MULTISCALAR FORMS OF RESISTANCE: THE MOLECULAR SWITCH, THE BACTERIUM, THE INDIVIDUAL, AND THE STATE

by Lara Tabet

For the longest time, my answer to the question: "What do you do?" was to say that I am either an artist or a medical doctor, but never both depending on the context and interlocutor. It was only fairly recently that I have come to terms with this double identity of sorts. Throughout my long years in medical studies, I developed an art practice alongside medicine that I kept totally separate. I used image-making as both a seductive and transgressive tool and this work, conducted in parallel, aimed to reaffirm the presence of the sexual body in the public space within the context of post-war Beirut. Three years ago, almost insidiously so, my two professions intersected as I began to explore biological materials through the medium of photography. I started photographing through the lens of a microscope as a result of spending long hours looking through one. Soon afterwards, I incorporated microscopic photography into my artistic practice as an essential visual tool. My methods then expanded to encompass a wider reflection upon the forensic image, investigating the boundaries between the diagnostic apparatus and the artefact.

As a result of this intersection, and the works that flowed therefrom, when posed with that same and somewhat dreaded "what-do-you-do?" question today, I reply that I am a visual artist and a medical doctor specialized in clinical pathology.

The term pathology itself is derived from the Greek words *pathos* and *logos*, as in "the study of suffering". As a medical specialization, it is concerned with the diagnosis of diseases through the analysis of tissue cell and body fluid samples, and encompasses several branches such as hematology, biochemistry, blood banking, as well the fields of microbiology and molecular biology; I had already incorporated these two last fields into my art practice, prior to my most recent work in the Molecular Environmental Microbiology Laboratory in Madrid, albeit separately.

The first instance was in *.DNA* (2019)[1], a project that interrogated DNA, both as content and container, and as a potential medium for encoding and storing archival images. It questioned the means by which we protect the physicality of a photo object, in an archive, in the age of dematerialized information.

My second foray into using pathology in my photographic work was in *The River* and *Eleven Fragmented Seas*[2] (2018-2020) in which I used photographic color film as a bacteriological incubator. I introduced microorganisms, collected from the water samples of multiple sites along the Beirut River and the Lebanese littoral, which were then allowed to alter the chemistry of the analog film emulsion process, thereby intersecting forensics bacteriology with landscape photography.

In the summer of 2020, I came across Biofaction's open call for an artist residency in a molecular microbiology laboratory. On the basis of the two aforementioned projects, the prospect of immersing myself in this sort of work was incredibly exciting for me, given that it would allow for me to bring both of my careers, and my interests in experimental photography and environmental/synthetic microbiology, to an even keener convergence.

The Laboratory of Environmental Synthetic Biology (headed by Prof. Víctor de Lorenzo) produces biological 'agents' for biosensing, and for the remediation of chemical waste through the use of the Gram-negative soil bacterium *Pseudomonas putida*. This was a perfect fit for my concerns with ecotoxicology and my previous research into the microbiology of water bodies. My initial proposal for the project read:

> "I am particularly interested in your research, in how it hinges upon the notion of reversal: that of the central dogma, that goes from genetic material to protein, and that of the industrial production cycle through cyborgization of the bacterium *P. putida*. With these shifts in paradigms as my point of departure, I would like to create an audiovisual piece that makes use of formal, social and performative strategies to investigate the braiding of ecological science

[1] Documented at: https://www.ltabet.com/DNA

[2] The River (2018) documented at: https://www.ltabet.com/The-River and Eleven Fragmented Seas (2018-2020) documented at: https://www.ltabet.com/Eleven-Fragmented-Seas

> with fiction, where prevailing narratives can be entangled, twisted, imagined, reimagined, and manipulated. I aim to contemplate microscopic life through the lens of body politics and scientific semantics, where the bacterium's modified body interrogates how under such scale and conditions the ideas of agency, transgression, performance may be approached."

I received news of my selection in November 2020. I was in Brazil at the time, and EU borders were still closed to me because of restrictions imposed by the COVID-19 pandemic. There was no way for anyone to foresee when I would be able visit the lab. Over the course of one year, I met with the team regularly online by attending their weekly conferences and I became familiar with their ongoing research. In May 2021, as soon as travel regulations allowed for it, we scheduled my first in-person visit. Prior to my arrival, I asked to have recorded private zoom conversations with each member of the team, as a way to break the ice, to learn about what they were currently working on, and to begin to imagine what form my own project would eventually take.

Once in the lab, I shadowed the scientists for the first few days, actively brainstorming with them. It became clearer to me, over time, how devising biotechnological tools preceded their potential widespread applications by many steps, and this allowed for me to better frame my project. As a clinical microbiologist, I was quite familiar with the world of laboratories, with benchwork and the handling of microorganisms. I was accustomed to looking for and identifying pathogenic bacteria, primarily ones that lead to diseases in people, assessing these bacteria's sensitivities to antibiotics, and studying their molecular mechanisms of drug resistance. However, I found that synthetic microbiology was very different in many respects; in this area, a non-pathogenic organism is engineered through the addition and deletion of genes to 'perform' new tasks in specific environments. This becomes what is called a biological chassis, a cell factory the production of which depends upon the exogenous genetic inputs given thereto. It was this microscopic performance-on-command that interested me, given that performance and performativity were concepts that I often explored in my art practice.

