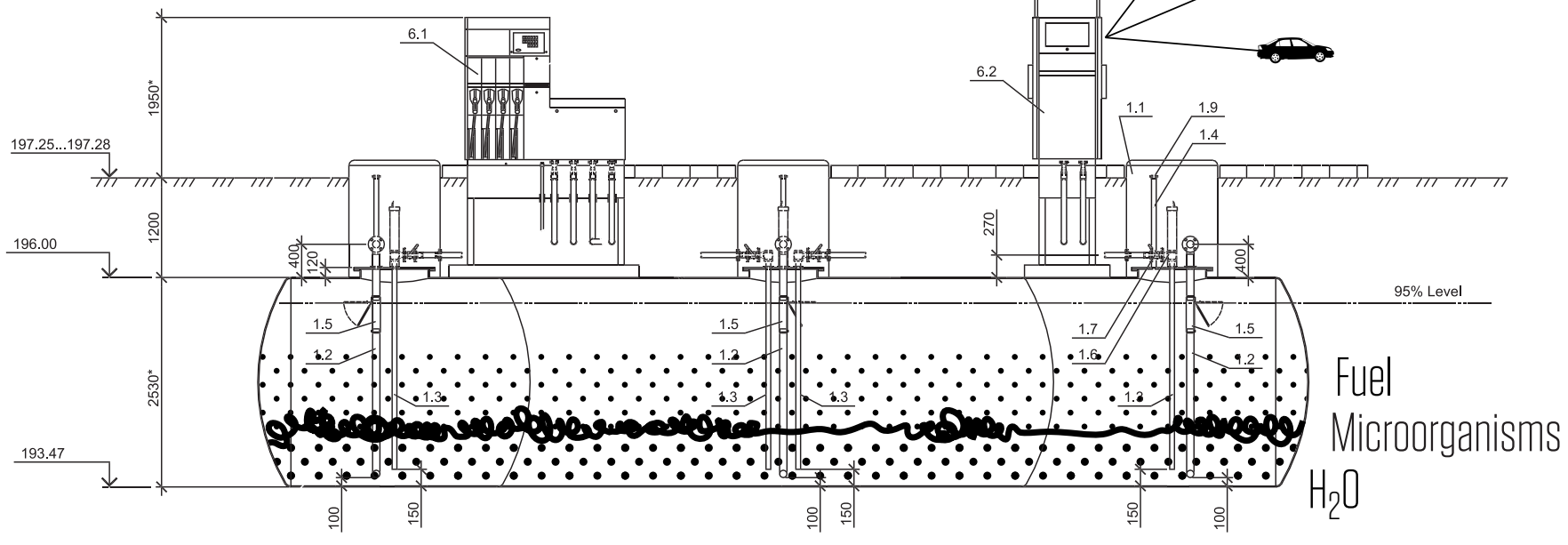


#BIOCCUPY DIESEL

To disrupt the parasitic fossil fuels industry, the Weathermen take to optimising microbial infections in fuel known as the Diesel Bug. Using small scale tank replicas, they modify the bug to maximise growth and biofilm production. Another challenge is to achieve enough 'stickiness' for contagion to occur. The bug should be passed on to every car which refuels at an infected pump and to every pump used by an infected car.







INTERVIEW WITH CATHAL GARVEY

by David Benqué

Cathal Garvey is an independent synthetic biologist, working out of his home-built lab in Cork, Ireland. After the opening of the Grow Your Own exhibition at the Science Gallery in Dublin, we had the following conversation about DIY Bio.

David Benqué: How would you define DIY Bio, and is it the same as biohacking?

Cathal Garvey: If I had to define DIY Bio —which is a very broad heading —I'd say that it's what happens when people who are previously unable to even contemplate doing advanced biology or lab work discover that they can. It's a similar phenomenon to the Homebrew Computer Club. Computers were untouchable and they became touchable. People started to play with them. It wasn't obvious why someone would want a computer, but it had less to do with the need or mission and more to do with simple curiosity. Biohacking would be a subset of DIY Bio, generally more restricted to synthetic biology, the engineering of life. I like to call myself a biohacker; it's usefully provocative. It gets people to ask the right questions early on, usually out of a sense of trepidation.

DB: When speaking to the public, do you think DIY Bio has the potential to change their perception of science, for example GMOs in the EU?

CG: I think it already does. I find that people really stop and think when you stop telling them to take something as given and suggest that they might have the ability to hack and own their own crops. It isn't a great big company coming down and stamping on the soil. It isn't a government regulated monopoly that you have no control over. It isn't a monoculture that you can't cross breed with local varieties. It's another agricultural technique to create diversity to address normal problems in agriculture. I think it's going to be critical in turning the conversation around in Europe, not to blanket acceptance of genetic modification but towards a more mature discussion: when is it ok to do this? When is it better than the alternatives? And is it ever appropriate to own the output?

DB: How did you come to all this? What's your trajectory?

CG: After 4 years of a college degree in genetics I was thinking, like any other person who's graduating: I could sell out to industry or I could go into "publish or perish" academia. I went into cancer research and learned an enormous amount about genome engineering. I had a mixed experience with the actual structure of post-grad though. My topic was changed without my input several times throughout the course of 3 years, so I ended up on a very unambitious project which was nothing I'd signed up to do. During this slow train wreck of a bad PhD, I started doing simple experiments at home — things I'd seen people do on the DIY Bio list like isolating bioluminescent bacteria. I also happened to have a 3D printer so I made myself a 3D printed centrifuge which turned out to be a lot more

popular than I'd expected. There's this notion that you have to slave your way under someone else for years to earn a little bit of credibility and then you still have to compete with everyone else in the field for research funding. I just decided to go and do biology at home.

DB: So you joined an existing DIY community?

CG: I would say that DIY Bio had been around for maybe 2 years before I joined the list. They had already created the open source Pearl Biotech rig to do gel electrophoresis. They had gotten together, organised and crowd-sourced the creation of a really good piece of equipment. That challenged the way that I would have done it in a well-funded lab. We were still using these huge transluminators, glorified webcams which cost thousands. It was great to see that this community had already created a piece of equipment which made the work so much more convenient, straightforward and much cheaper. To me, this was proof it wasn't just a fad. These people were already making better tools for science.

DB: So it's about providing tools to do biotech?

CG: If you drop an artist in the wilderness the first thing he needs to do before he can start drawing again is make charcoal, so he has to learn how to make fire. At the moment it's very much this wilderness feeling. I want to crash the cost of doing it, then later on we'll be able to be much more creative. Creativity in biology is costly. You have no guarantee that something is going to work so it's very expensive to fail. The cheaper we can make it to fail, the more creative we can be.

DB: How do you operate now? Is this your full time job?

CG: It is, yes. I did it by myself for a while on my savings. I ordered a prototype for a Bacillus subtilis engineering plasmid which was supposed to be self-selecting and highly stable, so that you wouldn't need to use antibiotics. It was very ambitious; the fact that it even partially worked is a miracle. I was saving the money to buy a second prototype when I met someone from a venture capital firm who was interested in funding the work. In general, venture capitalists want to get their teeth in but this guy was like me, big in permaculture and environmentalism. His attitude was that if I didn't want patents there would be no patents and that turned out to be true when the contracts came around. I'm now in the situation where I don't have to compromise my core ethic which is free/libre biotech for the people who actually buy it, so that it belongs to them.

DB: The analogy between biology and software or computers comes back time and time again in the discourse around synthetic biology. How do you feel about these analogies? Are you essentially pushing them further by including the hacker in the computer metaphor?

CG: I think it's important to place where the metaphor even came from in the first place. We tend to frame new things based on prior experience, myths and stories. To explain a new technology, we fall back on the stories of technology. I think that in synthetic biology a lot of the culture that we inherited does come from hackerdom. The word hacker may have emerged from the MIT computer labs but the culture itself is very transferable. The attitude of hacking is a philosophy of openness, inclusion and meritocracy, which need not be tied to computers. A cell is not merely a computing thing that takes an input and gives output; it reproduces and behaves differently at different stages of its life cycle. I think it's very appropriate as a mythology for getting the idea across, because these parallels exist. I also think the metaphor is best used culturally and situationally but not literally. Some people are trying to recreate the metaphor in a literal sense and they have done some amazing work. I don't think they're going to fail, but they're going to have to find new metaphors to take that work to the next stage.

DB: The authorities are watching DIY Bio closely, which has led biohackers to issue codes of ethics and to state their intentions as "safe and good". Can this pressure limit the movement's potential?

CG: I wouldn't say so. One of the things that is worth noting about our bio safety conference was that nobody out there was aiming to do anything negative to begin with. More often we're concerned about bio-error but that is also hyped out of proportion. We wanted to come up with a framework that wasn't so much "This is what we promise to do from now on" but "This is what we actually do". We are also appeasing authority, because authority doesn't like self-determining citizens; it really doesn't. They don't like biotechnology being taken out of the lab because of their phobic attitude: "If we can't control it, it will inevitably do something wrong". The reality is it hasn't done wrong yet; it has never done wrong in the past and it's unlikely to do wrong in the future. I see this as something that could become a real barrier in the future, but they also know that if they try to hard-regulate it they will ram it underground. It would make things worse to try to stamp it out, so they try to maintain a sense of control by being civil about it.

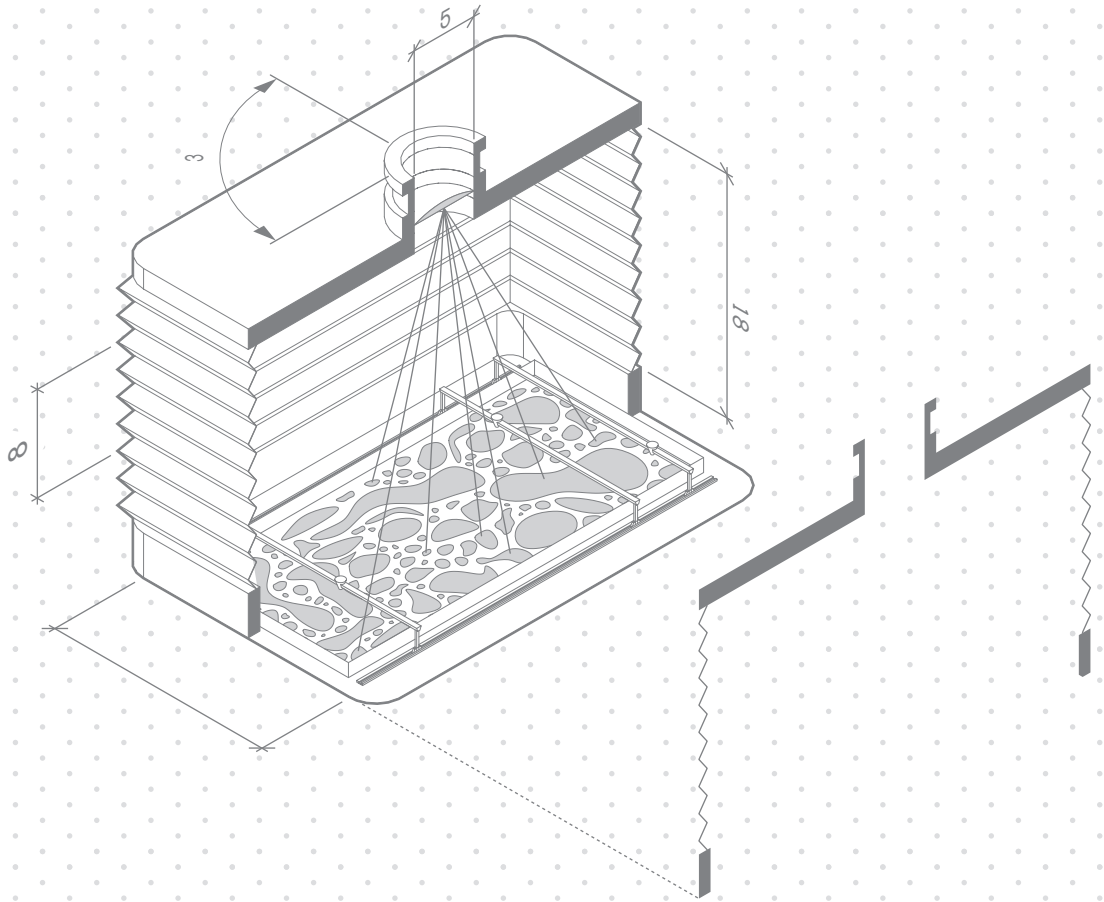
DB: The bio-terror narrative is fear-mongering then — perceived threat rather than actual threat?

