

### Future Life Will Be Synthetic:

Technology no longer appears as the result of a conscious human effort to extend man's material powers, but rather as a large-scale biological process in which man's organic functions are increasingly transferred to his environment. In other words, we have here a biological process which, as such, is removed from man's control; for *while man can do what he wishes, he cannot will what he wishes.*

- Werner Heisenberg, *The Physicist's Conception of Nature*, 1958.

Are we witnessing the emergence of synthetic life forms and forms of life? Synthetic biologists, this new breed of biologists who aspire to behave like engineers and/or designers, seem to want us to believe it is, or, that it will *soon* be, the case. From its inception, synthetic biology, indeed, has always been concerned with promises. One of its main figureheads, J. Craig Venter, for instance, has once declared "genome design is going to be a key part of the future."

In 2014-2015, I had the opportunity to join an international team composing the artistic component of a European Community funded consortium called SYNENERGENE and devoted to the study and implementation of synthetic biology. The project was called *Making\_Life*, a joint collaboration of the Finnish Society of Bioart with Biofilia–Base for Biological Arts–at Aalto University in Finland and Bio:Fiction in Vienna, Austria. In my application answering the call for participation in the project, I had argued that I had the necessary abilities to contribute in the project, even if a clearly stated goal of my participation was also to conduct fieldwork there.

Bioart was one indeed of the three sites of my on-going research program entitled "ZoeMedia: Contemporary Forms of Remediation of the Living in Bioarts and DIY Biology". For this research program, I wanted both to study *and* practice the contemporary forms of remediation of the living, that I saw occurring in two main sites outside of the highly institutionalized and commercial areas of the biotechnological university-industrial complex: bioarts and DIY biology. I had been following the bioarts for a good ten years by then, had read extensively and written a bit about them. I had also started to follow the DIY biology scene, the fablabs and (bio)hackerspaces devoted to the citizen science of biology. In Montreal, I was—and still am—a founding member of the Hexagram initiative, an attempt to federate artists, designers and scholars around all forms of contemporary technologized arts (electronic arts, media arts, bioarts).

I insisted that even if my work has been mostly ethnological so far (combining in passing, and multi-sites ethnography), I felt this would not be enough for this project. I wanted to reclaim my past training as a biologist and get involved in an actual project where writing would not be the only outcome. The *Making\_Life* research platform for art and synthetic biology could indeed provide a perfect opportunity to carry out some of the ethnographic fieldwork I intended to do for this research program *and* some extremely valuable hands-on experience at a crucial stage of my

work. To my surprise—and great pleasure—my arguments convinced the organizers, and in spite of a highly selective process, I was invited to join the team.

*Making\_Life* eventually happened as a series of three work periods, which allowed the multidisciplinary group of practitioners to critically engage, in an informed manner, with the socio-cultural, political and ethical ramifications of synthetic biology. A group of twenty-nine Finnish and international participants composed of artists, designers, architects, engineers, scientists and Aalto University students cooperated within the program. The methods consisted of workshops, laboratory sessions and field trips, forums, seminars and lectures. It comprised theoretical as well as hands on approaches.

The first and second one week work periods, in May and November of 2014, took place at Biofilia – Base for Biological Arts – of Aalto University. It covered the introduction to synthetic biology, its sciences and technologies and practical experience in the laboratory. In parallel the group worked on associated questions in art, ecology, ethics and politics. The third work period, in May of 2015, was an intense production session to create artistic responses and prototypes. It eventually led to an exhibition and a symposium articulating artistic responses to synthetic biology. The exhibition took place on May 22, 2015 at *Lasipalatsi Näyttely* gallery in center Helsinki and presented artistic responses and prototypes as the first tangible results of the *Making\_Life* process.

Four different groups composed within the workshop participants thus tested concrete approaches for a critical cultural perception of synthetic biology. I was a member of a group composed of four bioartists: Antti Tenetz, who also presides the Finnish Bioarts Society, Eric Berger, the main organizer of the *Making\_Life* project, Laura Beloff and Cecilia Jonsson. Our project was initially called “The Ironic Biomantic Machine” and was eventually exhibited under the title “Your Synthetic Future (at the Speed of Light)”. The exhibition also included a selection of videos from the Bio·Fiction Science Art Film Festival which took place in November of 2014 in Vienna, Austria. A symposium, held on May 23, 2015 also gave an introduction to synthetic biology, its key technologies, promises, and the hype that surrounds it. A key dialogue followed by presentations from the four groups of artists discussed issues and questions which address synthetic biology in relation to society at large.

