

STARTS Residency Public Report

Suspended Moment

D. PEYSSON

Abstract: *Suspended Moment* is a zero-gravity dance on the origin of life. Two liquid drops in levitation, dancing around, finally merge. Then the levitating drop starts a primitive life, dividing itself under the audience's eyes. Two questions arise from this artwork: how have chemical systems ever become primitive living cells and what are the ethical limits that we will have to answer soon, if scientist can recreate life from the beginning in their laboratories¹? The drops, as proto-cells, are suspended in the air thanks to an ultrasonic phenomenon. The residency allowed people from different fields of knowledge and countries to work together: the Tech Project LEVITATE in Glasgow, a Spanish researcher Asier Marzo and an engineer, David Olivari. From a scientific point of view, the study of protocells has never been performed under zero gravity whereas it would be particularly judicious since it is very possible that the early life-forms were formed on meteorites. *Suspended moment* wants to be an emotional experience, since sensations are part of our ability to apprehend issues affecting the living. Art can here ensure its historical function, which is to produce the imaginary proper to this life creation.

Index Terms— *Dancing drops, Mystery and technology, Origin of life, Protocells, Ultrasonic Levitation*

I. ARTWORK

Suspended Moment is a zero-gravity dance on the origin of life. The origin of life on earth remains an unclarified mystery... and the magic of the beginning is still happening over and over again, each time two gamete meet and become a single cell, ready to grow to achieve its goal of becoming an organism in all its complexity. *Suspended moment* proposes to live a particular moment out of time, to take a fresh look for a time on the mystery of life beginning... The incredible ballet of two drops of complex matter in levitation, dancing around in a slow and fragile manner. Two bodies and their milky way suspended in the air, leading to the watershed moment of the coupling. We are able to see that peculiar moment, that of creation, when all will become possible. For, as protocells, the two floating drops of matter give us to see a little miracle, finishing to be TWO inert units to become ONE living system. The move from non-life to life is concretized under our eyes by the generation of a visible organic growing structure, within the final drop. It is only when the two entities are united that the self-organization of organic matter can appear. A very beginning of metabolism, to grow an initial germ. Then the drop fall, and two new initial drops begin their ballet. Again, and again. Everything happens at the size of a water drop. A small-scale object theater,

¹ See on that very important question the MIT Press book: *The ethic of protocells*,
<https://mitpress.mit.edu/books/ethics-protocells>

whose image is also projected in very large by an optical process on the ceiling. A dance in spiral mists that defies the laws of gravity, leaves its part to time, back and forth, chaotic hesitations, then the meeting, finally... One plus one that is more than two, it's also our own story that is replayed before our eyes, in the simplest way.

A sound piece envelops the audience, and give them the feeling to also enter levitation. An important point, since drops are maintained in the air thanks to an acoustic phenomenon. A very pure stream of sound, combination between that of a very young voice, as if coming from heaven, and the work on two harmonics as in Tibetan chant, produced to achieve levitation. A work integrating pulsations, harmonics, sound movements and psycho-acoustics to access an ethereal state.

The public can simply watch the original scene, but for those who want to experience the feeling of being - for a moment - like the creator, it will be possible in a later device, to interact with the drops, helping them or preventing them from meeting by approaching the hand. But might this not pervert the fragile balance and lead to more disorder instead of allowing to take control?

Two questions arise from this artwork. The first is how have chemical systems ever become primitive living cells? Then, what are the ethical limits that we will have to answer soon, if scientist can recreate life from the beginning in their laboratories²?

There is no single, generally accepted model for the origin of life. Life arose under conditions extremely different from those on Earth today. Some researchers think that the first complex organic molecules occurred in the Solar System and in interstellar space³. In zero gravity... This biochemistry of life begun shortly after the Big Bang. According to the panspermia hypothesis, microscopic life could have been distributed to the early Earth by space dust, meteoroids, asteroids and other small Solar System bodies. All these points reveal that the beginning of life is strongly related to the space and heavenly bodies.

My idea was to take advantage of the feeling of magic caused by the sight of these levitating systems, but radically avoiding the feeling of technological prowess. Levitation is for me the privileged way to show this ontological passage which is the foundation of our earthly existence.

Several scientists work on the origins of life on Earth. How did inert matter become living matter? Key building blocks began to form. Protocells, which are specific drops of oil and water, are proposed to be a stepping-stone toward the origin of life. A central question in evolution is how simple protocells could enable emergences of life? Scientist - as Martin Hanczyc⁴ - use specific synthetic chemical systems to model the primitive living cells.

They are some kind of chemical artificial life. Protocell are just droplets, but they can undergo astonishingly varied and complex behavior. In my work, I don't show real arising life, but some kind of protocells with specific chemical systems inside, to show how they can behave toward complexity.