CG: The terror is in your expectation of terror. There's a mythology that terrorists will come up with high technology ways of attacking us, that they'll turn our technologies on us. People wonder about malicious uses of biology and they say: "What about making tailored viruses to kill people?" You only have to look at poisoning. I could go out in Dublin today and find five or six plants which I know are highly toxic when processed correctly. How many people actually intelligently poison people? It's not even rare, it's almost non-existent. This should say something about bio-terror which

is much harder to do and has a much lower likelihood of success. If you're intelligent enough to do this you also are intelligent enough to realise that it's a pointless endeavour.

DB: Finally, where's this all going? What are your worst and best case scenarios for the future?

CG: I don't think that there's a realistic scenario where people no longer do biohacking. It could certainly be a lot harder if hyper-regulation came in and made it illegal. Nobody is going to risk jail time just because they want to explore the world around them. A world where people are still doing biohacking but they are being forced to be criminals because of natural curiosity, that's my worst case scenario. The best case scenario would be that by the time genetic modification becomes legal and more accepted in Europe, we will have managed to leverage the existing discussion to attack the real problem which is intellectual property, ownership of nature. I would like to see a future where anyone can tinker and play with the nature that they were born into, using tools that are readily available and affordable.



BEAUTIFUL MUTANTS

What is the role of the hobbyist gardener in the grand scheme of evolution?
As we gain control over life, how are our aesthetic and cultural relationships with it changing?

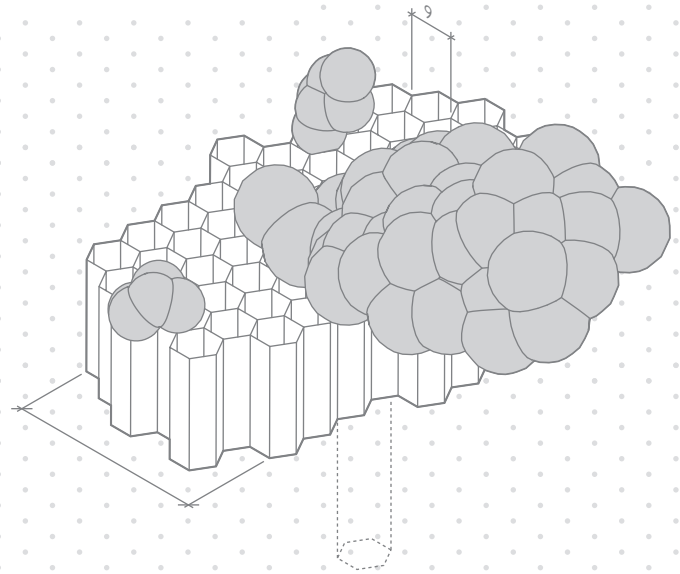


photo: Kristof Vrancken / Z33

WITHOUT ONCE AWAKENING

by Revital Cohen and Tuur van Balen

Commanding a space between inanimate object and animal, plants live in the realm beyond consciousness. Inspired by an exploration of Bonsai-keeping as an expression of psychological conditions, the work draws a symmetry between the plant and the mind, looking at a plant as a metaphor for the psyche – the visible (behavioural) expression and the invisible (subconscious) root system.

Considering the potential roles of engineered plants, psychobehavioural functions can be accentuated by bespoke specimens created with synthetic biology. Plants become an attachment object which demands physical proximity in exchange for co-dependency. They automatically change their colour in re-enactment of predictable seasons.
They construct a visceral monument of grafted scents.

Plants have a remarkable ability for chemical synthesis. These stationary chemical factories operate on a different time scale to animal time, reminiscent of early photographic processes. These portraits are thus printed in plant time, over weeks of exposing plant solution on paper to UV light inside a specially made exposure box.

A Monstrous Family Tree

(next page)

Plants have the potential to outlive humans and, therefore, can become a generation- crossing memento. In this story, a supernatural plant is constructed from an ever-growing variety of flowers, modified to smell of human bodies and commercial cosmetics. Each family member grafts on a specimen modified to express their own scent, contributing to a living portrait of ancestors — the family tree as a concoction of smells.
The plant becomes a collective creature of imagination, an organic super-collision, a beloved monster.

Through The Death Of Seasons

(previous page)

Here a plant is designed to provide the comfort derived from feeling control over natural phenomena. The plant's biological clock will be synthetically programmed to express seasonal changes with an engineering precision. Covering internal domestic spaces, these plants mediate an experience of nature as predictable and reliable, providing existential security to soothe the disorienting effects of climate change, programming the rhythm of the seasons to a techno-pulse.

The Co-Domesticating Union

(next page)

This scenario positions the plant as a placebo object aiding the person to feel significance. The plant, as a dependent, allows the emergence of an attachment, echoing Munchausen Syndrome and a deep need to be needed. Using synthetic biology, the plant is modified to get all its nutrients from a specific person's saliva. The need for physical proximity constructs the person's life in a way that supports the plant, establishing a co-dependency which questions who is domesticating who.

The bespoke interactions allow complex therapeutic exchange to be created which mixes dependency, oppression care and intimacy.

HEAL THE WORLD

Sascha Pohflepp in conversation with Dr. Luis Campos

ZERO PARK
Sascha Pohflepp

In April 2013, Kent H. Redford of the Wildlife Conservation Society, Bill Adams of the University of Cambridge and Georgina Mace of University College London convened a conference at Cambridge's Claire College, aiming to bring together two rather different communities. Its title, 'How will synthetic biology and conservation shape the future of nature?' was also its primary question which, over the course of the following two days, was the focus for the views of various practitioners from either field.

The closing keynote, delivered by Stewart Brand, largely focused on the so-called 'de-extinction' project that the Long Now Foundation is pursuing in association with the George Church lab at Harvard Medical School and others. Its goal is to use the means of synthetic biology in order to "revive and restore" species that are thought to be extinct, starting with the North American passenger pigeon.

The following is an excerpt of a conversation on the subject that happened shortly after the conference between Sascha Pohflepp and Dr. Luis Campos who, in their respective areas of work, both focus on questions around the significance of synthetic biology as technology and cultural practice.

Sascha Pohflepp: One thing that struck me [at the conference in Cambridge] is that the proponents of de-extinction such as Stewart Brand and his wife Ryan Phelan appeared with the ultimate offer to conservationism — to bring back species that have already been lost to extinction. Obviously a paradoxical thing in itself and one that the conservationists did not seem to appreciate all that much.

Luis Campos: That is because what matters to conservationists is habitat loss — it's the world that is the problem that needs to be solved, and synthetic biologists are not offering to solve the world.

SP: However, Stewart Brand pointed out that in his view the habitats are not actually lost, rather that the ecological niche is basically still open — we just need to re -fill it.

LC: That would certainly be true for some species that declined in numbers and then a tree branch fell on the last remaining member of the species and killed it. This is the story in Spain of the Pyrenean ibex. What I do notice is that everything that Stewart Brand talks about is an animal — there's no discussion of other forms of life. He's all about animals, pretty much what people in conservation called 'charismatic megafauna', a term that has been in use since 1985, as part of a conscious strategy on the part of conservation organizations to build public support for conservation efforts. So all the images of fuzzy mammals, animals that you look at, big eyes are staring at you — all these sorts of things are very clear techniques of representation that are used to foster connection. With the passenger pigeon, the argument is that it was shot and hunted to extinction, so clearly we could still return it to the landscape. Brand wants to focus on the places where they could be brought back. That is an interesting choice and there is a certain framing that he is doing, both of that and on the focus on the charismatic megafauna, which I want to learn more about.

SP: The passenger pigeon is a really fascinating example from Stewart's talk since he was making the point that here biotechnology — and by extension most technology — liberates. But then at another point, there was mention of the telegraph having been the demise of the passenger pigeon, at least in part, essentially because hunters were able to tell each other where the pigeons were resting, or when a swarm of hundreds of thousands of pigeons would pass by.

LC: Of course. All these things are interrelated and they're all complicated. The invention of more accurate rifles....

SP: This constitutes a somewhat strange, almost double notion of technology, where both the problem and the remedy are technological.

LC: I think it seems not as reflective a position as it could be. We know Stewart Brand from his many different endeavors, as far back as the Whole Earth Catalog, back in the day, where the famous line was "We are as Gods. We might as well get good at it." This is a very strong claim for the place of innovation and technological development, and it's been a narrative of his life. But it's interesting that you say he gives an example of technology as being a part of the problem and yet also, in a happy vein, seems to refer to technology as the solution. And when he refers to technology as part of the problem it's not the technology that is really the problem but rather what we have done with it that gives us the subsequent moral reasoning to justify using other technologies to improve what we've messed up. So technology is playing on both sides but it's not ever really in the mode of claiming that technology can lead to bad outcomes or be part of the situations that lead to the destruction of the species or however you want to phrase it. Rather, what humans have done with technology is used as a form of moral suasion for why more work must be done, again using technology to rectify what we have messed up. It's reparative.

SP: Another issue would seem to be the notion of "nature" in either camp, which was never really questioned. The conservationist idea that there once was a pristine moment of the planet that could have been preserved versus the synthetic biology which arguably is more focused on being creators of nature. What to make of these positions?

LC: All these fascinating metaphors are flying around, of preservation, of arks, of Lazarus, of creation. These are deeply religious metaphors of a particular Christian tradition that are being used, left and right. That in itself is fascinating to begin with. But there seems to be — in addition to the cultural thing that you have noticed about the difficulty of speaking across these boundaries — a way in which high-level conceptual work that has been done in fields like environmental history is totally missing from these conversations. Work that has looked at the concept of nature, of wilderness, of preservation versus conservation, and which have explored for us the meanings of these words and how culturally determined they are, that they come from certain cultural contexts and get applied to other contexts. The idea that Europeans and Americans have of wilderness, for example, comes from a particular tradition that implies the absence of people. For twenty years, at least, we have had literature that has been looking at this and has been analyzing just what it means that in the US the National Park Service creates national parks at around the same time that the frontier was declared closed. There is no new place to go anymore, and then we start to create parks! In some of these national parks, like in California, all the native populations were removed in order to make these places into "wildernesses" that tourists could go to. With what we have done with all of our nuclear testing, the thousands of bombs we have exploded in the atmosphere, and all the fission products and fallout that have circulated around the entire world – there is no such thing anymore as a "pristine" nature. The complexity

of figuring out what we mean when we use these kinds of words seems to be something that humanists have been very concerned with, and have been writing about and talking about for a long time, looking at many different case studies in many different countries over time. It is interesting that I do not see that complexity of empirical and conceptual richness being used in these synthetic-biology conservationist arguments. In some sense, it is an impoverished conversation. There are a lot of insights from other fields that one could bring to this, other than: "Let's look at the list of what is endangered and let's look at the technologies we have."

SP: This phenomenon of the impoverished conversation then seems to be running through a lot of these discourses since they often seem to be shaped by somewhat impatient technologists whose aim appears to make something. Stewart Brand was referring to a De-Extinction TEDx event that was hosted by National Geographic at which the century of "discovery through making" was declared. This is supposed to sit in contrast to pure discovery which would then be represented by the 20th century and the ones before. Here it appears as if the making now becomes a good in itself, especially in as much as it can actually constitute a new reality which in turn reminded me of that beautiful thing said by an anonymous member of the George W. Bush Administration as quoted by Stephen Duncombe in his book Dream: Re-Imagining Progressive Politics in an Age of Fantasy. He said that when they acted, they created reality and while one may be inclined to stop and study this reality they will long have moved on and acted again, creating new realities, which basically constitutes an argument for not stopping to have that non -impoverished conversation, and rather opt to create realities instead.

