Artwork presentation

Residency name: SENSORIAL SKIN [for an Intelligent Beehive]

Artist: ANNEMARIE MAES

General presentation of the artwork:

1. The project

It is by now well accepted that the ecosystem that sustains our human life is under great threat. One of the threats is the survival of the honeybee on which we crucially depend for pollination. My long-term Intelligent Beehive project researches sustainable solutions on the edge of art and science. Its goal is a double one. The inside of this bespoke beehive [Fig.1] offers a safe refuge tailored to the needs of a honeybee colony as if they were living in the wild. A co-habitation with symbiotic bacteria has a positive influence on their immune system. The outside of the hive is a biosensor that interacts with the environment. A bacterial biofilm measures the pollution of the foraging fields around the beehive by changing color when a specific threshold of fine dust is passed, because the bacteria change their internal (and hence external) state based on the degrees of atmospheric pollution that causes them stress [Fig.2]. The bacterial shield will thus reflect the information about the state of the environment, for example by changes in light, color or texture, so that the cover shield becomes a 'sensorial skin'.

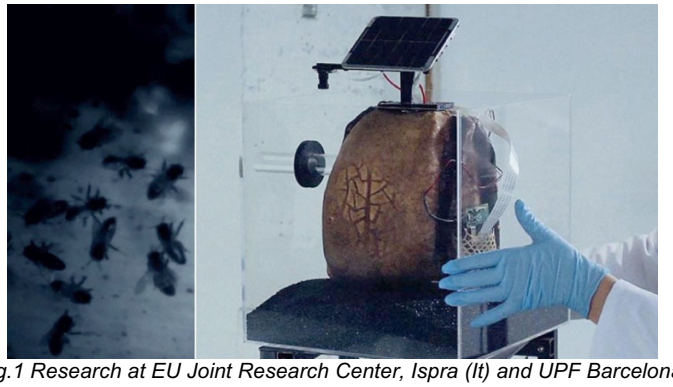

Fig.1 Research at EU Joint Research Center, Ispra (It) and UPF Barcelona, Complex Systems Lab (2016-2017)

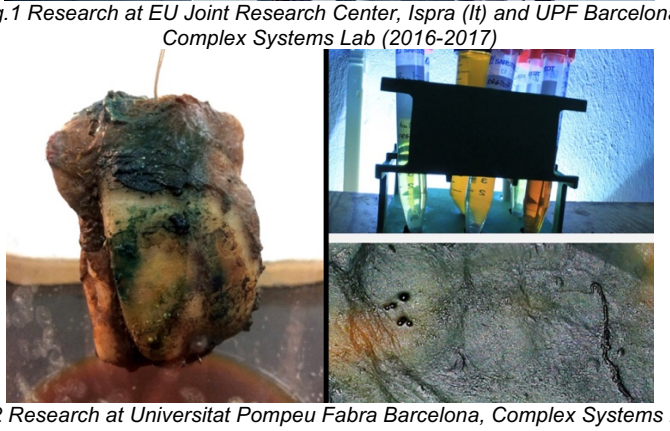

Fig.2 Research at Universitat Pompeu Fabra Barcelona, Complex Systems Lab and DIY BioLab Barcelona (2016-2017)

2. The research

My recent research developed this latter aspect, namely the Sensorial Skin on the the exterior shell of the beehive. I studied the possibilities to create a shield around the beehive, a biofilm grown by cyanobacteria [Fig.3]. Photosynthetic bacteria are autotrophic, which means that they provide in their own energy. They contain light-harvesting pigments, they absorb carbon dioxide, and release oxygen. In an actual phase, I am growing these bacteria in the form of a biofilm on a 3D printed, nutrient-rich exoskeleton that is representing the design of the beehive [Fig.2; Fig.9]. The cyanobacteria in the Sensorial Skin are reacting to airborne pollution particles. The effects of these reactions are visible through changes in color or texture of the biofilm.

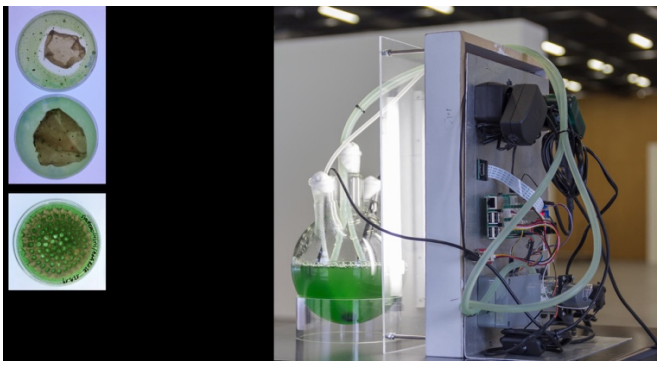

Fig.3 Growing and monitoring bacterial cultures, and tests on 3D printed shapes.
Hybrid Forms Lab, VU Amsterdam (2019-2020)