The Leap Motion finger tracking system will enable interactivity with the intervention of the audience to help or prevent the drop meeting. Many laboratories are currently working on this passage from the non-

² See on that very important question the MIT Press book: *The ethic of protocells*,
<https://mitpress.mit.edu/books/ethics-protocells>

³ See the article: Ingredients for Life Revealed in Meteorites That Fell to Earth,
<https://www.astrobio.net/also-in-news/ingredients-life-revealed-meteorites-fell-earth/>

⁴ How life might have first occurred on Earth and perhaps elsewhere too:
https://www.ted.com/talks/martin_hanczyc_the_line_between_life_and_not_lifells



living to the living. Researchers seek to reproduce this metamorphosis in their test tubes to understand the beginning of life. But also, to take the lead on the possibility of generating our own living systems, substituting nature. The creation of life as a demiurge has always been one of the main themes of our myths and legends.

II. METHODOLOGY

The first step was to build the hardware: the levitator, which was not an easy process. It is based on an acoustic phenomenon which cancels gravity to levitate particles in the air. Streams of sound can make objects fly in the air. Several beads of a diameter of 1-2 mm can be levitated and controlled independently. The levitation is possible thanks to ultrasonic waves, generated with lots of little transducers that have to be controlled individually: a Holographic Acoustic Tweezer (HAT)⁵. Three-Dimensional Manipulation is possible by using a double-sided arrangement made of two opposed arrays of 16 X 16 transducers separated by 23 cm to create multiple standing waves, with nodes located at the target trapping positions. The tech project LEVITATE is only working on applications of the levitation devices, not the hardware, nor the software. I had then to find a researcher specialized in ultrasonic levitation. I went to Spain to meet Asier Marzo⁴, a great researcher who made a lot of progress in this technology, and who built the levitation devices used by LEVITATE. He made several open source levitators, and provided step-by-step instructions to build them on www.instructables.com. I mounted with him a first tiny levitator, to begin with, and started experimentations with liquid drops. Making the final system took time, because he had to order the assembled boards and make all the connections. The difficulty here was to get the final levitator device, since Asier Marzo didn't have enough time to work on it. I then had to get used to the software to drive the system, especially to make the drops dancing around, and then merge.

I started to work with David Olivari, who is an engineer and artist, to develop a drop distribution system in the device. We have to make lots of tests to make it work properly, since dispensing drops of liquid precisely in this kind of system is very delicate. The drops size has to be controlled carefully, since drops can fall down if they are too heavy. The injection of droplets is done with a stepper motor that operates a syringe, with a specifically chosen needle. A small optical detector ensures that the drop is properly ejected from the syringe. At the end of the drops dance, the final drop has to be guided to the borders of the transducers array, and eliminated. And then a new drops injection begins.

I have initiated in parallel a work on the chemical processes which takes place inside the drops after their merging. I tried to find the best ideas reading many scientific articles on self-division of macro droplets. A great chemist, Ludovic Jullien, helped me to find different chemical systems to try. To make my experiments, I wanted to find products available to all, not products that are found only in the laboratory. That made me find a very interesting product: the spermine and spermidine! Spermine is a compound first found in human sperm. This molecule has potentially anti-aging results and control the cell metabolism. You can then find them in capsules to swallow, with the product in powder inside the capsule. No doubt that it is THE molecule that I want to use for my system!

My tests on chemicals led me to a quite convincing system. I developed a chemical procedure, so that the meeting of the two drops of fluid can first produce a mixture of fluids, then the generation of a soft

⁵ A. Marzo, B. W. Drinkwater, PNAS January 2, 2019 116 (1) 84-89; first published December 17, 2018 <https://doi.org/10.1073/pnas.1813047115>

material, which then divide itself. All of this happens inside the drop levitating before our eyes. The color of the drop in which the process is taking place gradually changes to become pale pink, little by little.

III. CO-CREATION PROCESS

The residency allowed people from different fields of knowledge and countries to work together.

The first meeting with the tech project LEVITATE gave me the possibility to see the powerfulness of the 16x16 transducers array levitator. I met the postdoc Euan Freeman, who kindly showed me the device in action. We tested it to see if we could make small polystyrene beads dance around and meet at the end. This scenario could be validated. But at the end of this first meeting stage, I had to build my own device, without any help from LEVITATE, since they do not know how to build it and they didn't write the software to use it. However, the postdoc Euan Freeman was at the end of his position, and nobody in Glasgow was working anymore on that subject until the end of the residency.

In place I worked with a Spanish researcher, Asier Marzo. This was a very profitable meeting, which allowed me to replace the work to be done with LEVITATE by a work with Asier and his laboratory. He invited me to come to his lab, and I stayed three days to work on a simple system of levitation to start with. I came back to France with this first tiny levitator to start to make tests. We could then continue to communicate about the levitation process, and the 16 x 16 array device to build. I finally bought the material and Asier made the device in Spain. But this step was extremely long, since Asier is a researcher, who has all his work to do, and is not a levitator device builder.