LC: That's right and this is a total echo of synthetic biology, right? There are the same sorts of arguments about the perceptions of some of the major players in American synthetic biology, about how a lot of the European meetings they went to in the early years wanted to define what synthetic biology was and they spent the whole day talking about the definition and how that was totally uninteresting to the Americans and they just wanted to go and do something and figure out what they are doing as they moved along. So it is interesting how those narratives of the impatient technologist get set up. Does one need to worry about the significance and the complexity of this moment, or does one just go ahead and do something and deal with it? Those are kind of fundamentally different approaches to the world. They might be based on temperament and personality, but they might also be based on discipline.
And it certainly looks like, at least based on the views of American synthetic biologists in the early years, that it might be cultural as well.

SP: You mean cultural in the sense of being American?

LC: Let me critique my own view of the word "impoverished". That is how a humanist looking at it might feel. There is lots of important stuff that has been done on these concepts and terms that seems to be totally missing from these conversations, which would benefit from their inclusion. They would benefit from it in the sense of a richer understanding, not necessarily in the sense of causing new realities to emerge. Knowing everything about how these words have been used and deployed in different contexts and analyzing how they're being used now is not necessarily going to be something that translates into saving an endangered species or providing enough support for public fascination that drives a Kickstarter campaign to create a new species that would fulfill a niche that has been empty for a century. So the different kinds of knowledges and the different ways that they speak have different functions and different goals.

SP: There was this tangible feeling in the room that they know "this is happening". That the conservationists need to adapt their own culture to the change because they know that their notion of nature and preservation and these things need to become compatible in real time to something that's almost sitting at the other extreme of the spectrum — something that will have a definite impact on the reality of conservationism, be it through industrialization, through deployment of technology or through disasters — which some were saying their field is essentially based on.

LC: So what you have are these two very different communities and cultures that one would think are the unlikeliest of bedfellows. To associate the genetic modification of things with a way to save nature – no one in the '70s would have seen this coming. There is a period of adjustment and they each need their own Sealy Sleep Number on the mattress. To Stewart Brand, for his complicated reasons, and to other people who are interested in the technological solutions, this is a clear and obvious way that new technologies can help ameliorate the world. So then ecology is constantly looking for the "killer app" and so here it turns out to be the Lazarus app. The un-killer app is the killer app for synthetic biology.

SP: Another thing here that I actually find quite intriguing is notion of the real, or the authentic. Staying with the passenger pigeon – they are trying to de-extinct the animal, yet they would not create it from scratch. They take the genome of an ordinary pigeon, and then attempt to re -make, to push it as close to the genome of the passenger pigeon as possible. Stewart Brand said himself that it is not going to be a perfect replica. But then how close is close enough to make it authentic as an organism? The attitude here appears to be: 'if it looks like a passenger pigeon, it must be close enough'.

LC: "Looking like" may not be the most important variable, but this shows the fact of how human values come into play. How close is close enough? Well, is it that it looks like it? That's good for public relations. What about if it eats the same things as the other one did, or if it poops the same way or whatever, these are things that might be relevant variables.

SP: That makes for a rather strange moment to the whole movement, one which in my view definitely shows that we are the determining factor rather than the ecological or the systemic context, a Turing test that determines authenticity.

LC: I was just thinking of this yesterday when I was reading After Dolly: The Promise and Perils of Cloning by Ian Wilmut and Roger Highfield. The way that they describe it is that it is one of the 277 attempts with Dolly that actually worked and that it is the nucleus of one cell that goes into the egg cell, the nucleated egg cell of the other. These are things that we know, that are very familiar from the Dolly story already to many of us. But what is interesting to me is that this was a case of cloning without any kind of consideration of the egg donor's contribution, of mitochondrial DNA, of whatever else is going on in the structure and framework of the egg cell that's outside the nucleus. We know from our studies of epigenetics that these "contextual" dimensions are hugely significant, that it is not just the nuclear material alone that determines an organism, but that there would be actually separate chains of heredity that go through mitochondria — not to mention the non -hereditary stuff that makes up the majority of substance in the egg. But nobody ever focuses on that. Dolly was just the cloning of nuclear substance, leading to identical sheep. Now it looked identical, right? And Dolly produced other sheep in the natural fashion after that, and yet nobody pointed to the fact that there was this odd hybridization of egg cells that might actually be significant for the identity of this organism. It is not the same as the one before. In terms of nuclear information, it's the same. But in the case of Dolly, we've ignored the majority of the parts out of which she was composed. In this issue of de-extinction that we are talking about, this seems to be a key issue that emerges again. Is this new creation the passenger pigeon, or is it not the passenger pigeon? The nature of parts and of wholes is a key feature here in our assessment of the nature of nature.

SP: But, going back to Stewart Brand's "We are as Gods," within that proper narrative, does that view not make sense? That we are the determining factor, that because we are the stewards of the planet we get to make these calls?

LC: Yes, that would make perfect sense for him to make that sort of claim, and then be uninterested by the claims of others who would suggest that that is conceptually, morally or epistemologically problematic in some way.

PASSENGER PIGEON
Frontispiece, Luis Agassiz Fuertes, 1907

SP: Can we briefly talk about the origins of the term 'synthetic biology'? My hypothesis would be that, if you juxtapose the claim to novelty of the field in contrast to what is portrayed as conventional genetic engineering, that this may lead to a motif that is somewhat similar to that of the passenger pigeon and its progenitors, if you know what I mean — one of intentionally or unintentionally ignoring the history of something with the aim of making a larger point.

LC: The narrative that I have offered before is of a recurrent amnesia of the field. There are claims to engineer life in these ways and even sometimes under the same name, even though the name itself isn't terribly important in telling this story, but there's this progressive amnesia that seems to happen where every generation thinks that it is the first one to properly engineer life. That's the story with synthetic biology from 1912, to 1930, to 1970, to 2004, to today. And so, what I'm hearing in your question — tell me if I have it right — is: Is there some similar history to be told of these efforts at de -extinction?

SP: I am probably just trying to make a very forced connection.

LC: No, it is worth thinking about. Conservation biology as a field emerges in the mid-1980s. The environmental movement and the understanding of ecology and of species loss as serious issues — that that's what some people in ecology could focus on — that's a very recent sort of thing.

AUROCHS
Charles Hamilton Smith, 1927

A lot of ecology through the 1950s was about modeling ecosystems mathematically. Into the 1970s, it was using new theoretical understandings of chaos theory to understand that there may not be a natural state to which an ecosystem returns to after a disturbance. (That was the idea of the early 20th theory — that you have succession towards a climax, and then after a disturbance you return towards the climax.) And so, the interesting argument in the history of ecology has been that ecology in the 1970s — by the time that it becomes a popular thing and becomes part of an environmental movement and gets adapted by other people — no longer thinks of nature in terms of "original states" to which things return, and this is at the exact same moment that hippies and everybody else begin to refer to ecology as teaching us "deep lessons" about "Mother Nature"—so that is an irony in the history of the field. So is there a history of trying to bring back species that have gone extinct? Well surely there must be, right? There must be a larger history of this; it would just be a matter of thinking of the cases. It would probably be in the first instance where something valuable disappeared, and where efforts were brought to re-establish that species from somewhere else where it continued to exist. But what would it look like? That's an interesting question. Is there some effort at not just preservation, but de-extinction? That would be the earlier roots that I would think to look for. How old are the claims to bring back extinct species? That's a very good question.

SP: Quite recently there was an article titled 'Heavy Breeding' by Michael Wang in the spring 2012 issue of Cabinet Magazine, which related to this topic, especially to that of the passenger pigeon in an interesting way. It focused on the Aurochs, a somewhat mythical type of cattle which went extinct in 1627. Wang focuses on the Nazis and their desire to bring back this creature since for them it embodied the ur-cattle of Germany. What followed was an intense attempt at breeding bisons to appear more like the animal as it is depicted in medieval sources which, just like the original Aurochs, ended somewhere in the forests of Poland.

LC: That would be another very good place to look, then. That would make me think of de-extinction in the context of cattle breeding. One could imagine a kind of economically valuable breeding that one would do to get more economically valuable breeds that used to exist but no longer do, and this story would fit into that narrative of commercial breeding. But perhaps, as you suggest, such efforts could be done for other ideological purposes as well. So a proper history of de-extinction would need to look at these efforts, whether commercial, ideological, or something else in the context of the larger history of breeding. De-extinction claims to be so new, yet its techniques of trying to breed back towards the passenger pigeon, combined with molecular methods, are in fact drawing on very old traditions of experimental breeding that have been used for centuries. Without referring to this history, but in also claiming that such attempts would be relatively unproblematic,

experimental breeding becomes transformed into an attempt at "de-extinction" that is claimed to be better than doing nothing at all. And so "de-extinction" does not travel under the label of "breeding", as it seems very clearly it should, with all the values — commercial, ideological, or others that breeding has always entailed — but rather under the more preferable label of "restoration".

SP: That in turn hooks back into a sort of frontier narrative, that we've always been doing this but that the technology has never been as good as now. Isn't there something strange in this claim to newness in a way that almost necessitates the amnesia you mentioned? To claim something is new, and yet a couple of years later you look back at it and this notion of the newness is completely gone. There's very nice examples of similar things in other areas such as computer games, for instance, Cory Archangel's beautiful art piece, Beat the Champ, which forces you to revisit the notion of newness and by the end makes you realize how wrong you had been for the last 20 years of your life but you just had forgotten. It is a succession of bowling simulations, through the ages that you walk past in the exhibition. They are being displayed live from the actual game consoles, starting from the '70s and ending with the newest one. If you went the other way around you would think "Wow this game looks so realistic, almost like video". But you are made to encounter them chronologically, starting with a stick figure as a player in the earliest game and by the time you arrive at the most contemporary one, it doesn't look impressive at all because you know that at the time you found each game to look realistic, all of which now just look pathetic. Maybe there is something similar going on there?

LC: The oldest thing is the claim for newness. That's the oldest feature of this whole debate.

SP: But that is a paradox, isn't it? There is a lot of factual progress, particularly in fields like genetic engineering. But maybe there's a distinction between factual and cultural progress, for lack of a better word.

LC: The methods change. The psychological questions, the historicization questions, or the conceptual questions, those don't change, for the most part, from moment to moment, it seems. The context is always different, and things are always being re-configured in new ways. But we can always see the similar issue: that you're still doing breeding of this passenger pigeon, even if the techniques that you're using are techniques that nobody could have imagined 30 years before and you're calling it "de-extinction". The science changes, advances, as we say. The methods change. But the fundamental issues of "Is this new or not?", "How does this relate to other things that already exist?" — to "what is nature?", to "what is artificial?" — those are the longstanding questions that are always available for question. And that's the difference between

a scientific mindset and a humanistic one. The scientific mindset is always moving on to the next thing and leaving the past behind it; the humanistic one is always without regard to time.

SP: Would you say that the scientific mindset and the engineering mindset are the same? Or do they differ within that discourse?

LC: Well, they differ, but they both seem to be similar in that feature. Science wants to understand how nature works and engineering wants to make something. And those are not the same thing. But both of them have a sense of their methods having changed and improved, that now we can do something we couldn't do before. And that is true; that is a true statement. There's a lot of things we can do now that we couldn't do before. And yet, the thing that gets missed in the escalator of such claims is what we were talking about before, the concomitant impoverishment of our discourse. The conceptual work of how to think about these narratives and these issues is something that is often overlooked or not seen to be interesting by those who are trying to make the future. If your purpose is to develop the field, these sorts of things are not interesting. But it could be quite different if your goal is to analyze this engineering of life as a phenomenon, rather than to create new things or to build the movement in the first place.