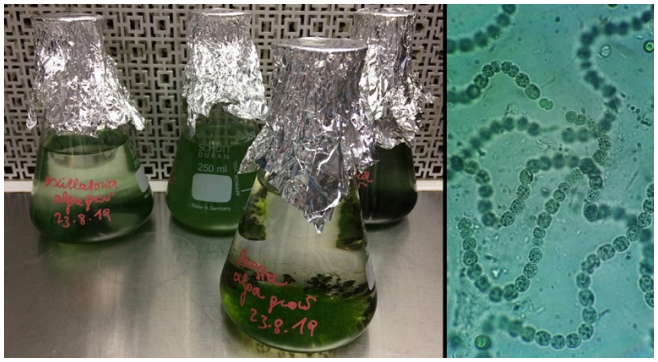

Fig.4 Monitoring of cyanobacterial cultures with the light microscope,
Open BioLab Erasmus Hogeschool Brussels (2019-2020)

3. The artwork

The work 'L'Origine du Monde' [Fig.5, Fig.6 and Fig.7] is the first artistic outcome of my research with respect to the creation of an organic grown Sensorial Skin. The installation 'L'Origine du Monde' shows a strongly enlarged bacterial chain made from glass cells. Every cell is filled with cyanobacteria producing real-time photosynthesis. Together they form a complex microbial population that communicates via quorum sensing and reduces CO2 emission from the air, whilst producing oxygen and biopolymers. Due to these qualities, the bacterial chain can be qualified as an active biological interface.

Fig.5: L'Origine du Monde, try-outs and SEM photography of bacterial chain. Brussels (2020)

Photosynthetic cyanobacteria are autotrophic, which means that they take care of their own energy provisioning. They perform photosynthesis in a similar manner to plants. They contain light-harvesting pigments, they absorb carbon dioxide, and release oxygen. These micro algae have had a huge impact on how our planet evolved. They contributed heavily to the biodiversity on earth, by helping to convert the earth's early oxygen-deficient atmosphere to an oxygen-rich environment, so that new organisms that were dependent on oxygen began to emerge. This is also why I call this artwork, which is a result of my research, *'L'Origine du Monde'*. The title is of course a wink towards the famous painting of the French painter Gustave Courbet.

The visual aspects of the artwork progress over time during the exhibition: in every glass cell, the bacterial colonies grow and consequently, their color deepens in hue, which gives the audience a different experience with each visit. The overall installation of the work is very versatile. It consists of 50 individual, custom made borosilicate glass cells (each ± 15cm long en ± 12cm in diameter). It can be presented in a range of different setups: a cluster of large chains, smaller chains, or individual couplings, presented on hot rolled metal sheets [Fig.6] or presented in a kind of laboratory setup on tables or pedestals. The latter presentation focuses more on the metabolism of the cells and the process of photosynthesis, whereas the 'chains' presentation focuses on the general concept [Fig.7] of a living interface. But for me, as an artist, the aesthetic dimension is equally primordial. The forms created by natural systems such as bacteria have an astounding beauty which needs to be made visible. It creates awe and hence appreciation and respect for Nature.

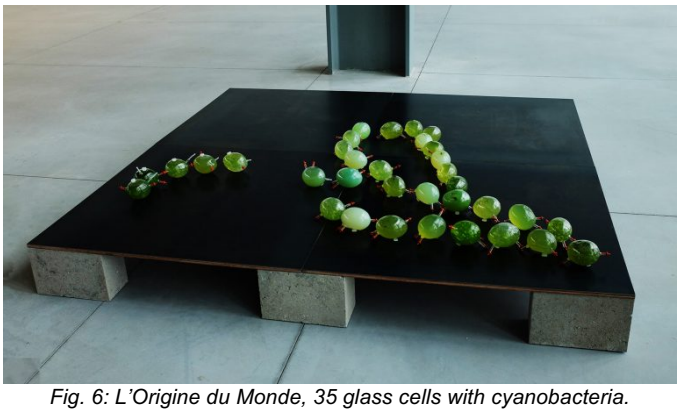

Fig. 6: L'Origine du Monde, 35 glass cells with cyanobacteria. Exhibition 'New Green Deal', Regional STARTS Kortrijk (2020, Be)

Fig.7: L'Origine du Monde, 35 glass cells with cyanobacteria. STARTS residencies days, Le Centquatre, Paris (2020, Fr)

With the artwork 'L'Origine du Monde', the project 'Sensorial Skin' [for a Guerrilla Beehive] tackles a new challenging application domain where a collaboration between human and non-human actors comes in action to maintain the resilience of our ecosystem. As artists, scientists, beekeepers, makers and thinkers, we have to collaborate with insects, plants and micro-organisms. With the bees as go-between, and with the help of bacteria, the bio-design of the Intelligent Guerrilla Beehive has come into focus. This project is driven by the intelligence, complexity and self-organisation of a Super Organism. The collaboration with Nature should lead to a more diverse and thus more resilient system, post-human and post-anthropocentric.

Technical set-up:

The presentation of the artwork 'L'Origine du Monde' is rather simple. The installation requires a room of at least 5m by 5m or larger, with natural light but no direct sunlight. Living organisms -cyanobacteria- are the most important part of this work, and they will need to make photosynthesis to grow into colonies during the time of the exhibition.
The installation can take multiple directions for presentation. The focus can be on the form of the bacterial chain, inviting the public to learn more about what this object stands for (Fig.5, 6 & 7); or the focus can be on the art/science research. In this case, the installation can be completed by a setup of research items, as there are the DIY bioreactor (Fig.8) and or some samples of biofilms grown on miniature prototypes of Intelligent Beehives (Fig. 9). The additional research items will be presented on a separate pedestal or table.

