BIO-SONIFICATION

I've been working with/exploring various methods of bio-sonification for quite sometime now. Placing pic-up mics, transducers, bone conductors onto surfaces, inside molds, buried in soil. Working with 555 timers and ATMega chips and various electrodes really started taking shape in 2016 with slime mould and quickly moved into fungi. *Visit my residency info to see what I am currently up to>
2011 was when I started looking for sustainable materials. Materials with less of a negative impact then working with metals, or working with glass. To be honest, this venture has not been an easy one. Everything has an impact. Even being a raw vegan has its down side. Trying to be zero waste for me is virtually impossible, but perhaps there is a way to use this waste towards cultivating mycelium? But even this takes energy. Can bio-sonification be used in tandem with bio/myco-remediation? I think it can.

All that to say, Bio-Sonification to me is a way to connect people with nature, with nonhumans through sound. Sounds heard and felt create lasting memory.
If my work makes someone stop and question, "...should I cut down this tree..?" or "Is my life more important than running over a rabbit or hitting a deer, rather than slowing down?" Then I feel my job is done here.

To paraphrase Sam Cusumano
“Bio-sonification,” basically means using technology to turn the bio-rhythms of living organisms into sound.

Biodata Sonification is a process to translate complex real-time sensor data into musical notes and controls, exploring auditory sensory modality to provide insights into invisible phenomenon. The Bio-Sonification module is a purpose-built circuit able to detect micro fluctuations in conductivity that have a duration between 1000th and 100,000th of a second.
The Open Source Biodata-Sonification Modules were originally designed and created by Engineer, Sam Cusumano. Visit Sam’s biodata forum over at electricity for progress http://electricityforprogress.com Plus, he sells a bunch of super cool electronic kits, boards and more!

While in Australia researching bio-sonification of Gum trees and Aussie fungi, I was interviewed by ABC
What do mushrooms sound like? On Statewide Drive with Fiona Wyllie
https://www.abc.net.au/radio/programs/nsw-statewide-drive/recording-mushroom-magic/11501874

Neuroscientist, Dr Yewande Pearse interviewed me for her Sound Science Podcast:
https://www.soundsciencepodcast.com/episodes/2020/9/14/episode-18-forest-underground

Projects working with Bio-Sonification include:

- Do Mushrooms Dream of Electric Humans?
- Chaos fungorum
- The Mycelium Martian Dome Project
- Forest UnderSound
- Symbiosis.Dysbiosis
- The Mycorrhizal Rhythm Machine
- Mycelia for A MAZE Berlin with collaborator Sara Lisa Vogl - VR/IRL performances check it out> nanotopia

Bio-Sonification modules -all based off of Electricity for Progress's design/schematic/code:

• Sam Cusumano's Midi Sprout: https://electricityforprogress.com/
• Spade Electronics (Italy) expanded Midi Sprout called the **Symbiotic** with CV, Gate, Trigger output!
https://www.tindie.com/products/spadelectronics/diy-kits-symbiotic-biodata-sonification-midisprout/
• Instruo module for Eurorack, the gorgeous Scion: https://www.instruomodular.com/product/scion/
• Clatters Garden Listener (Eurorack): https://www.thonk.co.uk/shop/clatters-garden-listener-full-diy-kit/
• Arduino Shield Build: PDF Download

• Manuel Domke: https://leetronics.de/en/blog/2017/08/04/midi-biodata-sonification-device-settings-menu-for-the-midi-sprout/

BioData Workshop in Northern California at the Larry Spring Museum of Common Sense Physics 2022
Biodata workshops 2023 at Interaccess- sign-up to Axon
Biodata workshop in Venice, Italy

Politically speaking- Nanotopia's work with bringing fungi biodata, fungi frequencies into mixed reality installations, VR is to speak of our shared environment, humankind's Other-than-human entanglements.

People often view -nature- as something outside of themselves; nature is over there, in a forest, or nature is the weather. This is how, in my humble opinion, many humans can deny the climate crisis- which is indeed a crisis for life.
Being Terrestrial- humans require clean air, clean water, and clean food to thrive and survive, as does most oxygen-breathing life on Earth. Earth. Humans come from the Earth; therefore, they are a part of this incredible organism. However, centuries of religious oppression have sadly sought to remove humans from the natural world—position humankind as "man-kind" and remove it from nature, from being animal.
Being Human is a collection, an entanglement of organisms that make up the whole, a Holobiont. Fungi are a significant aspect of our human entanglement.

If you've read this far- thanks! ;)

Meanwhile, here is a link to a sonic podcast episode the Goethe-Institute commissioned, headphones are best for the spatial quality.
Sounds of Nature: https://www.goethe.de/prj/tbp/en/eps/son.html

Kindly
Tosca

Saturday, April 14th 2018 started the Mycelium Network's podcast/radio station called, Midnight Mushroom Music. Tune in Saturday nights & float into the Mycelium network. Non-human lullabies. Non-human sound-based collaborations.
I am starting with Mycelium midi bio sonification.
First experiments placing electrodes onto mycelium, which send impulses that are converted to Midi. This Midi data is then plugged into AniMoog. Mycelium Music.
Each Saturday the pulses taken from various non-Human organisms will be introduced.