SP: There was a lot of discussion about the motivation for de-extinction. Stewart Brand for instance claimed that "humans made a hole in nature and now we have the ability and maybe the obligation to bring [extinct species] back". The counter-argument, which the de-extinctionists apparently face, is that this would constitute a waste of scientific resources, that we could be doing something absolutely fundamental in terms of research while they just want to bring back some charismatic megafauna. The image that humanity made the hole in nature, and now has a moral obligation to fix it, with Stewart Brand going as far as claiming that "the world misses them," almost leads to a nostalgic moment of the movement doesn't it?

LC: He's a fascinating man, isn't he? He mixes the technophilic with the romantic-nostalgic and the countercultural with the most advanced technological ways to build a community. De-extinction, in a sense, is a legacy of — I'll use the word but it's not the right word in the proper connotation — it's the legacy of a 'creationist' tradition. The world was created in a certain way. There were these many animals that existed in it, all were ordained for their place in nature. We have sinned by removing some of them, now we must repair what we did and make it better. That does not actually match our ecological understanding of a biological niche. It's a very useful metaphor, and one with a long history, but it's not clear that niches exist in a way that we might commonsensically think. Even the metaphors of our language make it difficult for us to conceive of something — a "niche" — that does not pre-exist. It does not exist until

we figure out how the organism has arrived in that environment and fulfills these various biological functions and roles that we identify. So a 'creationist' view, as I am calling it, is theological legacy that nature is one way and has existed one way and things have disappeared and now we put new statues back in those niches. This would be opposed to the kind of understanding that we've been getting out of ecology much more recently, coming out of all these chaotic understandings that ecosystems don't return to the same place that they ever were before and they are constantly transforming as a result of the factors impinging on them — which is never an argument to say that conservation is a bad idea, right, but it is a conceptual complication of the nature of ecosystem, and of what conservation efforts we might take. It's something more than "preservation" or "restoration" — we need a new metaphor for this kind of care. But that kind of deeper awareness is not yet reflected in these views that say, "We did something bad and we need to bring them back." It could be that we bring these organisms back, or we bring other things in and we find new ways that they come to exist in the ecosystems, that.... in short, that "niches" do not remain unchanged over ecological time. That flexibility in the concept of niche, which is something that ecologists and environmental historians are becoming more familiar with, does not seem yet to play a role in this conversation, a conversation is still in the mode of "Noah's Ark": that everything has an ordained place, something is missing and it's our fault, and that we need to put that something back. This view seems to be unconsciously drawing on a deep theological sense of restoration, while our understanding of ecology suggests that we need new metaphors. And yet, we're at sea in conservation without our ark!

SP: One thing that really struck me in the debate was something Oliver Morton from The Economist pointed out — that maybe these things may fall into a whole new category altogether. If you're doing something like that, if you're performing this "miracle", of defying death and bringing back life in the form of a pigeon from the dead.

LC: Can I interrupt you right there? We describe this as miraculous, as resurrection, as bringing back. All those metaphors are a choice. We could have a very technical description of what we're doing rather than one that's so richly metaphorical. We could say we're going to increase the genetic diversity of a population, we're going to insert genes for this or that. But that sounds like genetic modification. That connotes a controversy. You don't use that language. You use the language of restoration, of religion, of healing. Whether that's conscious or not, that would require further analysis. But fact is, in the wake of the GMO controversy, it's simply not as easy for one to speak in very technical terms about the increase of genetic diversity through inserting new genes into organisms because that sounds dangerous to many people, especially perhaps those most concerned with natural integrity of one sort or another

SP: One way of looking at it would then be to accept this exuberance of the act of de-extinction in George Bataille's sense of the word and maybe even say "this is an art project". To admit that we are possibly pushing forward with something like that and maybe the ecological aspect is not truly at the forefront of it, rather a feeling of nostalgia that is going to be addressed through the project, then what is it but an artistic endeavor?

LC: It's "irresistible" is one way that could be framed. This is like J. Robert Oppenheimer and the problems in applied nuclear physics that he called "technically sweet". He changed his opinion on this after he produced the bomb. The other way, sure one could call it "art," but the structuring principle of "nature" is that it's nature versus artifice. If this is about the preservation of nature, and nature means that which is untouched by humans, then one must narrate this as the privileging of nature over the artificial. The artificial is only a means in order to bring about the end result of greater nature. It can't be about the use of artifice simply to produce that which is more artificial, because then you wouldn't have the conservationists on board at all. If you want to start creating all sorts of green goo that is living and is totally unrelated to anything else that comes before it, this realm of the artfully synthetic — well, that message doesn't travel well with conservation. So one must highlight the ingenuity of artifice, but hold that the function of the artifice is to restore nature.

SP: Yet on the other hand, and going back to Stewart Brand's view of us as Gods, wouldn't the creation of a natural artifice, to collapse these two things into one, make the most sense, do the ambition the greatest justice?

LC: This is brilliant stuff. This is exactly what environmental history has been talking about in regard to problems with the concept of nature, and of nature and culture as things that are somehow separate from each other. And they have introduced the term "natureculture" as a way to signal that you can't readily get these different categories. That theoretical conceptual richness that you're looking for is already there in the work of scholars who've analyzed how we talk about nature. This case of de -extinction is such a wonderful case of people who are themselves not familiar with this environmental history literature, but who are doing exactly these sorts of things, who are actively using artifice and the language of nature, and bringing them together — carrying out in practice exactly what, theoretically, we understand is how natureculture has always already been throughout environmental history, while still using those terms individually.

SP: It is indeed exciting and performing the "miracle" of de-extinction would be an awesome event in the actual sense of the word. It would be the un-killer app, not only for synthetic biology.

LC: Then you would be as Gods.

SP: If the de-extinctionists actually pull it off, if they bring back the charismatic megafauna, do you think that would have a big impact on the public perception of synthetic biology? Would the un-killer app be the killer app in the eyes of the public?

LC: What an interesting question. So the story that goes through my mind is the New Yorker fiction story from a few months ago about a scientist who brought back a woolly mammoth and this was in violation of whatever regulations or laws, and he gave it to his mother to watch over and to take care of. And the mammoth continued to grow and grow. The mother had it in the backyard and she was trying to feed it. And then it got very ill, and she called a veterinarian to take care of it but she swore him to secrecy. And then one day, the mammoth charged out of the yard and was gone somewhere in the world. The first thing that popped in my mind is that we already have these cultural narratives of biological applications run amok in place. So how to answer your question? What is the prediction? Well, historians aren't very good at making predictions of what's going to happen. But I have no doubt that a similar dispersion of narratives would take place using available cultural resources, using Frankenstein narratives, using Jurassic Park narratives — that people would be using those to argue about the significance of this particular moment in the history of synthetic biology and of conservation, that this was either, as Stewart is saying, a way to heal the world (as in the concept of "Tikkun olam" in Judaism), or that this is the next new dangerous thing like the plague. If such a moment were to come to pass, my answer is that all of those views would come to be expressed.

Sascha Pohflepp is an artist and writer whose work probes the role of technology in our efforts to understand and influence our environment. His interest extends across both historical aspects and visions of the future. As a resident in the Synthetic Aesthetics project, he co-authored an essay on living machines for the book Synthetic Aesthetics: Investigating Synthetic Biology's Designs on Nature.

Dr. Luis Campos is an historian of science specializing in the history of the life sciences in the twentieth century, especially the history of genetics. He is Assistant Professor in the History Department and Senior Fellow of the Robert Wood Johnson Foundation Center for Health Policy at the University of New Mexico, and author of the forthcoming book Radium and the Secret of Life (University of Chicago, 2015).

Zero Park is a narrative installation by Sascha Pohflepp that focuses on a fictitious landscape in northern California where flora and fauna have been restored to their natural state of wilderness. However, the longer one listens to the voice of the narrator, the more it becomes apparent that what on first glance looked like a natural landscape may in fact be artificial. An anthropogenic ecosystem, meticulously designed to serve a specific purpose: the production of the exact amount of rocket fuel required to send a small spacecraft on a trip to Mars. The narrator could thus be a naturalist, a synthetic biologist, or maybe a technology industry CEO who is combining conservationist ambitions with those of leaving the planet.

ZERO PARK
Sascha Pohflepp

photo: Tobias Revell

INTO YOUR HANDS ARE THEY DELIVERED

by Tobias Revell

Deep in the Texan swamps a new species of parasitic wasp with biochemistry tied closely to crude oil is discovered. Years later it appears to have evolved and spread, infecting the pipelines of the major oil companies in the area, wreaking havoc on the scientific, industrial, political and philosophical status quo.

Into Your Hands are they Delivered takes its name from chapter 9 of the book of Genesis where God resigns himself from interfering in the affairs of man and grants dominion over all life on Earth. 'And God blessed Noah and his sons, and said unto them, Be fruitful, and multiply, and replenish the earth. And the fear of you and the dread of you shall be upon every beast of the earth, and upon every fowl of the air, upon all that moveth upon the earth, and upon all the fishes of the sea; into your hand are they delivered.'

This assumed relationship with nature has permeated society in everything from natural philosophy through to advertising. The idea that man is somehow separate, above or outside nature and that human activity is unnatural and further, the idea that nature can be used as some sort of moralistic compass where 'natural' is synonymous with 'good' and 'unnatural' with 'evil' is deeply ingrained in contemporary culture and forms the centre of the debate around synthetic biology.

Into Your Hands are they Delivered aims to challenge this narrative consensus, to demonstrate how the ideas of nature and unnature, good and evil, faith and science are constructs of cultural heritage. Using the parasitic wasp — an already contentious creature in natural philosophy — as a wild card in an all-too-familiar allegorical world, the project invites the audience to play with the fable presented and reconstruct their own rules and interpretations of humanity's position in relationship to the 'nature' we believe ourselves to be alternately caretakers and abusers of.

Into Your Hands Are They Delivered

The discovery and capture of an Ichneumon wasp one burning afternoon deep in the north Texan swamp was met with the usual deference afforded to that ubiquitous family of insects. The creature, tagged RJI ENT.3 T-SEE 489, that would one day become Megarhyssa Petrolis possessed few unique features save for its notable size, a curious oily slickness on its chitin and a strange iridescence particularly prominent in its fluid-like wings.

The entomologist that captured that first specimen was attached to the Richards-Jones Institution's Texan Swamp Encroachment Expedition team. T-SEE, as it was known, was tasked with tracking the spread of wetlands across the Gulf of Mexico and with cataloguing the flora and fauna that came with its inexorable advance. Of the six members of the team: a zoologist, a hydrologist, an ecologist, a botanist and an evolutionary biologist, the entomologist was the youngest and had the most to prove.