I treat photography as a spectrum that oscillates between the act of the documentation of space and as a performance for the camera. At times, image-making becomes a transgressive gesture for me to re-appropriate the public urban sphere and/or to reverse the male gaze in the

representation of the queer Arab body in liminal spaces that exist at the edges of privatization.[3] At other times, photography has been a way for me to deconstruct the aura of the figure of the 'healer' across both western and traditional medicine perspectives.[4] However, when working with tiny living organisms, such as bacteria, performativity became multi-scalar, functioning on two corresponding scales with each having their own spatio-temporal frames of reference.

The first scale existed at the macro level and corresponded with my actions as an artist. For example, in *The River* and *Eleven Fragmented Seas* (2018-2020), it was the actions of sampling water, culturing bacteria, identifying it, and re-inoculating it onto photographic film. The symbolism of this gesture was one of ritual, but also one of transgression. As Lebanon's coastline has been heavily privatized and has become replete with cement, due to the illegal construction that encroaches on public land, sampling water every 20km first meant finding access to the sea to begin with, and sometimes trespassing on (ostensibly private) property in an act of re-appropriating public space.

The second scale functioned at the microscopic level, at the scale and the resolution of the bacterium; it was the sum of the microbial processes that altered the film's chemistry in this case.

The resulting image was not a direct visualization of the microorganisms, but rather was an indirect indicator of their presence. This involved posing the question of how one can interpret this non-human information. What are our frames of reference? How can scalar differences help us to think outside of our common perceptions, and how might they allow us to think of new modes of languages and possible meanings and collaborations?

Microperformativity

Scholar and art curator Jens Hauser, in a volume edited together with artist Lucie Strecker, posited what they believe led to the emergence of the

[3] Examples of this can be seen are in the following works: *The Reeds* (2012), available from: https://www.ltabet.com/The-Reeds and https://www.ibraaz.org/essays/165. And: *Underbelly* (2018), available from https://www.ltabet.com/Underbelly.

[4] Here, Lara Tabet references her work *The Return of the Old Man*, not available online at the time of publication.

neologism "microperformativity", notably through the re-definition of the notion of the body to include non-humans and in terms of the shift in performativity from physical gestures to physiological processes:

> "Artists, beyond employing genes or cells just to act as ontologized proxies for (human) identities, also stage proteins, enzymes, bacteria or viruses, among others, indicating a growing interest in non-human agencies at large." (Hauser, 2020:12)

Microperformativity, thus, crosslinks performance and media theory with science and technology, redirecting the gaze towards these 'other-than-human agencies' in the process and challenging the human scale as central.

Early on during my process, I knew that I had wanted to build upon my experiences in my previous works, which had featured intersections of performance, photography, and bacteriology. As an art form, performance's ephemeral nature addresses the necessity of its documentation. This new shift away from the human scale and resolution created both new limitations and possibilities. As noted in a conversation between artist Lucie Strecker, Jens Hauser, and historian and philosopher of science Hans-Jörg Rheinberger (Hauser & Strecker, 2020), this shift in scale implies manipulating both spatiality and temporality, as well as enlarging what is invisible, and the compression and dilation of time become a necessary visualization tool in this pursuit.

> "'What is too big must be downsized' and 'What is too quick to be observed must be slowed down; and what is too slow to be observed must be accelerated' [sic]." (Hauser & Strecker, 2020:66)

One thing became evidently clear to me from my many conversations with the scientists in Víctor de Lorenzo's laboratory, which was that any 'performance' that we were going to stage would take place over a certain period of time, the scale of which was bacteriological. That is, the performance should take both the specific demographics of the bacterial cycle of growth and the spatiality of the laboratory setting, in which contamination can be avoided, into account. This meant that the final work would definitely have to be the documentation of the performance, rather than the performance itself. As a visual artist trained in photography, I was drawn to this idea; after all, photography and video have been the major tools documenting performance

art from its inception because of the way in which cameras capture time. There is an inherent contradiction in the act of recording and reproducing live art, of course. For me, what was particularly interesting in this practice was the reliquary connotation of what sorts of images and imaginaries could withstand.

Another limitation that I kept in mind was that the necessary visualizations of microbial processes were created artificially. In order to make the bacteria visible, they were grown into a bacterial culture, made of colonies rather than an individual bacterium; in this case, the clone becomes the substitute for the cell. Other methods of visualization and verification included the introduction of a gene expressing a fluorescent protein that conferred a color (such as the infamous GFP green fluorescent protein), or a LUX gene that conferred bioluminescence, or even an antibiotic resistance gene that allowed for the selection of our modified organisms in a culture media that included that same antibiotic and that would be lethal to other bacteria.

All of these methods required specific timeframes. We allowed 24 hours for bacterial growth on solid media, and around three hours in liquid media, in order to achieve growth and to reach the optimal optical density in which these performances could then take place.

