

Microbial Schöppingen

By Mick Lorusso

Microbial Schöppingen, a model based on an old German village, acts as a parallel town where communities of bacteria, one of the most ancient life-forms on earth, inhabit Plexiglas houses where they work together to create light.

Bacterial communities are diverse, much like human communities, and each type of bacteria can perform a number of different functions within their society. In Microbial Schöppingen, certain bacteria make an electrical current as they break carbohydrates down into smaller molecules, namely carbon dioxide and hydrogen. These anaerobic bacteria, meaning they live in spaces without oxygen, gradually build bio-films, thin groupings of bacteria stuck together, on graphite electrodes.ⁱ Each anaerobic house connects to a neighboring oxygenated house via a semi-permeable membrane. Protons, (hydrogen ions) travel through the membrane from the anaerobic chamber (the negatively charged anode) to the oxygenated chamber (the positively charged cathode). The electrons that the bacteria release as they eat collect on the graphite electrodes and push their way through the wire and a resistor toward the cathode. Once these bacteria have developed a strong habit of eating in this way and releasing electrons and protons in the process, they can be harnessed to create small currents of electricity. The technology is known as a Microbial Fuel Cell.

Researchers at the Laboratory of Microbial Ecology and Technology (LabMET) in Ghent helped me make these Microbial Fuel Cells function more efficiently. When we met, they described a variety of applications that Microbial Fuel Cells could have: making bio fuels and plastics, recharging off shore ocean sensors, and cleaning wastewater.

To create the microbial communities for Microbial Schöppingen, I combined local river mud, which can contain the necessary metal reducing bacteria, with a sample of “trained” electricity-producing bacteria from LabMET in a large one-chamber MFC, which was producing 0.4 Volts with approximately 5 milli-Amperes within a month. I divided the mud and water from this “Mother” Fuel Cell into smaller two-chamber Plexiglas Cells, in the shape of paired houses. After another month of experimentation, I connected my best MFCs in series. For four days I continuously monitored and fed them to help them maintain a high enough voltage to power a bright white 3 Volt LED placed in the center of the Altes Rathaus (Old City Hall) model. The light from the Altes Rathaus projected shadows of the town architecture on the wall of the gallery, which became a screen for short wordless shadow-puppet plays about the lives of the bacteria producing the electricity. Public from the Künstlerdorf, from Schöppingen, and from nearby towns came to see the work and speak to me about the convergence of science and art in this sculpture.

Inspired by a local bronze model that depicts the village of Schöppingen in 1600 surrounded by walls that form an organic, cell-like shape, I decided to construct a version of the old town. Its concentric walls that embrace little houses provide a visual reference for the idea of holarchy,ⁱⁱ in which a system of interacting wholes (called holons) are imbedded parts of more complex holons. The cells inside our bodies are great examples of holarchy, in which tiny ancient bacteria became the unique functional components of each large human cell. Some of them produce energy, others store data, and others clean and regulate the cell. They are holons within another holon (the cell) and our cells are holons within our organs, making a fraction of an ever-expanding holarchy. In the same way, Microbial Schöppingen can be seen as a collaboration of cells, an organ, a body, a town, and even a galactic system, depending on one's perspective.

The model town could be described as a Utopia, and alternately as a Heterotopia, a term developed by Michel Foucault to describe places and times that operate on the fringes of hegemonic society: pockets of otherness that give us a glimpse into the underlying dynamics of society.ⁱⁱⁱ As a Utopia, Microbial Schöppingen imagines a sustainable Schöppingen on a tiny scale, a place where its inhabitants create electricity from waste, sugars, and acids. But it might be more accurate to see Microbial Schöppingen as a Heterotopia, since it reflects on a hidden and often rejected layer of our world: the world of tiny unicellular beings that cooperate with each other and with us to do millions of things, which we often judge as good or bad. This world exists parallel to our own daily, ordered, reality. Long before we developed the Internet, bacteria developed the first efficient information exchange technology in the double helix of DNA. They, unlike us, can directly exchange and recombine DNA while they live, allowing them to adapt and evolve rapidly.^{iv} And we can learn from them in many ways if we observe them. They can give us new insights into our technologies, our waste management issues, our body systems, our architecture, and even our social systems. On a fundamental level, they remind us of the versatility that all life has in harnessing and transforming energy.

Like the bacteria in Microbial Schöppingen, we work together to pool our energy and our ideas. We evolve in our ways of communicating and using resources. We can transform our hearts and minds and bring light into the areas of our lives that lie hidden or rejected. That which seems dirty and useless to us can reappear as something glowing with value if we look deep enough and break out of conditioned ways of seeing. Humanity is at an important threshold point, and if we look to the other, more ancient species on our planet for guidance we may find many beautiful suggestions of how to deal with our current ecological and social crises. Together we may sustain the light at the core of all life.

Technical Details and Maintenance for a Museum Setting:

Since Microbial Schöppingen is not connected to any pumps to circulate nutrients and regulate pH, it requires daily manual feeding and monitoring of pH to insure that it continues to produce a high enough level of electrical current to illuminate the 3 volt LED in the Altes Rathaus and even a second 1.8 volt LED in the church. Although the first version of Microbial Schöppingen did not include a capacitor in order to show how much power the bacteria were producing in the moment, future presentations would include capacitors to supply the LEDs with a more regulated current.

Although I originally fed the bacteria with discarded household starches, fruits, and sugars, in a museum setting, the easiest feeding method would be with acetate (vinegar). The pH tends to become acidic over time, so baking soda can be added to make the solution more alkaline.

For a museum presentation, I would invite performers to interpret the lives of bacteria in shadow puppet plays in front of the light from the small Altes Rathaus, based on discussions with microbiologists at LabMET and research on bacterial communities.

Thanks to:

The Stiftung Künstlerdorf Schöppingen, Germany, for sponsoring and encouraging the creation of Microbial Schöppingen.

The Laboratory of Microbial Ecology and Technology (LabMET), at the University of Ghent, Belgium for their technical support and guidance

ⁱ Graphite electrodes include graphite felt generously donated by the SGL group, and graphite granules bought from Mersen.

ⁱⁱ A term coined by Arthur Koestler that Elisabet Sahtouris uses to describe a hopeful perspective on human co-evolution with the planet: Sahtouris, Elisabet. *Earthdance: Living Systems in Evolution*. San Jose: iUniversity Press, 2000.

ⁱⁱⁱ Foucault, Michel. "Of Other Spaces". *Utopias: Documents of Contemporary Art*. Ed. Noble, Richard. London: Whitechapel Gallery, 2009.

^{iv} Sahtouris, Elisabet. *Earthdance: Living Systems in Evolution*. San Jose: iUniversity Press, 2000. pg. 45.