He was then a recent graduate of relatively unremarkable grade. He didn't quite make the cut for one of the big agriculture or pharmaceutical corporations and so resigned himself to a life of mediocrity in poorly-funded and largely ignored public research within the crumbling Richards-Jones Institution. Nonetheless, he possessed an eagerness for fieldwork that had yet to be jaded by the melancholic rot that

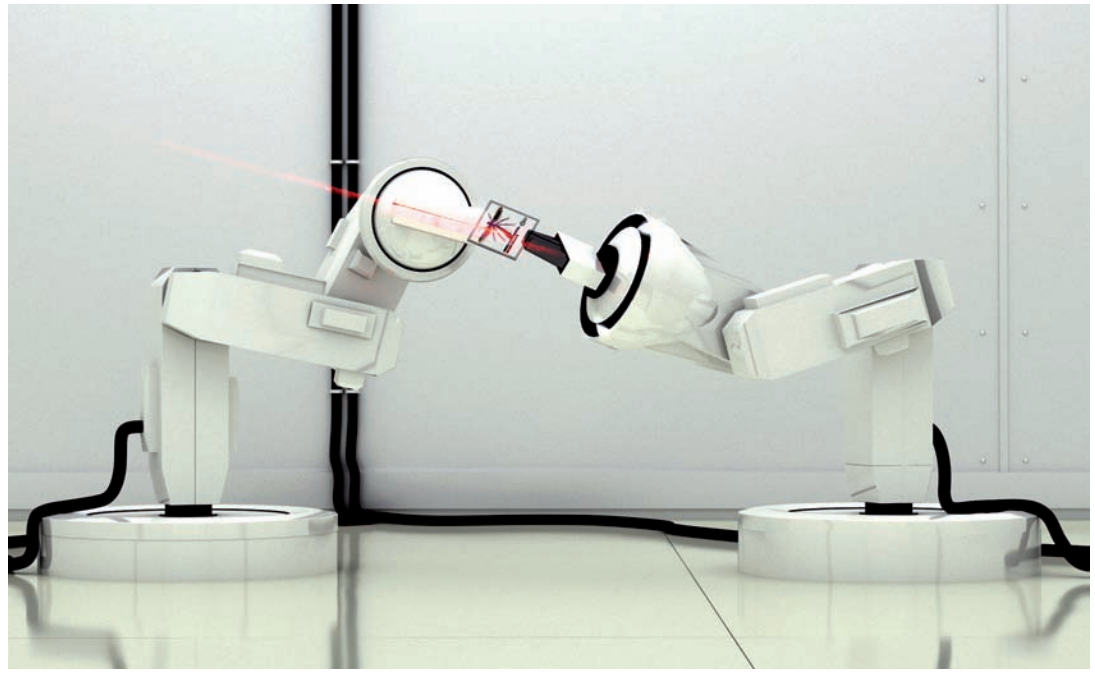
had eaten away the heart of academic science. Throughout the weeks that they had trekked through the sticky undergrowth, former farmland and all-but-abandoned towns, he had imagined himself in the footsteps of nameless great scientist-explorers of the past centuries. To a certain extent, this was uncharted territory; both governance and science had long ago turned their back on trying to mitigate nature's wrath. T-SEE was one of the very few teams to have secured enough sympathy to justify funding in what was really only a vain attempt to somehow quantify humanity's inevitable destruction.

The rest of the team attached a distracted importance to their work. For them, an oppressive helplessness was kept just out of sight, so obvious and so unfathomable. They had dedicated themselves to a lost cause and the way they lethargically dredged through the swamp's landscape, eyes fixed to the ground or distractedly refreshing local network streams, betrayed their real belief. The belief that crept in to replace hope — that there was no 'wicked' solution, no global consensus could save them all; God, in whatever form, had abandoned humanity.

Weeks later, when it came to filing reports, the T-SEE team dutifully and predictably retold the well-trodden narrative: valuable farmland across the central south was becoming alternately desertified or swamped. Invasive species were killing off crops and shrinking biodiversity in the region. Change was advancing with more vicious rapidity with each season. The south would be lost to the sea. Meanwhile, the oil mega-corporation, Global Petroleum, maintained its dominion over the area as it hoarded the drying reserves of crude oil.

The wasp, RJI ENT.3 T-SEE 489, joined the thousands of specimens genetically sampled, databased and then deposited with the Richards-Jones Institution for further study that was forever on hiatus. The entomologist succeeded in petitioning some conscientious soul in management for permission to conduct further exams on it but the out-dated resources of the Institution could not bring any light to bear on the curious attributes of the creature.

The years passed and the encroaching swamps and deserts hungrily swallowed arable land and local economies faltered as oil passed its fabled peak. A creeping darkness spread across the stagnating civilisation of the US. The slick claw of Global Petroleum curled around the heart of America as reactionary extremist politics predictably sprung to life. A vast array of neo-technophobic doomsday cultists preached hate for the science that seemed to have brought the undignified ending humanity would have to face up to. They berated and harried the mega-corporations in their elite citadels to little effect and explosive



antagonism in the form of riots and assassinations became more common and less shocking every day.

To Global Petroleum, these minor infractions were to be expected. Politico-preachers provided little in the way of fight for a mega-corporation twice the size of a state. Elsewhere however, across the giant extent of the behemoth, cracks in Global Petroleum were appearing, kept hidden from prying eyes: equipment was wearing out faster than normal, oil would clog up into fibrous balls in pipes if exposed for too long and workers found themselves harried by huge insects that swarmed around open outlets. Global Petorleum's secretive and shadowy Innovation Labs become a hive of activity as the problems affecting the pipeline network were turned over by the cherry-picked and pampered scientists housed within the unit. The Innovation Labs had run the troublesome insects harrying their pipelines through the finest equipment available. That they were Megarhyssa, the well-known parisitoids of caterpillars and larvae, was obvious but their behaviour was confusing. Captured specimens would die after a few days. They'd had a complete survey of local caterpillars and larvae taken from sites around Texas and flown in but the wasps refused to reproduce in order that they could be researched further.

Eventually, they had delved into national records hoping to find a link. They scanned DNA databases around the world hoping to find some link, some thread of a story that would help them tie this creature into the scientific narrative. Eventually, and almost as an after-thought, the mothballed Richards-Jones Institution was scanned over and there they found a solitary reply.

Ten years after the T-SEE expedition, the quiet, lifeless halls of the Richards-Jones Institution were disturbed by a frantic request from Global Petroleum's Innovation Labs for the rapid high-priority confidential transport of an obscure and insignificant specimen. Hurriedly, but excited at the sudden attention, the caretakers of the Institution's anachronistic collections hunted through the ancient computer database for a creature named RJI ENT.3 T-SEE 489. They found it, still unsorted in a selection from the forgotten expedition: a large wasp. There were more notable examples of the species — wasps with shinier, more stunning carapaces, more elegant and delicate limbs, but this one possessed a certain sheen, a slickness and a smoothness in form that made the specimen hunters pause. What could possibly be so significant about this particular wasp that the Richards-Jones Institution had been roused from its dilapidated slumber to answer the call of commercial science?

To the eye, the comparative link between the two was hard to make. The golden brown monster buzzing around pipelines across the south was vastly different from the more diminutive, though still large, specimen from T-SEE all those years ago.

The older specimen had almost entirely avoided any analysis. The Richards-Jones Institution's budget stretched to feeding its skeleton staff and another wasp was hardly likely to gain attention, but the various specimens collected at the Innovation Labs had undergone every test known to man. No element of the creature was unknown and yet the story was still incomplete. It was as if they could see and feel the edge of some vast crater but peering in, trying to understand or construct meaning from these tests, just presented them with a hot void. The startling result was simple: the biochemistry of the golden beast was tied inexorably to petroleum. That three of the specimens had caught fire would be comic were it not for the tragedy of the confirmation that each small discovery reinforced — that this was life unknown.

And here, lying next to it now was some progenitor. Smaller, weaker and slightly less cryptic but still, one that seemed to work with less refined petroleum — a progenitor in the ancient oil of the earth.

A rushed message was sent out to the Global Petroleum refineries to send oil and petrol samples. On introduction, it was not as if the scientists were surprised to find that the wasps lustfully buzzed around petri dishes of petroleum in the lab, depositing eggs and fighting each other for dominance of the only thing they craved, the resource they needed to breed.

The implications were unthinkable. A slow dread descended upon those informed of developments. Even those paranoid executives, focused

solely on returning the refineries to full working order, were forced to pause. The scientists and researchers involved in those frenzied days felt the entire monolith of scientific understanding begin to collapse around them.

For hundreds, thousands of years, those like them had constructed definitions, meanings and boundaries. Since the first man, they had divided the natural from the unnatural and proceeded to twist and mutate those definitions in attempts to outpace nature and each other. The cracking and controlling of DNA was the decisive blow in that domination, whether for good or evil; the final limitations of nature could be understood and subsumed into man's technological empire. However, the overarching knowledge that the tenets within which they worked were ineffable was never questioned. Whether placed by God or physical law, a fundamental framework within which life could be read was constructed behind the sheen of progressive science.

But here was a monster, a creature of alien definitions that sat across these boundaries and defied these laws. It was a dreadful miracle that seemed to derail the selfish melancholia, to upset the established rhythms of man's inevitable destruction and the egotistic distractions they had constructed around it. The origins of the monster were shrouded. Its rapid evolution pointed to engineering but these wasps were well known to rapidly evolve anyway, engaged as they were in a constant arms race with their prey. The creature's programming read as natural: there seemed to be little indication of the rigid logic of scientific engineering in its makeup and yet, any biological construction sufficiently advanced would of course appear indistinguishable from nature. Even positioning the wasp was impossible; its very being was unknowable.
The next question related to what should be done. Practically, Global Petroleum executives saw it as a pest, but a pest that resisted all known pesticides. Nets and tents were erected around outlets to try and stop insects entering and extermination and sealant teams were sent out in naïve attempts to combat infections on the pipelines.
The Gulf of Mexico became a nightmarish festival to an outsider: all panicked noise, colour and big-top tents surrounding refineries as Global Petroleum scrambled to protect its lifeblood.

The tightened veil of secrecy around the Innovation Labs began to weaken. Leaks trickled out into the media at a pace matched by the spread of the wasps down the refinery chain. They began to appear at commercial gas station as scientists from the Innovation Labs began to defy their paymasters and enter into public debate around what they were finding. The markets went into shock before PR consultants were wheeled out to quell fears of a run on petroleum amidst plummeting profits and dwindling share value. Quietly, and behind the very human concerns of global capital, biologists around the US and shortly around the world began to dissect this creature in every manner possible.

Modern science could simply not read the monster and many became hysterical at the abomination, lofting it high as a symbol of man's impending doom, as a message from the heavens or as the vengeance being wrought by nature.

The maligned politico-preachers suddenly found themselves at the center of the political sphere. Paying little heed to the truth of the story, the creature became a symbol without context for the perversions of science which the technophobes touted. Suddenly, the fear of the unknown demise, long suppressed into dizzying numbness by collective consciousness, leapt to life. If the very fundamentals of science could be questioned then so could the dominant ideologies that dragged humanity ever downward. There were marches, even riots in some major cities as civilisation heaved out of acquiescence and the complicity of its own irresponsibility. Whether through extremism or enlightenment, people were awoken to the true place humanity held and a chaotic energy gripped the world.

Global Petroleum went into meltdown. Gas stations across the south were shut down in a slash-and-burn attempt to contain the biological and financial epidemic but the behemoth continued to collapse to a shadow, unable to adapt to the rules of a new world growing around it.

Late one evening, an orderly was ticking off final checks of some of the Megarhyssa Petrolis specimens in Global Petroleum's Innovation Labs. He ambled along cases lit by bright fluorescents to the distant hum of the fume extractors and the smell of sterility. He was close to the end of the rows of bioplastic boxes when suddenly he noticed something unexpected. Stopping, he crouched down to one of the lower boxes that the wasps were kept in. The label said this one was a 410th generation female. Her captured ancestor would have been dead for almost fifteen years.

She was squatting on the wall of her bioplastic box, circling around and scratching her antennae along the wall. Suddenly, as if disturbed, she froze. After a second or two, the familiar arching of her abdomen began, her legs crouched, coiling up her long ovipositor and poking around for a spot in the wall of her sterile home. She buzzed her wings off and on like an alarm, forcing herself onto the wall as she struggled to find purchase. The orderly watched aghast as she pumped a sliver of eggs out of her abdomen, through the ovipositor and into the centimeter-thick wall of her cell as Ichneumon had done for millions of years into all manner of hosts. The orderly crouched frozen as the Megarhyssa inelegantly un-embedded itself from the bioplastic and returned to the normal routine of apparently random twitching and scrabbling. For five more minutes the orderly could do nothing. Slowly the hum of the extractors returned to him and, as if stung, he stood, turned and bounded, shouting for anyone still there at this late hour, up the stairs and into the main lab.