With all of these limitations in mind, I set out to look for a specific microperformance that I wanted to stage. I ended up developing two separate microperformative bodies of work. I learned about the 'suicide gene', during one of my talks with Dr. Belen Calles at the lab, which is a lethal gene that codes for a restrictive enzyme that would destroy the bacterium's DNA and would cause its death once induced. It is similar to an ON/OFF switch, kind of like a bomb devised by the scientist to mass extinguish their culture at any point of their choosing. The technical term for this is "biocontainment", a strategy that is applied to ensure that harmful organisms remain confined to controlled laboratory conditions and are not allowed to escape into the environment. This gene became the basis of my first work/protocol.

Necropoiesis
Collaborators: Belen Calles, PhD & David Rodriguez Espeso, PhD

In *Necropoiesis*[5], I induced the bacteria *Pseudomonas putida* to self-destruct through a voice command. Once the death sentence was pronounced, the lethal gene was chemically induced and caused programmed cell death. I chose bioluminescent cloned bacteria in order to visualize bacterial death as a gradual loss of light emission.

We started by genetically modifying colonies of *Pseudomonas putida* KT2440 to constitutively express a LUX reporter gene, which caused the bacteria to continuously exhibit bioluminescence. The samples were then kept inside of a black box, one reminiscent of a camera obscura (one of the oldest types of photographic apparatus). Temperature was maintained at 30 degrees Celsius for optimal bacterial growth. I issued a specific command (a sentence) that chemically induced the lethal gene EcoRI, causing bacterial cell death by means of a voice-recognition software that we programmed. After the suicide gene's induction, a camera inside of the box recorded the loss of luminescence over a period of three hours. The sequential pictures showing the gradual waning of bluish light will be made into a video piece.

In parallel with this, we captured the loss in bioluminescence of another colony of *Pseudomonas putida* (also KT2440 and also induced to die on command) onto analog X-ray film every ten minutes. The sensitivity to the X-ray was proportional to the quantity of light emitted by the colonies and in which the images recorded show the waning of its light signals.

Both the rayographs and the video were recorded evidence of the human-induced microbial performance. The former is an analog snapshot, the latter a digital long exposure: An analog trace and its digital twin. Each one exists in its own frame of semiotics. The X-rays are reminiscent of the cosmic death of a star. They speak of (light) decay, of cosmic decomposition. The time-lapse video, conversely, exists in a moving image frame of reference, and the combination of motion blur and phosphorescence brings us back to the imaginary of the primordial soup.

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[5] *Necro* refers to Ancient Greek νεκρο-, *nekró*-, meaning "dead body". *Poiesis* is etymologically derived from the Ancient Greek word ποιέω, *poiéō*, meaning "to make". It is the root word of "poetry" and is used as a suffix in the biological term "hematopoiesis", the formation of blood cells.

fig. 3.2 Digital animation I
Bioluminescent *Pseudomonas putida* induced to die.