<u>Resources for the presentation of the installation to be provided by organiser</u>:

- A presentation platform of 2m x 2m (height variable) topped with a sheet of wood (for stability) and a top layer of black metal sheets of 2 mm (cfr. Fig.6 and 7).
- Window with natural light (no direct sunlight)
- In case of short exhibition (less than 1 week), the installation can also be shown in a room with artificial light
- Transport and insurance covered by the organiser

Resources provided by the artist:

- A contingent of (max. 50) handmade glass cells filled with biological growth medium, each of the cells inoculated with cyanobacteria. The cells can be presented in clusters of large chains, smaller chains, or individual couplings. The are on a support of hot rolled metal sheets [Fig.6] or presented in a kind of laboratory setup on tables or pedestals.
- The artist will prepare the cells (1 day work for 25 cells, 2 days work for 50 cells) in her lab (for exhibitions with transport less than 1 day) or on location (for longer transports/distances). In the latter case, a room with access to water, electrical boiler, microwave oven and working table needs to be provided by the organizer).
- All items (glass cells, DIY bioreactor + electronics + sensors) come well packed in wooden boxes.
- The artist will set up the installation once the cells are prepared. Set-up time: 1 day.

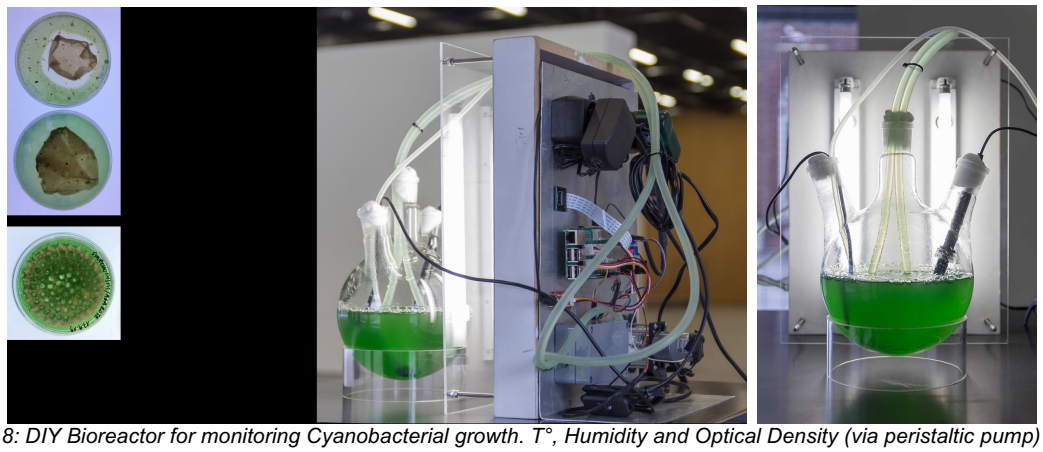

Fig.8: DIY Bioreactor for monitoring Cyanobacterial growth. T°, Humidity and Optical Density (via peristaltic pump) are monitored by digital sensors connected to a Raspberry Pi microcontroller. Exhibition 'Seeing Together' at KASK Ghent (Be), Sept. 2019

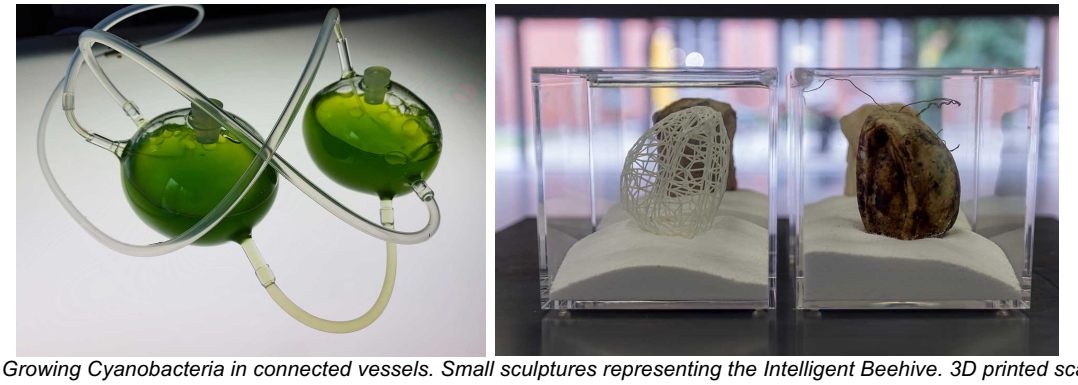

Fig.9: Growing Cyanobacteria in connected vessels. Small sculptures representing the Intelligent Beehive. 3D printed scaffold, bacterial skin grown around scaffold and inoculated with a layer of cyanobecteria. 'Seeing Together', KASK Ghent), Sept. 2019.