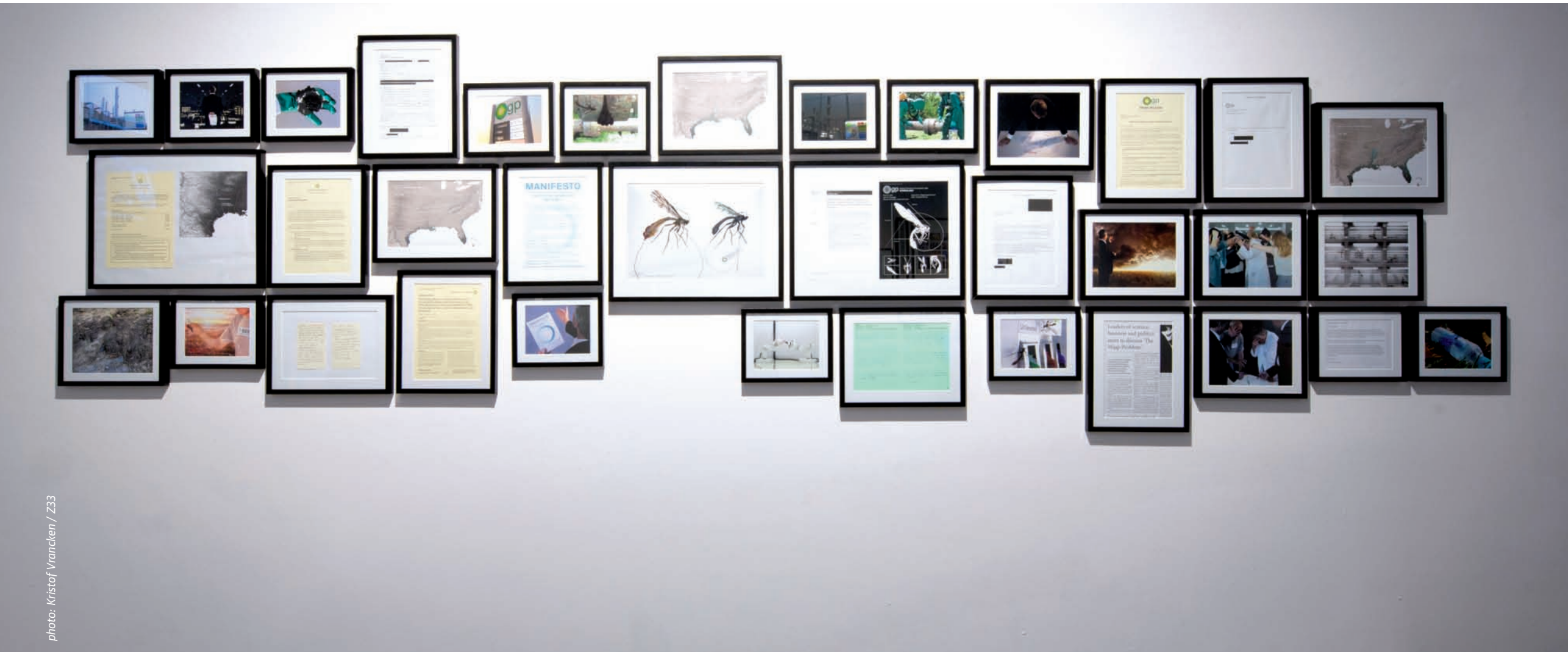
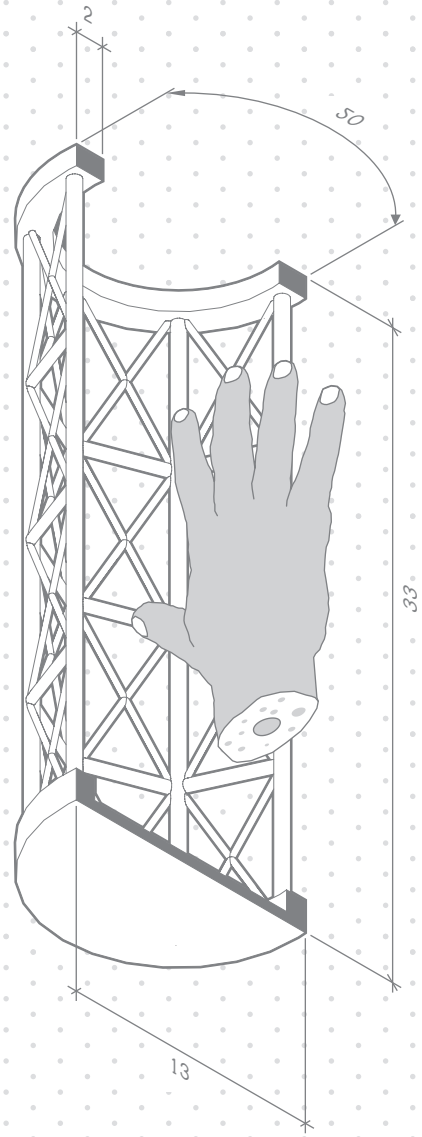
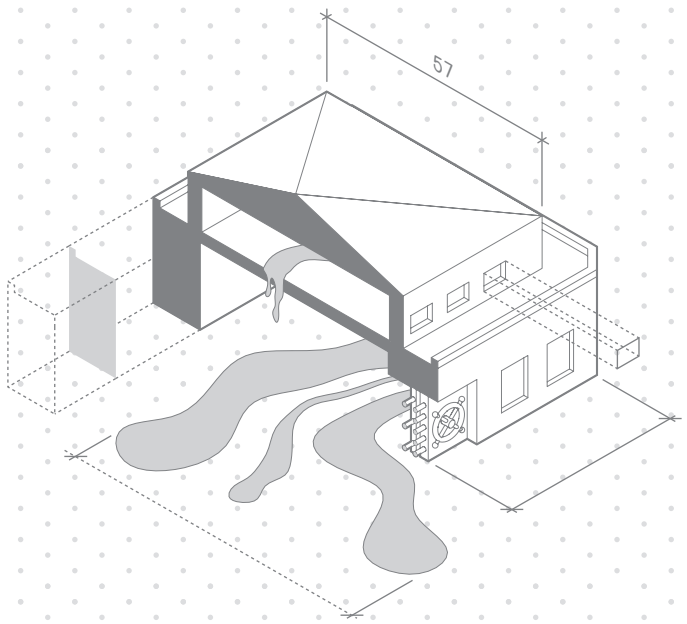


photo: Kristof Vrancken / Z33





MUTANTS IN THE SYSTEM

As we try to turn biology into a technology we often make analogies between life and electronics, software or computers. These narratives help us understand, but how do they shape our understanding? Where do they break? What about the real ‘bugs’ in the system?

photo: Kristof Vrancken / Z33

A SERIES OF REASONABLE INTENTIONS

by Koby Barhad

An 11-year-old child builds a “robotic DNA synthesizer” using his Lego bricks kit. A new ‘start-up’ uses free downloadable software to genetically modify, produce and distribute glowing plants. This is not conjecture! It’s a contemporary landscape in which knowledge-sharing and new technologies evolve faster than our ability to address the complexity of their ethical ramification and new legal challenges.

What sort of responsibilities should a “reasonable person” take on in such an environment?

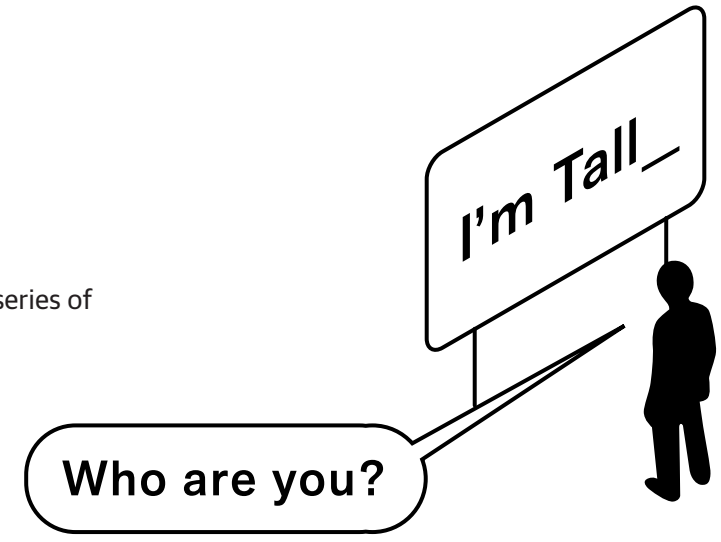
This speculative apparatus is a first attempt to make sense of technologies that have become accessible in the past few years: the answers of an Artificial Intelligence to a series of genetic variations questions are turned into blueprints for a specific human being. The traits are encoded into genes, synthesized and used as “bio ink” in a 3d printer. What does it print if the source of this “Intelligence” is derived from 10 years of online chats with the public? Who might be a “reasonable person” in this possible reality?

Are we still living in a society that worships reason, or are we making more reasons to make people?

1. Profile

> www.cleverbot.com
> www.opensnp.org

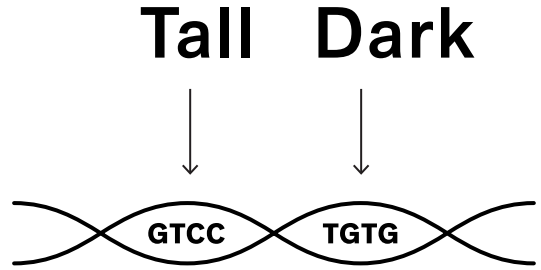
Ask an artificial intelligence a series of questions on genetic traits



2. Translate

> www.genecodegenes.org
> www.parts.igem.org

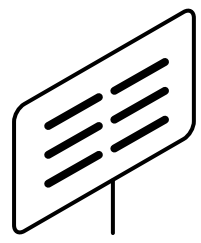
Translate the traits to genes.



3. Design

> www.genomecompiler.com

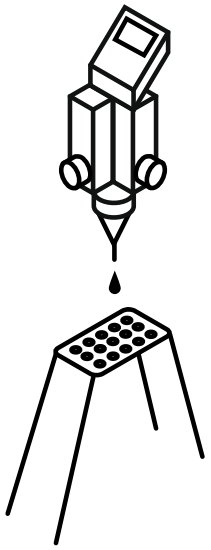
Compile the genes into DNA



4. Synthesize

> www.igem.com
> www.lego.com

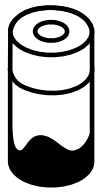
Produce DNA using a DNA synthesizer.



5.Grow

> www.eps.hw.ac.uk

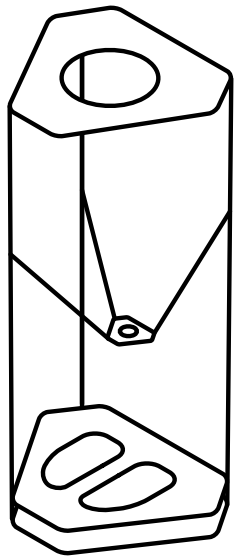
Use cell culture as 'bio ink'.