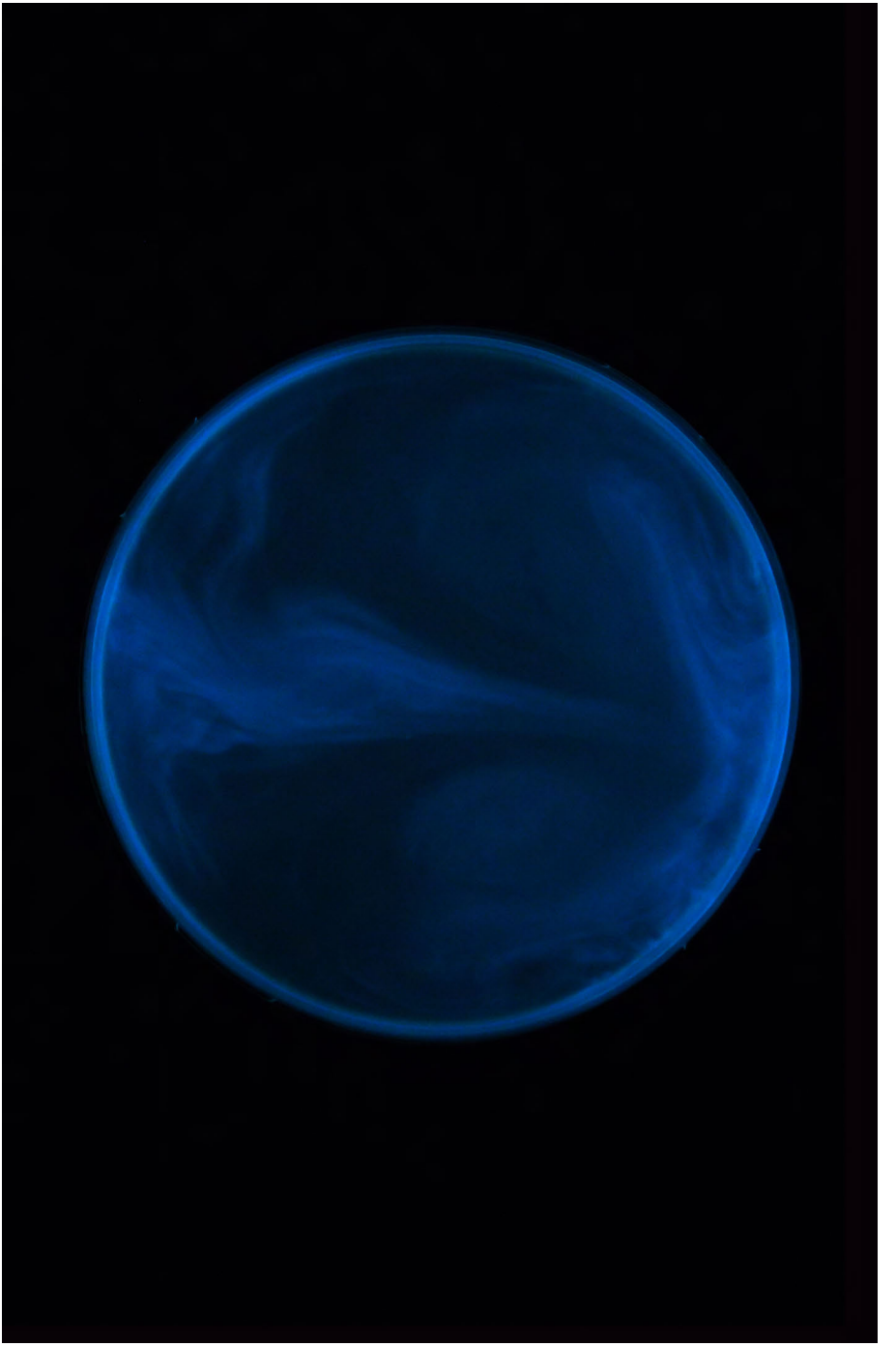
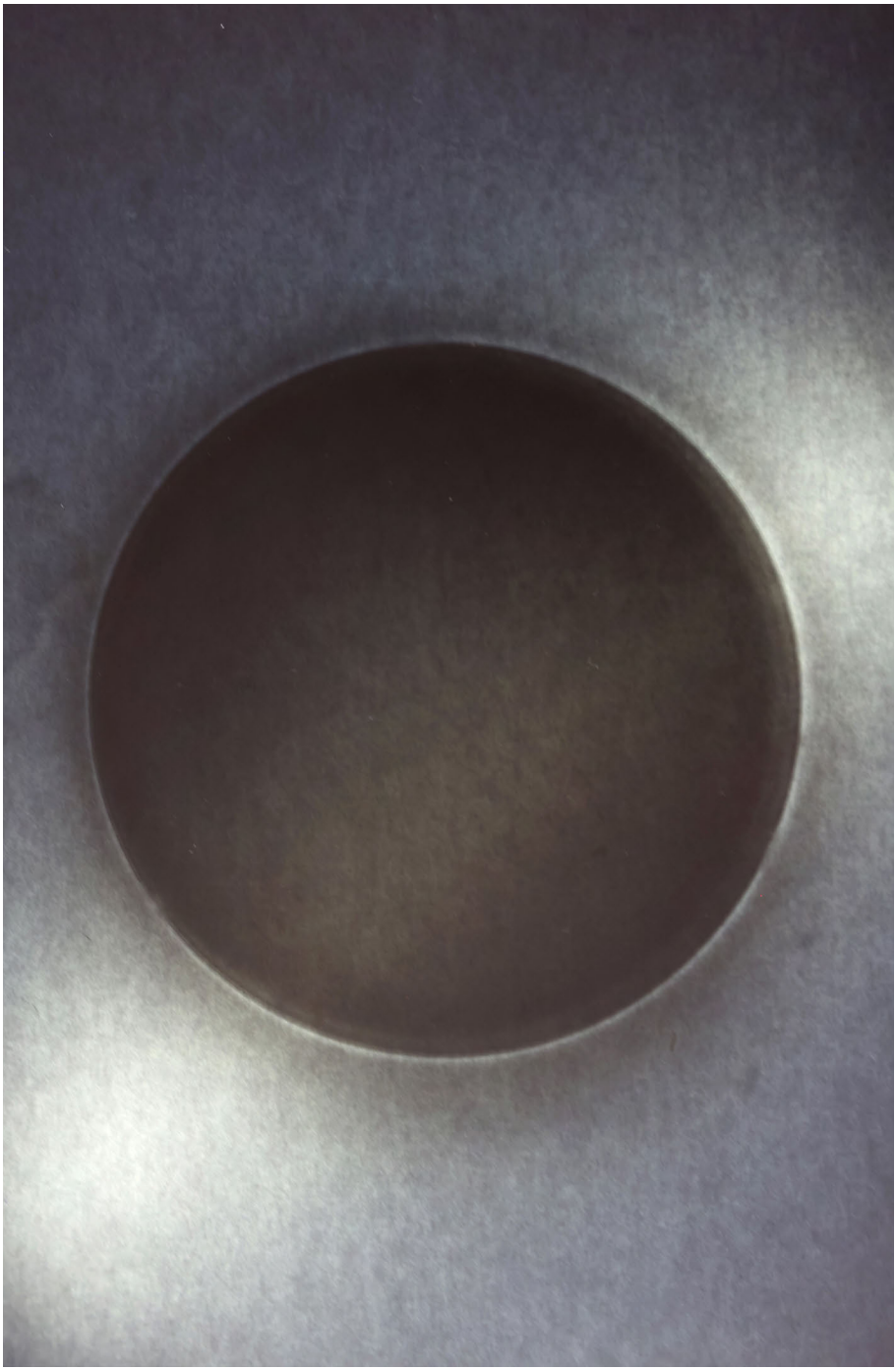