The Ironic Biomantic Machine is a prophetic machine devoted to answer any question about the future of synthetic biology raised by a visitor to the exhibition. In the tradition of using pieces or even whole animals, dead or alive, to predict the future, we are using a mix of programmed lifeforms to do the job. This way, we hope that there will not be any anthropocentric bias in the interpretations of the living answer. The whole process is twice ironic: once because of the play on words of the title of the piece (iron-ic, magneto tact-ic), and twice because, of course, the bacteria do not actually answer any question about the future. In fact, all they will do is move according the movements of magnets that actually translate and transduce the questions of the visitor.

From its inception, synthetic biology has been concerned with promises. Some, like Evelyn Fox Keller, even argue that synthetic biology was, from the start, the very promise of biology itself: “to many authors writing in the early part of the twentieth century”, she wrote, “...the question of what life is was to be answered not by induction but by production, not by analysis but by synthesis.”<sup>1</sup> Today, the promises of synthetic biology still abound, but are somewhat addressing a more pragmatic purpose: “for synthetic biologists”, write the editors of a recent and very visible anthology, “biology could be just another material to engineer, its living machines driving twenty-first century progress”. Again, they insist, and evoke “this desire... to design biology rather than to understand it.”<sup>2</sup>

At the same time most biologists, true to their rationalist and mechanist inheritance, strongly oppose any mention of a potential transcendent designer, they cultivate this desire, which ultimately amounts to this wish for mankind to design its “successor”, or more prosaically, for parents to design their babies. In other words: no design in life if a watchmaker, or a great architect or whatever name you please to grant Him, could be the designer, but all design if we can take his place. The problem is not design, but the designer: the Gnostic script has been reworked to accommodate us—and especially synthetic biologists among us—in the part of the demiurge. Although we are not dealing with this issue as bioethicists would, we still feel that thinking about biology in terms of design (rather, say, than in terms of evolution and emergence) could be questioned.

The will to self-design supposes some sense of anticipation: the science of heredity turned upside-down. Genetic engineering is also a kind of prophetic technology: given this instance of a “genetic message,” given a normal functioning of the “genetic program,” one should obtain a certain result (that given body, and maybe even that certain mind). Genetic determinism is today’s credo for brand new religions, new kinds of cargo cults derived from the central dogma: transhumanists, extropians, etc. Synthetic biologists just want to improve on genetic engineering: in their eyes, it is still too much of a craft, their goal is to make it more predictable, systematic, functional, efficient, and “ultimately cheaper” (still in the words of the editors).

When the religious is disqualified, remains the mantic, its prophetic function. For all technology indeed develops a mantic function and requires a kind of act of faith in the mantic workings. In order to use a specific artifact, one must believe that it could, or rather that it will, do the job at hand. Technologies are teleological devices, and the intention to use them is but the flip side of their purpose—when they actually work. Final cause is the bottom line of any technological artifact: to use them is to conjure up their workings.

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<sup>1</sup> Evelyn Fox Keller, *Making Sense of Life*, Harvard University Press, 2002, p. 18.

<sup>2</sup> Alexandra Daisy Ginsberg, Jane Calvert, Pablo Schyfter, Alistair Elfick and Drew Endy, *Synthetic Aesthetics : Investigating Synthetic Biology’s Designs on Nature*, MIT Press, 2014, pp. x-xi.

As sure as progress eventually became the cardinal principle of modernity, the anticipation, nay, the technological *conjunction* of progress, lies even more deeply into the modern psyche. And when we decided that we could actually be that rational, we turned to the machine to make it happen and shouted ek-statically, “I wish by God these calculations could be made by steam!” (Charles Babbage) The (difference) engines of progress, no less: to get rid of human errors by mechanical means.