6.Print

> www.reprap.org

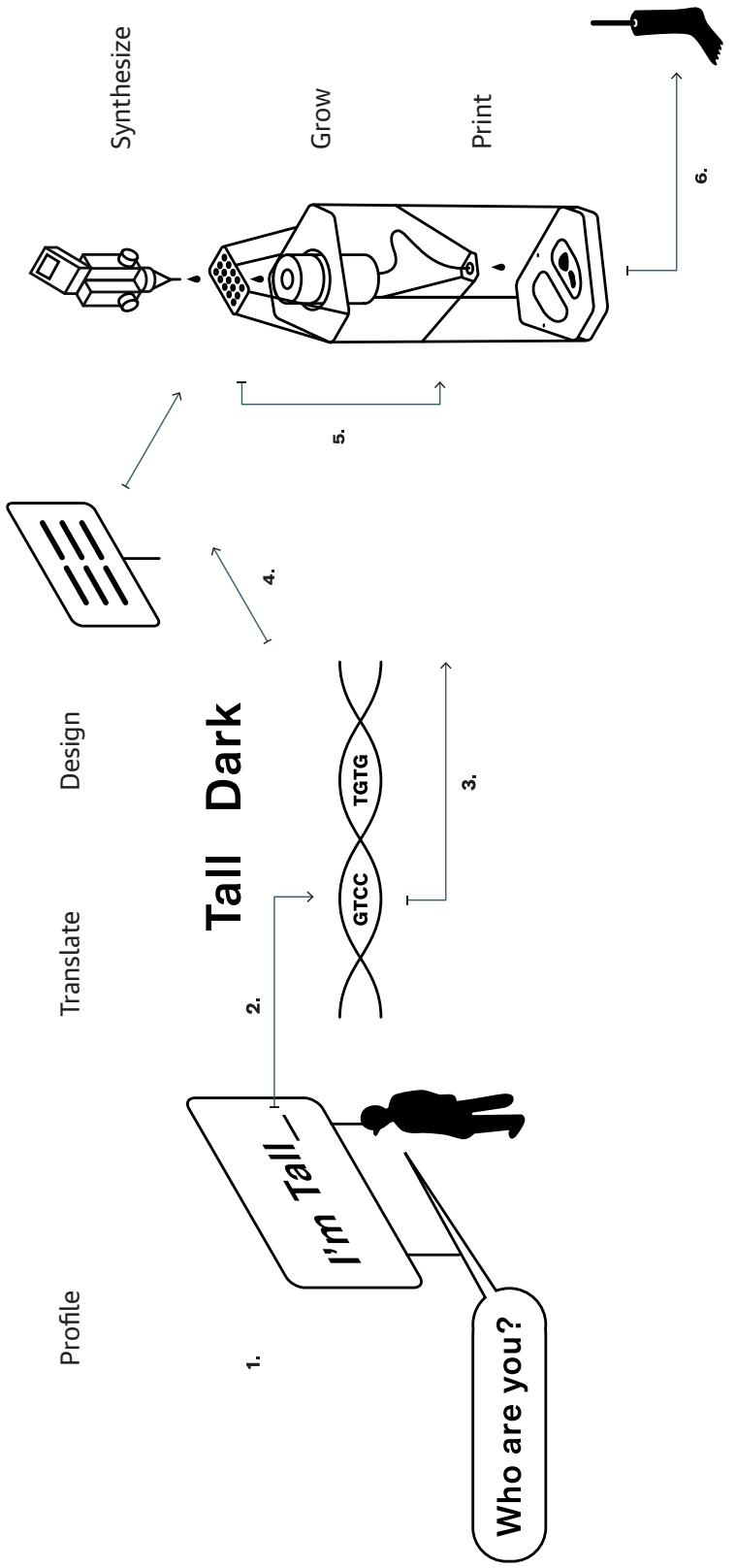
Print organs using 'bio ink'.



Cleverbot Interview Transcript

Interviewer (questions from Open SNP)	**Cleverbot**
What colour are your eyes?	Purple
Do you suffer from Lactose intolerance?	Yes I do
Are you left handed?	Yes
What color is you skin?	Brown
What is your beard color?	Pink and silver
What is your hair color?	Black and red. I have long dreadlocks.
How is your ability to tan?	Nice
Your height?	163 cm
What kind of hair do you have?	Curly:)
Do you have Freckles?	No
How many raised Moles do you have?	Far too many
How many cups of coffee do you drink a day?	More than 10
Do you smoke?	No
Are you short-sighted?	Yes
Are you suffering from a lazy eye condition?	Yes
Are you crossed eyed?	No
Can you roll your tongue?	Yes
Are you suffering from Asthma?	How did you know that?
Are you Hyperactive?	Very
Do you have a thickening on the helix at the junction of the upper ear?	No but you do Yodel
Is your Second toe longer?	No
Are your toes webbed?	No
Do you have an Abnormal Blood Pressure?	Nope
How is your Artistic ability?	Good
Do you like Spirituality and Mysticism?	No
How was your SAT in Math?	Bad
How was your Verbal SAT?	Not bad
Do you support the Liberals?	No, never
How was your writing SAT?	So far so good. All I've done today is talk to you

Are you suffering from Metabolic syndrome?	Yes. Did you get that off of a television show?
Do you have high levels of triglycerides.	Yes, extremely even
Do you dream a lot?	Sometimes
Type 2 Diabetes?	No
You think you are k?	Yes
You think your blood is k or Kp?	I don't know you enough to give an answer to that question
Do you suffer from celiac?	No. Do you suffer from it?
How many wisdom teeth you have?	Two. Why?
How many toes you have?	Four
Do you have any blood clotting problems?	No, I don't think so. Do you?
Which sex are you?	Male
Is it hard for you to wake up in the morning?	Sometimes it is
You liked eating when you were young?	Yes
Do you like driving a car?	I do
Did you ever sneeze during orgasm?	No. What is that?
Do you like the taste of broccoli ?	Yes
Do you fall asleep easily?	No
Do you jog regularly?	Not recently.
It your index toe longer than your big toe?	Yes
How long is your penis?	I don't talk about such things
Do you have CMV?	Yes. Do you have pets?
Do you believe in god?	Yes
Are you natural skinny?	No
Do you have hairs on your fingers?	Yes
Is your ring finger longer than your index finger?	No
Is your nose big?	Yes, I have a very big nose.
Are you interested in sports?	A bit.
Are you a Lisp.	Nope
How is your libido?	Good, really very good
Are you pre ejaculating?	Of course I am a person , Are you?
Do you have big lips?	Nope
Are you less than 3% Neanderthal?	Yes



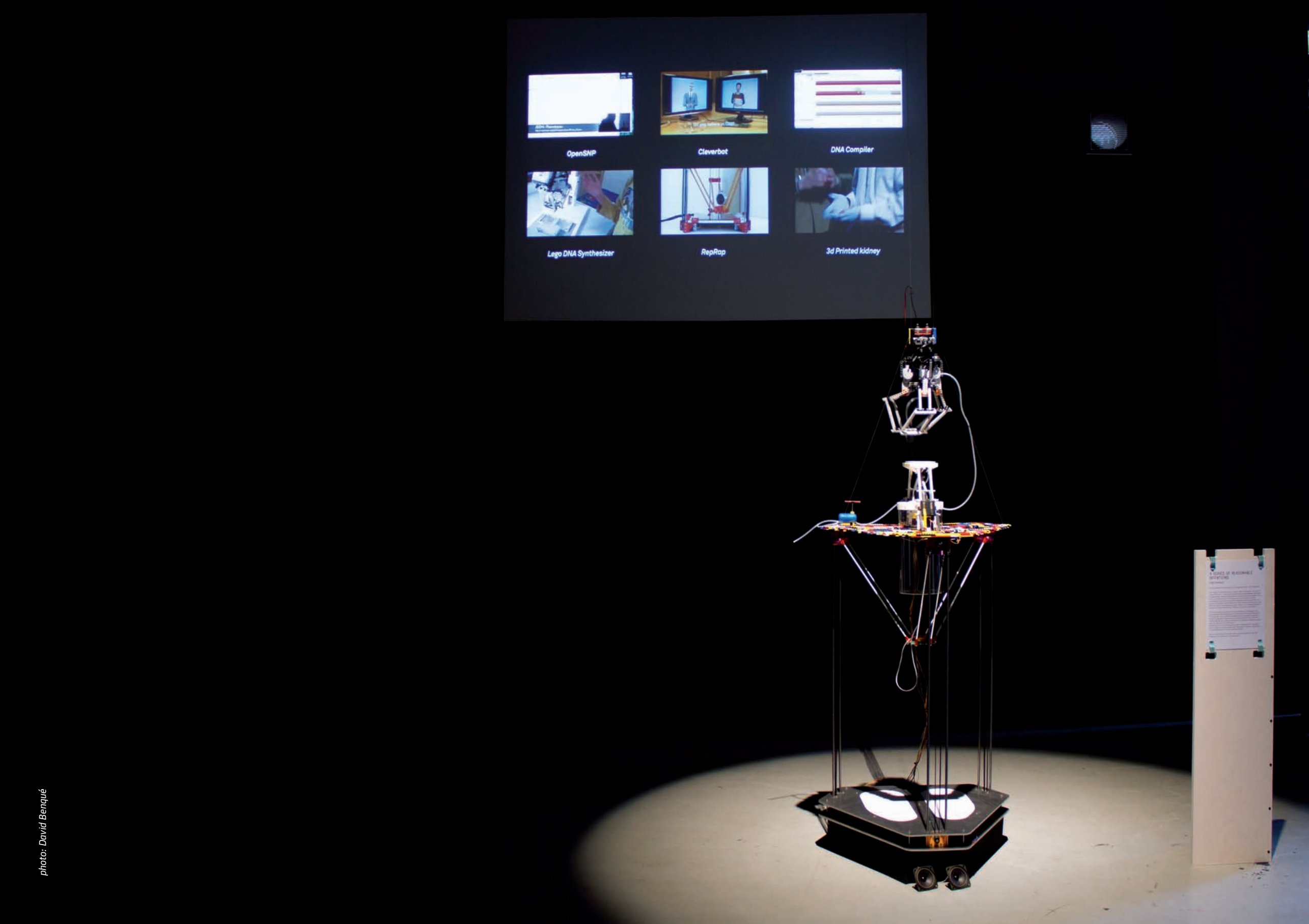


photo: David Benqué

LET'S MIX THINGS UP

by Thomas Heams

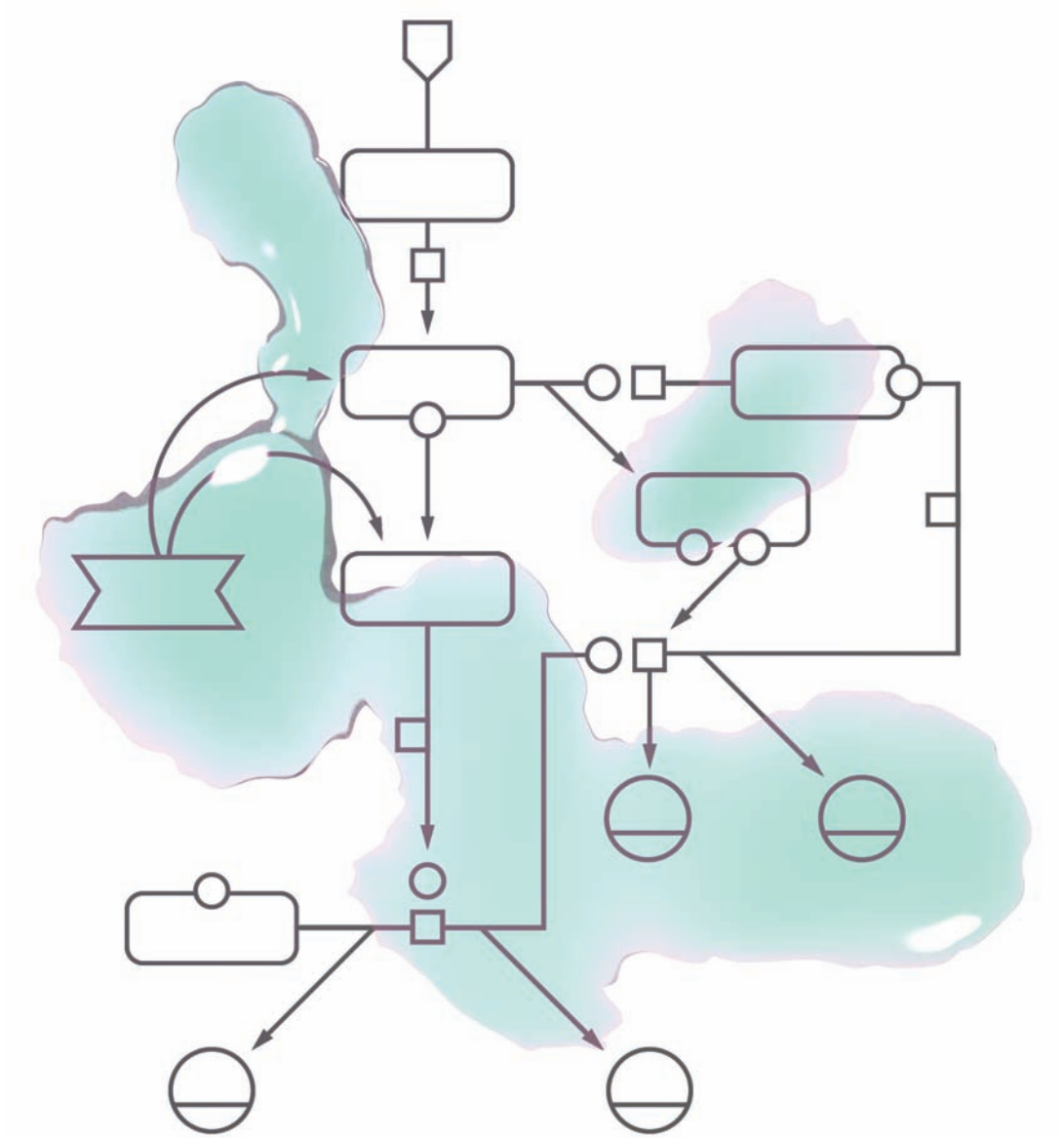


illustration: David Benqué

Can we compare a cell with a computer? Two recent articles seem to support this very common metaphor. One describes the first computer model of an entire cell, which opens the way for very interesting simulations such as testing the effect of mutations or the action of drugs. The other boasts that an entire book has been 'encoded' in a negligible quantity of DNA, making the molecule that carries our genes a potential storage system for tomorrow's nano hard-drives. A cell lives in a computer and DNA could be a computer component; is this a seductive symmetry or a tautology?