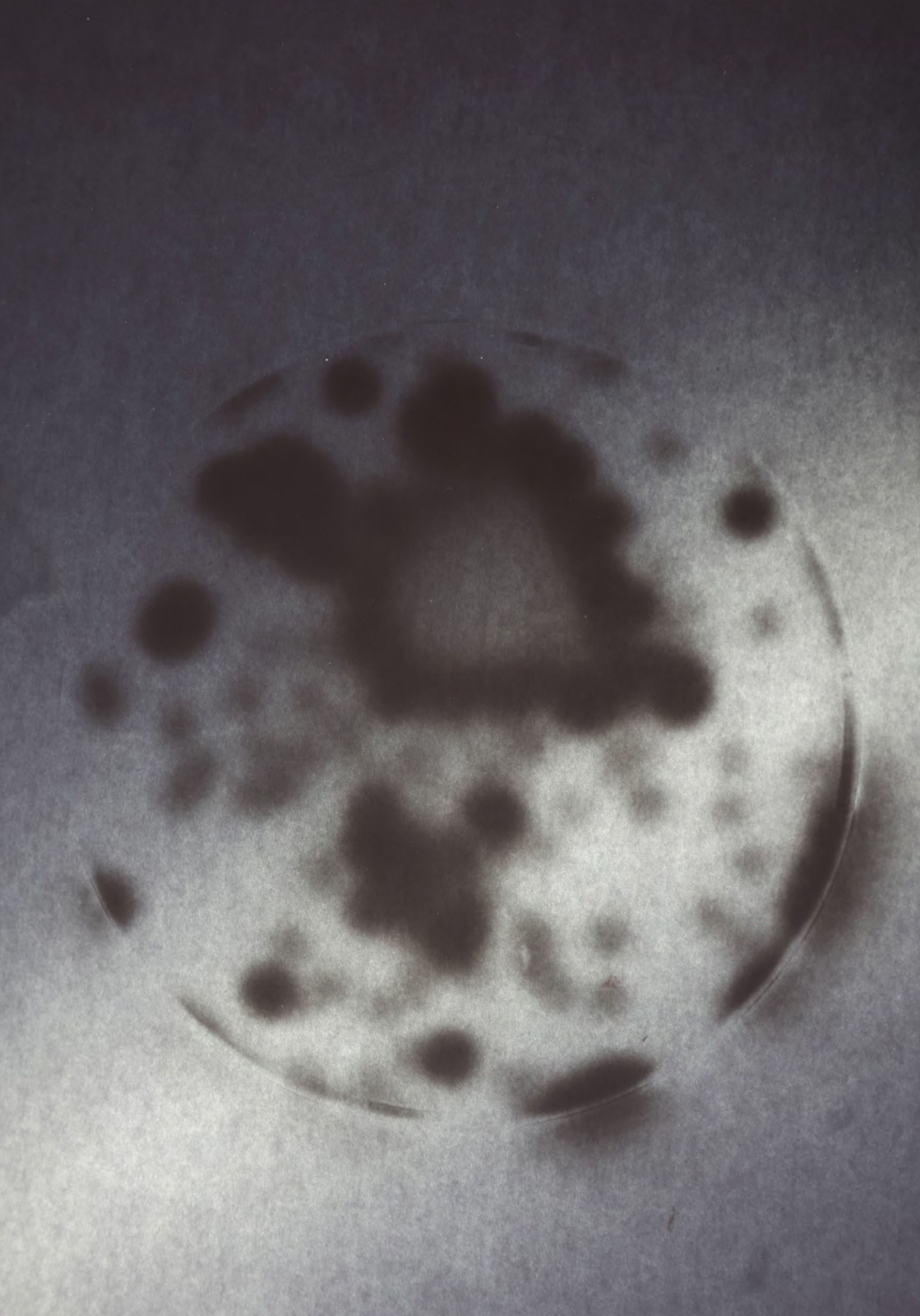