Dominic Pettman insists, and rightly so: “human error is evident wherever human eyes care to look without the rose-tinted lenses bequeathed to us by our forefathers.”<sup>3</sup> Günther Anders even diagnosed an acute case of promethean shame potentially generalized to all late modern humans: the shame to have been born rather than to have been fabricated, this eerie feeling that whatever we do, we will never measure up to the standard now defined by the machine.<sup>4</sup> It was already confirmed on the 1952 U.S. presidential election night, when the CBS crew refused to believe the first computerized prevision made by a computer (the UNIVAC), only to realize a few hours later that the computer had been right all along. This inspired CBS commentator Edward R. Murrow’s most famous quote, and probably the most efficient way to state the “human element” problem: “The trouble with machines is people.”

Hans-Georg Gadamer once considered that “Hermeneutics is a mantic art involved in the translation of the unintelligible into the intelligible. However, within modern contexts the term possesses a more methodological sense - ‘a universal doctrine for the interpretation of signs’.”<sup>5</sup> To think and to project share the same Indo-European root, *-men*. It gave the Greek *mantis*, usually taken to be synonymous in English with “seer”, “diviner, prophet; akin to Greek *manesthai*, to be mad” (Merriam Webster). Plato had already noticed this kinship, and defined three modalities of the mantic function, this daemonic madness: prophecy, poetry (or “possession by the muses”) and erotic intoxication.<sup>6</sup>

The mantic function certainly concerns time, but it is in no way limited to the predictive function along the past-future axis of chronological time. The story is well known: Prometheus always had a brother. The one who thinks before the fact, the wise and prudent, the one who is even thought to *know* the future, is brother to the one who thinks after the fact, the idiot, the one who forgets. When their titanic match is over, when their duel among themselves, but also with the Gods, and

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<sup>3</sup> Dominic Pettman, *Human Error : Species-Being and Media Machines*, University of Minnesota Press, 2011, p. 34.

<sup>4</sup> Günther Anders, *Die Antiquiertheit des Menschen* [The Obsolescence of Man]. München: H. Beck, 1956.

<sup>5</sup> Hans-Georg Gadamer, “Classical and Philosophical Hermeneutics”, *Theory, Culture and Society* 23(1): 19-56, 2006, p. 19.

<sup>6</sup> In *Phaedrus*, 244b-d, and 265a-b. See Angus Nicholls, “The Secularization of Revelation, From Plato to Freud”, *Contretemps*, 1: 62-70, September 2000.

first of them Zeus, and Hermes, and also with men and even with the first woman, Pandora, when all this is over, there is but one remainder, one evil trapped in the box: *Elpis*. The story seems to end with this: Pro- and Epi-metheus' series of double-faults cost us the match and deprives us of hope. Really? In fact the only evil that we are spared might not be hope, but anticipation of the worse. Could we now find another positive meaning to this, and restore our conjuring powers to a better light?

There is a fine line between conjuration and advocacy, prediction, anticipation and hope. Usually, all these processes are put in relation to the contingency of the future (remember Bartleby's "I would prefer not to"<sup>7</sup>). But what if the mantic function could deal with the future contingents (that is neither necessary nor impossible) on an alternating mode, forever oscillating between pro- and epi- manticism, pro-phycey and pro-duction, *poesis*? It is basically what we propose with this piece; that, and to minimize the human error in the mantic process.

Traditionally, the mantic arts have often made use of animals either in parts (as in *aruspicina*, with the study of entrails, or *patilomancy*, with the study of excrement), or through the study of their behavior (also known as *theriomancy* or *zoomancy*): by cats (*aeluromancy*), roosters (*alectoromancy*), horses (*hippomancy*), fishes (*ichthyomancy*), rodents (*myomancy*), ants (*myrmomancy*), spiders or crabs (*nggàm*), snakes (*ophiomancy*), bird formations (*auguri*) or migration patterns (*avimancy*), etc.. During the 2010 world cup final of soccer, Paul the octopus foretold the victory of Spain over the Netherlands, as it had successfully predicted the outcome of all seven of Germany's matches during the competition, thus proving once again, if needed, the excellence of *octopomancy*. In Northern America, our desire for an early spring is informed or confirmed in advance each year with the help of a well-managed session of *groundhogomancy*. This piece modestly proposes to add to this longlasting series of well-established cultural practices, through the careful staging of *magnetobacteriamancy* (MBM hereafter).