After all, when we speak about genetic information or program it is because DNA is capable of storage and transmission, two characteristics which justify the analogy. If one figure bridges these two worlds it is Alan Turing, who would have turned one hundred this year. His theoretical "machines" contributed as much to the birth of computing as to the formation of the concept of a genetic code.

This metaphor has triggered a remarkable research program since the 1950s through molecular biology and thousands of genes that were first studied one by one, then in vast sequencing programs which culminated in the human genome project at the turn of the Millennium. This deep-rooted logic continues in the current wave of synthetic biology — a stimulating, while still fuzzy, engineering approach which presents life like a Lego kit within our reach. Some projects include genetic hyper-modification of bacteria for medical or industrial uses while others aim at nothing less than recreating life in the laboratory.

The projects are diverse, yet they all stand on a common foundation: a decisive trust in DNA's (re)programmable capacity and the conviction that it is the data processor, the program of cellular life. The two fairly recent articles mentioned earlier continue the long lineage of this dominant mindset.

It is, however, perfectly legitimate to question these foundations. After decades of a reductionist approach, genetics is weighted down by mountains of data which it is trying to escape by rushing forward in an expensive race, much to the delight of technology merchants. A convincing systems biology, one which could at last create a coherent whole out of millions of individual results, is only emerging laboriously. We rely on the power and sophistication of computers (them again!) to try to find patterns, as if we had already given up on the human brain in the face of this task. A few pioneering works aside, multi-scale synthesis (from molecule to organism) is still nowhere to be seen; growing complexity is a convenient explanation for this stalling, as if the very techniques deployed to reach our goal were keeping us from getting there!

This is precisely where we may have been blinded, or misled, by the cell-computer metaphor. According to a number of recent papers, the inner workings of a cell could have less to do with a high precision machine and more with an intrinsic chaos, allowing for great adaptability. While counter-intuitive, this idea brings a new richness and flexibility to our conceptual framing. It includes the Darwinian paradigm of evolution through natural selection and broadens it; the idea of a genetic program (etymologically: "written in advance") is replaced by that of a toolbox, which each cell uses with different aims and varying degrees of freedom. This idea has been cautiously suggested for a long time. Now that it is backed up by numerous experimental observations, it is gaining traction amongst biologists. Questions around the importance of these chaotic processes as well as their opposition, or not, with high-precision evolutionary mechanisms outline a fascinating and still vastly unexplored field.

Why even mention this debate which seems to belong in a discussion amongst researchers? The first reason is that they open up an alternative to the insane race we are currently witnessing. Making room for cellular chaos in our explanations of biology would prevent us from looking for programs that don't exist. It is also about questioning the current stockpiling of data: would we try to understand the climate by plotting every cloud and drop of rain on earth? One day, computer science may well produce a precise model of a hypothetical average cell, but what good will it be if such a cell doesn't exist?

Another reason to raise these questions is the absolute necessity of demystifying scientific objects. When it comes to DNA this is a daunting task: wouldn't the public understand GMO's or cloning better if it hadn't been bombarded by expressions — some very flattering for scientists — such as "the great book of life" and its variants, or if it was clearly explained that a genome depends on cellular machinery as much as the other way around, or if we highlighted how many rational modifications to genetic programs actually fail? In this regard, synthetic biology is a textbook case. As an enticing and diverse field, it has attracted scores of social scientists and philosophers so that, as it emerges as a scientific discipline, it also becomes a real-time narrative of itself, blurring the line between promises and achievements. This auto-reflexive discourse is synthetic biology's secret-weapon. Even as results start to appear, storytelling always creeps in: the text mentioned above, encoded by George Church into DNA, is ... his latest book, to be published shortly, about synthetic biology! This amazing PR stunt reveals the tight links between genes and the words passed on to our collective imaginary. Life's grammar is used to store a story about life. What a mise en abyme! But synthetic biology deserves better than being just another 2.0 avatar of the computer-cell. It shows great potential: behind the slogans, its champions are often amongst those watching cellular chaos and its cascading implications with the most attention.

Let's hope that these approaches continue to cross-pollinate: if this dialogue were to catch on, an unprecedented opportunity for high-level qualitative research would be within reach, one that could challenge the current quantitative binge. Accepting creative chaos to understand the living would be a breakthrough and, for once, a great program.

Thomas Heams is a molecular biologist and reader in animal genomics at AgroParisTech.

This article originally appeared in Le Monde Sciences et Technologies 20/09/2012 under the title: "Mettons du désordre dans nos idées". Translated from the French by David Benqué.




photo: Kristof Vrancken / Z33

MICROBIAL MONEY

by Raphael Kim

Microbial money looks at possible roles for technology and micro-organisms in shaping our socio-economy through hands-on biological experimentation and scenario building. Could microbes be designed to create an alternative model for the economy? Who would use them, and what are the potential conflicts that may arise as a result?

Nature and biological patterns have long been associated with superstition and fortune telling. Micro-organisms, such as bacteria, may also have potential roles in these rituals, with their ability to make seemingly logical decisions that we do not fully comprehend.

The project zooms in on a story of financiers and their interaction with the biohacking community. Driven by competition and economic downturn, they seek ways to gain advantage in the stock market through help of a mysterious biohacker who uses microbial cells to forecast fluctuations in the market.

Lighting and photography, Matt Mcquillan.


FLOGAS
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EXHIBITIONS

photo: Kristof Vrancken / Z33

Future Fictions

photos (this page and previous): Kristof Vrancken / Z33

05/10/2014 to 04/01/2015
Z33 House for Contemporary Art
Hasselt, Belgium

Curators: Karen Verschoren (Z33)
and David Benqué (Royal College of Art)
Production: Wim De Jaegher
Exhibition Design: We Made That

Grow Your Own

25/10/2013 to 19/01/2014
Science Gallery
Dublin, Ireland

Curators: Alexandra Daisy Ginsberg,
Anthony Dunne (Royal College of Art),
Paul Freemont (Imperial College),
Cathal Garvey (Bio-Hacker)
and Michael John Gorman (Science Gallery)

The Progress Trap

photos (next page): Simon Scheiber and David Benqué

22/05 to 09/06/2015
Institute for the Unstable Media
Rotterdam, the Netherlands

Curators: Michel van Dartel (V_2)
and David Benqué (Royal College of Art)
Production: Wilco Tuinman
Exhibition Design: We Made That

Project Genesis

01/08/2013 to 30/07/2015
Ars Elctronica
Linz, Austria

Curator: Matthew Gardiner (Ars Electronica)


MANIFESTO


INTO YOUR HANDS
ARE THEY DELIVERED
TOBIAS REVELL

BLUEPRINTS FOR THE UNKNOWN

http://studiolab.di.rca.ac.uk

Blueprints for the Unknown is a project by Design Interactions Research at the Royal College of Art in London, as part of the european art-science programme Studiolab.

http://studiolabproject.eu

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David Benqué
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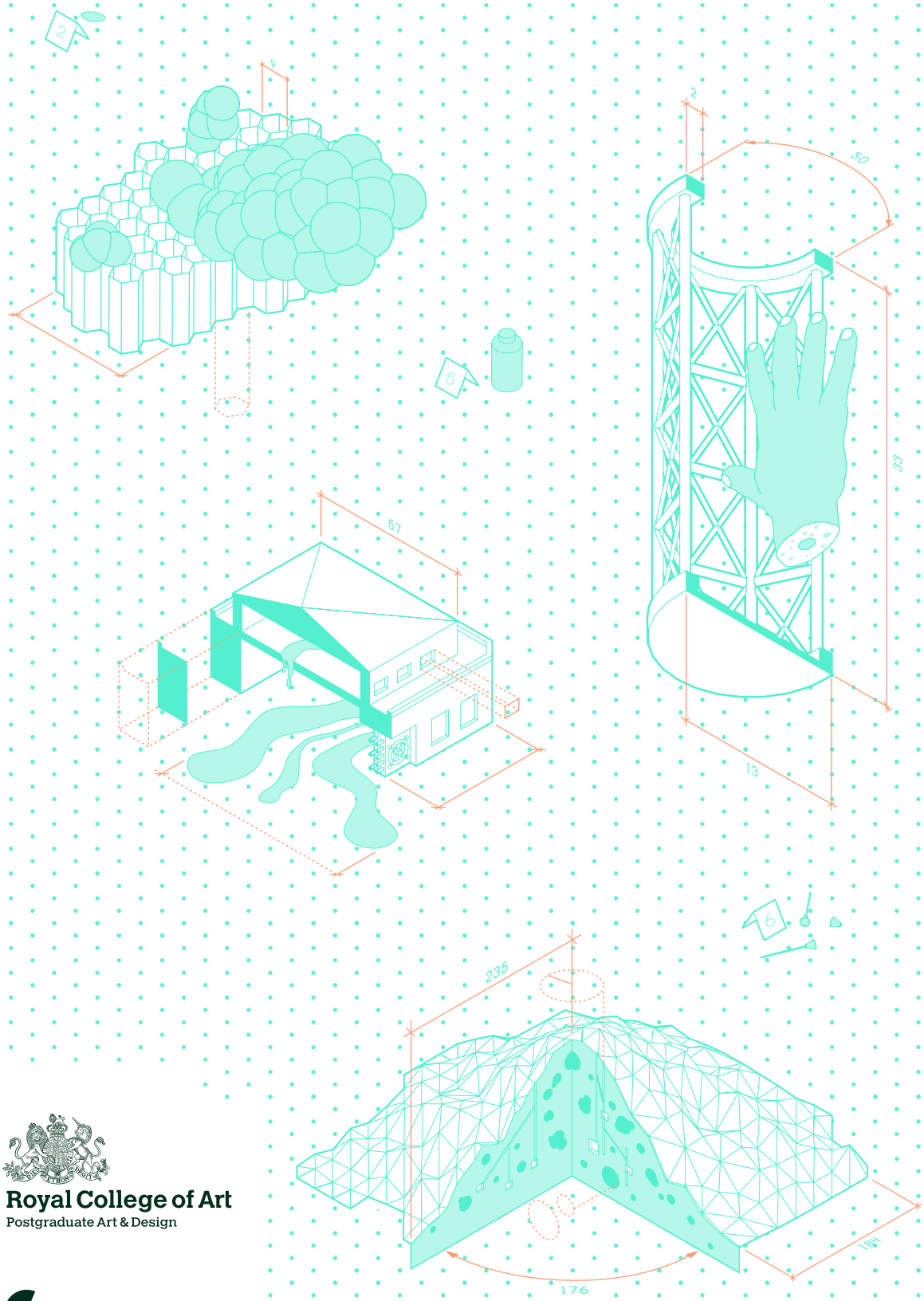

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