fig. 3.3 Digital animation II
Bioluminescent *Pseudomonas putida* induced to die.

X-ray I

fig. 3.4 Recording of waning bioluminescence after death induction.





X-ray II

fig. 3.5 Recording of waning bioluminescence after death induction.

In Plato's *Symposium*, Diotima described how mortals strove for immortality in relation to *poiesis*, and how an impulse beyond the temporal cycle of birth and decay lay in the act of creation itself. This triad of time/death/light questions the semantics of death and the correspondence between the macrocosmic and the microcosmic, perhaps through what Adolf Portmann described as penetrating beyond the limits of the mediocosm that governs our everyday views,

> "...into a submicroscopic world of molecular and submolecular forces, into a microcosm-we penetrate beyond the everyday zones into extraterrestrial spheres, into a macrocosm which determine our life on earth, our spiritual creation, our economic efforts." (Portmann, 1961:48)

Our experiment relied heavily on the kinetics of microbial growth and death. Each day, I would cultivate a new batch of bacteria, patiently waiting until it reached its optimal growth phase (as measured by optical density) so that it would display its maximal bioluminescence. Only at that point would I pronounce my lethal command.

It is a human characteristic of ours to assign our emotions and behaviors to other living creatures. Microbiology literature is crowded with vocabulary about choice/war/love. Bacteria are said to "make a choice to use a particular substrate" or to "need something", bacterial conjugation is equated with sexual mating, and there are countless references to bacterial "warfare" (Davies, 2010:721). Over the course of two weeks, I aligned myself to that calculated, cyclical rhythm of life and death that culminated in the visual documentation of what I came to think of, in anthropomorphic terms, as agony.

There was something ritualistic and hypnotic about performing such an act, looking for its evidence day after day. When I thought about these unicellular organisms at the origins of life, day in and day out, the words of evolutionary biologist Lynn Margulis came to mind, in that:

> "Life on earth is such a good story you cannot afford to miss the beginning...Beneath our superficial differences we are all of us walking communities of bacteria. The world shimmers, a pointillist landscape made of tiny living beings" (Margulis & Sagan, 1986).

I recently read Donna Haraway's book *When Species Meet* (2008). In it she mentions Margulis, pointedly stating that: "Reading Margulis over the years,

I get the idea that she believes everything interesting on earth happened among the bacteria, and all the rest is just elaboration" (Ibid:31). Indeed, in her Serial Endosymbiotic Theory (SET), Margulis theorized that eukaryotic cells (cells with a nucleus including the cells in our human body) evolved from prokaryotic cells (aka bacteria). Vital organelles such as mitochondria, chloroplasts, flagella, and cilia could have entered the cell as an ingested prey or as a parasite and could have developed a mutually beneficial symbiotic relation with their host cell over time. This view positions 'symbiosis' as a major driving force behind evolution, thereby challenging competition and natural selection as its primary compelling process. This theory, one that was much disputed and ridiculed in the 1970s, is now widely accepted, as a recent new study led by evolutionary biologist William F. Martin traces back many of the genes integral to the functioning of cells of higher organisms to bacterial DNA.

Autopoiesis, or 'self-production', was a concept introduced in the 1970s by Chilean biologists Humberto Maturana and Francisco Varela. An autopoietic system was defined as one that was capable of producing and maintaining itself by creating its own parts through a network of inter-related component-producing processes (Maturana & Varela, 1973). The smallest recognizable autopoietic entity is a tiny bacterial cell and the largest is 'the symbiotic planet'. It was Lynn Margulis, and her long-time collaborator James E. Lovelock, who applied the concept of autopoiesis to the entirety of planet earth through the Gaia hypothesis which stated that every organism, and their inorganic surroundings on Earth, are closely integrated and form a single and self-regulating complex system, maintaining the conditions for life on the planet (Lovelock & Margulis, 1974).

This idea of self-regulated systems and symbiosis between humans and non-humans led me to the second protocol/artwork that I conducted during my residency, *Resilience Overflow*, which questioned the role of human and non-human alliances in the absence of the state.