I also worked with David Olivary for the injection part of the device. David is used to work with artists on their electronic devices. He is very competent and reliable. We work easily together since I made an engineer school and a scientific PhD, and we fully understand each other.

IV. IMPACT

A. Research Impact

LEVITATE tech project and Asier Marzo generally don't use ultrasonic devices for manipulating drops of liquids, and even less to make them undergo chemical reactions. The way I will insert drops of liquids inside the device, manipulate these drops and make them react together will be of great interest for both of them. Lots of chemists and biologists would like to test chemical reaction and biological process in levitation, outside of any container and any gravitational force. From a purely scientific point of view, the study of protocells has never been performed under zero gravity whereas it would be particularly judicious. For it is very possible that the early life-forms were formed on meteorites. This work could open a new axis of scientific research and would constitute perhaps a nice step on our understanding of the early live-forms formed outside the earth.

B. Artistic Impact

The novelty of this artistic work will also be the combination of technical performance to control levitation and the simultaneous control of the chemical processes of these drops. *Suspended moment* is an attempt to be above all an emotional experience. It does not try to recreate a «small laboratory» in the exhibition space. The aim is to make things come into the sensory sphere. To bring the public to witness a suspended moment, out of time, when the very first life begins. Because scientific research advances on a path on which the sensitive does not have its rights. Yet, sensations are part of our ability to apprehend issues affecting the living. The philosopher Marie-José Mondzain speaks of the necessity for a collective



questioning «on the political destiny of our emotions». A principle that the philosopher Gabriel Tarde already mentioned: according to him, artistic productions can allow to socialize the sensations. Art can here ensure its historical function, which is to produce the imaginary proper to this life creation.

This does not mean that the work is only based on emotion. It connects on the contrary all the links that bring together experiences on protocells: the beginning of life on earth, the eventual emergence of life outside our planet, the possibility of the existence of an extraterrestrial life... But also, the fact that we are now at the point where we can really SEE with all our sophisticated technologies how things are happening. This raise some questions: the possibility that the human hand intervenes now in the very first phase of the elaboration of life, to move from protocells to living cells. Or that some researchers handle more and more the content of gametes in the process of human procreation. Practices that raise the question of ethics, and the limit that our society will choose to give to this kind of manipulations. Without losing sight, never, during the researches, that it is about life.

V. ART-SCIENCE INTER-RELATIONSHIPS

The concomitant progress in the fields of materials science, cell-biology and biochemistry leads to a very large number of studies on the relations between inert matter, artificial living matter and living matter. One of the key points on these issues is the understanding of what makes life emerge from inert matter. The sciences of life, chemistry and physics must unite to seek to solve the great enigmas of this question. A meeting point for exact science and human science researchers, putting the ontological questions again - that man has always asked - what is life? Are we alone in the universe? Or even: can man give itself the right to create new forms of life from nothing? A question that ethics committees are certainly asking at the moment, the advances in this area being so fast.

VI. FUTURE DIRECTION AND ACTIONS

The next step is first to finish the art work. I will then contact lots of different art places to organize art exhibitions, in France and abroad.

I am also planning new artworks using the same scientific and technological framework.

Finally, I am sure that I will continue to communicate with Asier Marzo, since he is developing new devices, different from ultrasonic levitation, that could be useful for my work. We had very fruitful interactions, and we would like to continue. He would also be very happy to participate to other artworks with me.

VII. CONCLUSION

To work in the context of STARTS VERTIGO residencies is a wonderful opportunity for me. My difficulty was that the TECH PROJECT was not really able to provide any help on the technical or scientific aspect of the work. The residency has to be an exchange of knowledge between the two protagonists, the artist and the Tech Project. But I still don't see what the TECH PROJECT wanted to share with me. I had then to search by myself somebody else, able to help me to make the levitation device. I hopefully found it, Asier Marzo. But it took me time, and since he was not integrated from the beginning in the residency, he had no reason to concentrate on my device, and it took me a lot of time to be able to get the technical device. Fortunately, I could manage to continue the residency with him. And, even if it took me much more time to start than expected, I am now in the best conditions to continue and realize even a better artwork than intended. I hope I will be able to share experience with STARTS VERTIGO for the following for the last stages of the work, in particular its exhibition and its promotion.

ACKNOWLEDGMENT

My specific acknowledgment are going to the starts vertigo program, for giving me the possibility to develop *Suspended moment*. I acknowledge all its staff, and specifically Louise Enjalbert and Gregory Beller. I thank very warmly the scientists Asier Marzo, and David Olivari. I also thank a lot the LEVITATE tech project, specifically Euan Freeman, Jens Ahrens, and Julie Williamson.