In fact, we built a biocomputing machine that, without any human interpretation required, answers directly to the questions raised by the contingent futures of synthetic biology. It is crucial to us to eliminate the human source of errors, the ideologies, the conservativeness and the resistance to change, and to let life itself answers these questions. Our device is thus an automatized mantic machine: there is no human mediation, no operator, between the answers provided by the machine and the truth seeker, the questioner. Also, it seems only fair that it is one of the most basic life forms on Earth, but also the beast of choice, the model organism of synthetic biology, i.e. the prokaryotes bacteria, that provides the answer. Ultimately, our machine also closes the loop of the history of computing. While Leibniz allegedly invented the very idea of a universal characteristic and thus re-invented the binary language on the well documented cultural instances of computation and permutation provided by *sikidy* (a geomantic *technique* from Madagascar) and the Chinese practice of the *Yi Jing*, we quite simply p inverse this historical trajectory to let a modern day (bio)computer tell us about the contingent futures of Life

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<sup>7</sup> Giorgio Agamben, "Bartelby, or On Contingency" in *Potentialities. Collected Essays in Philosophy*, edited and translated by Daniel Heller-Roazen, pp. 243-271, Stanford University Press, 1999, p. 266.

itself (no less).

In a preliminary design for the piece, we had planned to have the question of the visitor translated and transduced into direct movement of magnetotactic bacteria. The questions would have been spoken out loud into a microphone and then translated into instructions to move a set of motorized permanent magnets located besides the microscope plate, much higher in amplitude (up to 50mT) than that of the earth magnetic field. Magnetotactic bacteria are self-propellant bacteria with an internal chain of magnetic Fe<sub>3</sub>O<sub>4</sub> crystals. This chain passively aligns them to external magnetic fields, which they exploit in nature to find their desired water depth with the right oxygen concentration. In our preliminary design, the bacteria would have been placed in a microfluidic device consisting in a 5 micrometers shallow glass channels. Our system would have been able to track the trajectories of many bacteria at once with high spatial and temporal accuracy. We had thus planned to use the behavior of magnetotactic bacteria as the ironic engine of our piece, because—and here the project became rapidly twice ironic—we could coerce them into “doing the prophetic job”.

When it became clear that this would not happen, thanks to some human errors of course, we had to change our plans, and to make, as the great albeit popular philosopher Michael Jordan once stated, failure the engine of our success.<sup>8</sup> This is when we realized that having a digital ecology at the center of the piece was actually truer to the most crucial promise of contemporary synthetic biology, the *digitizing* of life itself. In the version of our piece that got eventually exhibited, we thus introduced a digital ecology consisting of flocking creatures made of chains of icons borrowed from the graphical language of an open source DNA editor (a free CRISPR). In our system at rest, the analog and the digital ecologies mingle: the digital creatures flock and follow the analog ones. When the visitor asks his or her question aloud in a microphone, the two ecologies are disconnected, and the flocking behavior in the synthetic ecology is guided towards one quadrant of the screen, arbitrarily assigned to one out of four possible answers: *yes*, *no*, *probably no*, and *maybe yes*. Instead of reacting to the analog creatures of the live *medium*, the digital creatures react to the analog waves of the visitor’s voice. Their behavior becomes *personal*.

In order to do so, we have thus recycled a device used in spiritualism *séances*: our apparatus answers the question of a visitor through the mediation of a schematic *OuiJa* board, also known as a spirit or talking board. It is a flat board usually marked with the letters of the alphabet, the numbers 0–9, the words "yes", "no", "hello" (occasionally), and "goodbye", along with various symbols and graphics. The classic design uses a small heart-shaped piece of wood or plastic as a movable indicator to indicate the spirit's message by spelling it out on the board during a *séance*. We made no such use of such *planchette* in our design, since the bacteria would directly move over the board (a hole in it allows to look directly to a screen) to provide their answer. We thus

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<sup>8</sup> “I failed over and over again in my life. And that’s why I succeed”, Michael Jordan in *Failure*, Nike commercial, 1997.

avoid the usual criticism of the scientific community, which has long held that “the action of the board can be parsimoniously explained by unconscious movements of those controlling the pointer, a psychophysiological phenomenon known as the ideomotor effect.”<sup>9</sup>

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<sup>9</sup> *Wikipedia*, entry “Ouija”, <http://en.wikipedia.org/wiki/Ouija>.