Resilience Overflow

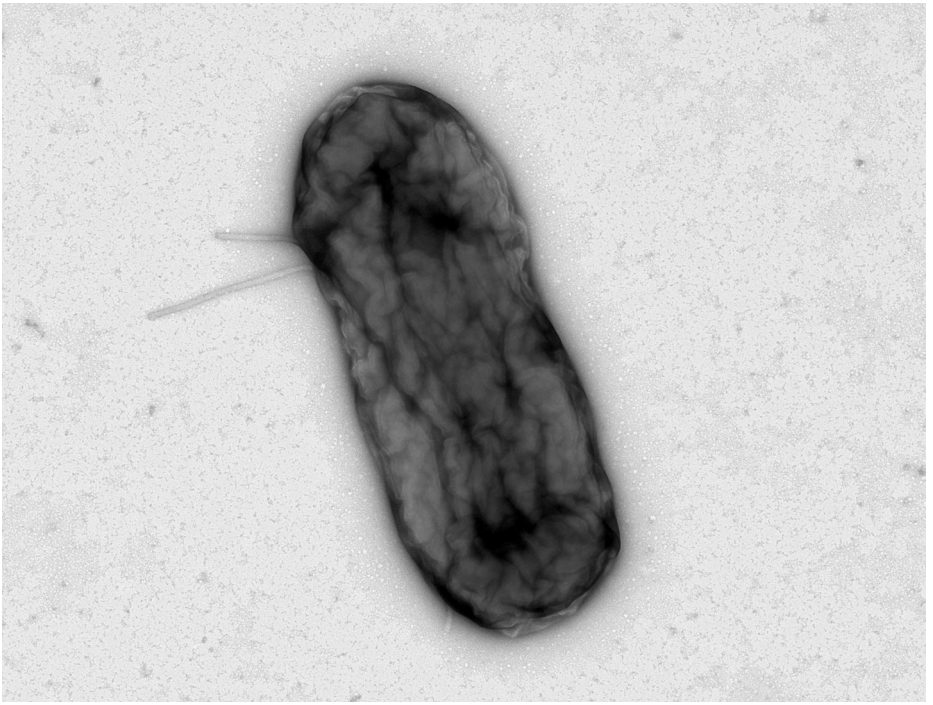
Collaborator: Esteban Martínez, PhD

In *Resilience Overflow,* I considered the ethical and symbolic implications of hypothetically releasing modified organisms into the environment to remediate the shortcomings of an absent and neglectful government in a general sense, with regards to public health in particular.

This project consisted of genetically engineering my own fecal bacteria to produce the psychoactive human molecule Neuropeptide Y and speculating around the idea of releasing it into Beirut's water system. Neuropeptide Y is one of the key mediators involved in stress resilience in humans and has been shown to significantly decrease the effect of post-traumatic stress disorder. Beirut has recently suffered one of the biggest non-nuclear explosions that the world has ever witnessed. The capital city has also suffered the burden of a total financial collapse that has resulted in both a high rate of anxiety among its inhabitants and a massive medicine shortage, particularly in psychotropic medications.

Bacteria have the ability to exchange genes very easily and rapidly, even between different species, through tiny mobile circular DNA called plasmids. In this project, a plasmid construction containing the Neuropeptide Y gene was introduced into the bacterium through conjugation or 'mating'. The bacteria then incorporated the gene and began to produce its corresponding molecule, thereby becoming like tiny factories that can produce medications and distribute them on the scale of an entire city.

fig. 3.6 Electron micrograph of *Citrobacter amalonaticus* extracted from my gut and modified to express the gene for human Neuropeptide Y.



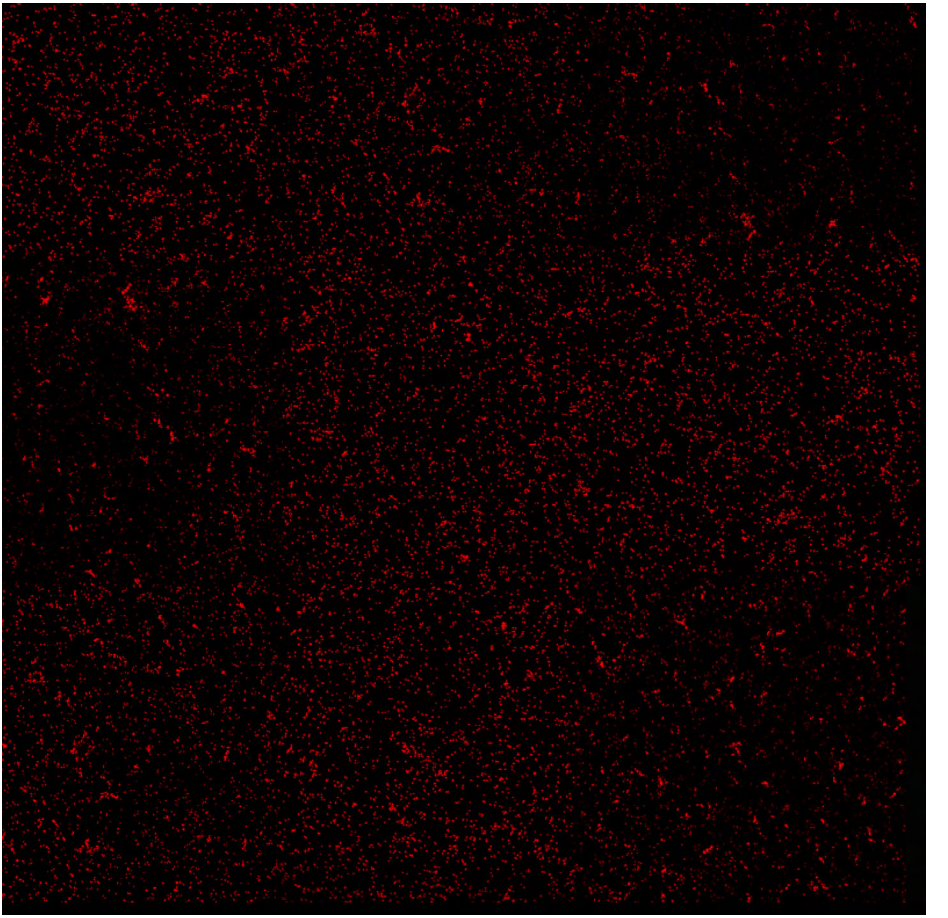
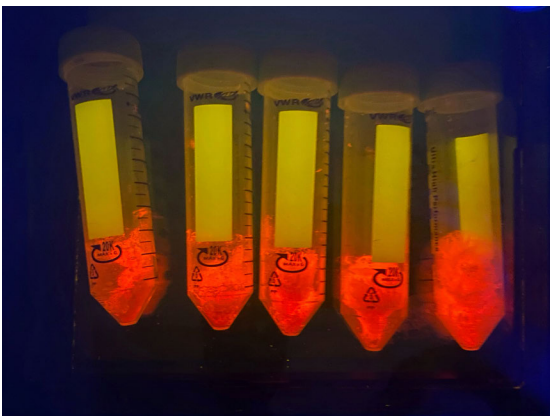


fig. 3.7 Confocal microscopy showing *Citrobacter amalonaticus* expressing Neuropeptide Y gene tagged with the fluorescent protein m-cherry protein.

As a long-time sufferer from irritable bowel syndrome (a chronic digestive disorder that is due to an imbalance in gut bacterial communities, or dysbiosis), I chose to use my own fecal bacteria to produce Neuropeptide Y as a way to draw attention both to the gut-brain axis and to the crucial role played by intestinal microbiota in influencing our emotional and cognitive behavior. The engineered bacteria were then freeze-dried into probiotic pills. From then on, the project becomes purely speculative.

What if I could re-ingest these, now psychoactive, probiotic bacteria and undertook a scatological gesture to release them into the 'wild', and completely untreated, Beirut wastewater system, the same one that flows freely into the sea? Would the psychoactive bacteria heal an entire population? In the absence of regulation and control provided by the state, what becomes of an individual's own power, role, and scope? What are possible modes of alliances that exist between humans and non-humans? How can we discuss agency and labor in wet media art? This project also considers and interrogates the multifold role played by water as a carrier of intergenerational trauma, toxicity, and healing.

fig. 3.8 Lyophilised bacteria containing human Neuropeptide Y gene.



Center periphery: bio-poetics/bio-politics

Being able to work in a state-of-the-art biotechnology laboratory, assisted by passionate scientists at the forefront of their field, was a monumental experience for me, one that I have sought for a long time. With this kind of access to science being impossible in our part of the world, it is important for me to ponder on what it means to be working in wet media art from the 'periphery' of progress. What does a specific geopolitical context bring into the conversation when using bio-art as a medium?

My work lies at the breaking point of tension between biopolitics and bio-poetics and questions the ways in which we can navigate our bodies' livelihoods within toxic and corrupt state systems of control, all while thinking through living systems in order to stir new imaginaries and to consider possible futures.

fig. 3.9 *Resilience Overflow*, Film still I.

fig. 3.10 *Resilience Overflow*, Film still II.

Cohabiting with toxicity requires constant negotiation

During my last trip to Lebanon, almost two years after the port explosion, I was finally ready to visit my old neighborhood again. I went up to my old apartment, which was in a rundown building that had a panoramic view on the city's harbor. When the blast went off a few hundred meters away on that day, the impact caused the space to implode onto me. Managing to survive, I moved out of the ruined apartment in a matter of days.

Returning there, I rang the bell. My name was still on the door. A young woman on the other side opened it. I explained to her that I was the previous tenant, and that I needed to flush something down the drain. She said she understood and said that it was in no way a strange request.

BIBLIOGRAPHY

01. Davies, J. (2010). Anthropomorphism in science. *EMBO Reports*, *11*(10): 721.
02. de Duve, T. (1978). Time Exposure and Snapshot: The Photograph as Paradox. *October*, *5*, 113-125.
03. Haraway, D. (2008). *When Species Meet*. Minneapolis: University of Minnesota Press.
04. Hauser, J. (2020). Microperformativity and Biomediality. *Performance Research*, *25*(3), 12-24, DOI: 10.1080/13528165.2020.1807745.
05. Hauser, J. & Strecker, L. (2020). Agency is Everywhere: An encounter with Hans-Jörg Rheinberger. *Performance Research*, *25*(3), 65-71.
06. Ku, C., Nelson-Sathi, S., Roettger, M., Sousa, F.L., Lockhart, P.J., Bryant, D., Hazkani-Covo, E., McInerney, J.O., Landan, G., Martin, W.F. (2015). Endosymbiotic origin and differential loss of eukaryotic genes. *Nature*, *524*(7566):427-432.
07. Lovelock, J.E. & Margulis, L. (1974). Atmospheric homeostasis by and for the biosphere: the gaia hypothesis. *Tellus*, *26*:1-2, 2-10, DOI: 10.3402/tellusa.v26i1-2.9731.
08. Margulis, L. & Sagan, D. (1986). *Microcosmos: Four Billion Years of Evolution from Our Microbial Ancestors*. Berkeley and Los Angeles: Univ of California Press.
09. Maturana, H. R. & Varela, F. J. (1973). *Autopoiesis and cognition: the realization of the living, its characterization and a model*. Amsterdam: North Holland Publishing Company.
10. Portmann, A. (1964). *Neue Wege der Biologie*. Munich: Piper, 1961 (engl. transl., *New Paths in Biology*, Harper and Row, New York, 1964, p. 48).