Badhamia utricularis. Image: Marco Bertolin

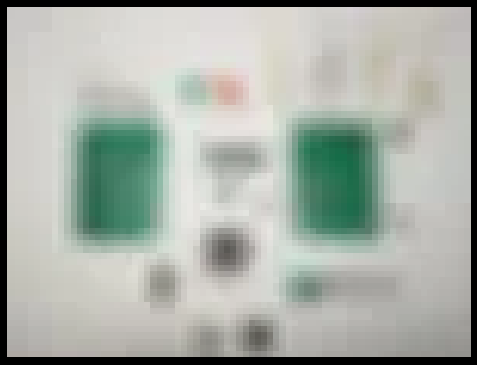
Saturday, April 17th 11pm, Myxomycetes: Physarum polycephalum, literally the "many-headed slime"
Tune-in to Midnight Mushroom Music and contemplate the unknown.
I've been working with sensors, modifying them, building them from scratch to purchasing them from Sparkfun/Adafruit, and other vendors for decades. My fascination with what makes 'us' Human, and the vast, incredible world of non-Human organisms and the possibility of collaboration- I find thoroughly exciting! I believe every species has a language (if you will) of its own. Whether through body language/signals, eye movement, chemical, vibration or pattern language is not always represented in word or sound.
It was through a workshop, in 2016 with doctoral candidate, Sarah Choukah that introduced me to Slime mould, aka Physarum polycephalum. Sarah implied that we all consider collaboration with the non-human. What that means, how that might look. At the time I was already researching algae, mosses, lichens, kelp towards the concept of renewable, sustainable sculpting materials, that might also be used towards bio/myco-remediation. Now I would view my research as a collaborative effort- with the non-Human entities I touched, caressed, grew. Having 'minds' of their own, I could create a scenario, however, it was anybodies guess what direction(s) it might grow in (literally!). This, to me is amazing and room for a lot of discovery.
Mycelium.
the vegetative part of a fungus or fungus-like bacterial colony, consisting of a mass of branching, thread-like hyphae. The mass of hyphae is sometimes called shiro, especially within the fairy ring fungi. Fungal colonies composed of mycelium are found in and on soil and many other substrates. A typical single spore germinates into a homokaryotic mycelium, which cannot reproduce sexually; when two compatible homokaryotic mycelia join and form a dikaryotic mycelium, that mycelium may form fruiting bodies such as mushrooms. A mycelium may be minute, forming a colony that is too small to see, or it may be extensive:
Is this the largest organism in the world? This 2,400-acre [970-hectare] site in eastern Oregon had a contiguous growth of mycelium before logging roads cut through it. Estimated at 1,665 football fields in size and 2,200 years old, this one fungus has killed the forest above it several times over, and in so doing has built deeper soil layers that allow the growth of ever-larger stands of trees. Mushroom-forming forest fungi are unique in that their mycelial mats can achieve such massive proportions.
— Paul Stamets, Mycelium Running[1]

pesticides (typical soil contaminants) are organic molecules (i.e., they are built on a carbon structure), and thereby present a potential carbon source for fungi. Hence, fungi have the potential to eradicate such pollutants from their environment unless the chemicals prove toxic to the fungus. This biological degradation is a process known as bioremediation.

Mycelial mats have been suggested (see Paul Stamets) as having potential as biological filters, removing chemicals and microorganisms from soil and water. The use of fungal mycelium to accomplish this has been termed mycofiltration.
Knowledge of the relationship between mycorrhizal fungi and plants suggests new ways to improve crop yields.
When spread on logging roads, mycelium can act as a binder, holding new soil in place and preventing washouts until woody plants can be established.
Since 2007, a company called Ecovative Design has been developing alternatives to polystyrene and plastic packaging by growing mycelium in agricultural waste. The two ingredients are mixed together and placed into a mold for 3–5 days to grow into a durable material. Depending on the strain of mycelium used, they make many different varieties of the material including water absorbent, flame retardant, and dielectric. [2].
I ordered Mycelium material from Gro.Bio aka Ecovative Design at some point in 2016/17. Already working with gourmet mushroom grow kits, I was interested in how Gro.Bio's GIY materials might differ. And they certainly do in many ways. For one, GIY materials arrive in a dry state and you have to add flour and water to the substrate to activate the mycelium within.

Gro.Bio combine mushroom mycelium with various substrates: hemp, flax, aspen and Kenaf. I started with hemp and flax. At first the flax didn't appear to be growing well, while the hemp mix was. After a week the flax took-off and kept growing! In February '18 I started printing up circuit boards towards my own capacitive sound sensors.... which got me thinking about sound collaborations with the Mycelium. I was already intrigued with the Slime mould music Paloma Lopez and Leslie Garcia were experimenting with through bio-electrical activity translated into a sound process with the Energy Bending Lab and the Phytracker. So, I research further on how I might construct my own version of a Bio-Sonification circuit and came upon the Midi Sprout. MIDI Sprout translates biodata from plants into music. That said, I could not afford a Midi Sprout so, I turned again to Google to find a method of, perhaps replicating the Sprout.
Parts:

- Circuit Board
- Power Header (2Pin)
- ATMEGA328P-PU (pre-flashed)
- LMC555/NOPB
- 10K Potentiometer with Switch
- 100µF capacitor
- MIDI connector
- 16MHz Oscillator
- 3,5mm Mono Input Jack
- Electrode pads & cable
- 7x 220R resistor
- 2x 100nF capacitor
- 1x 0,047uF capacitor
- 1x 100K resistor
- 6 LEDs (2x red, 1 blue, 1 green, 1 yellow, 1 white)



All of the above I found through 13-37.org an open-source electronics shop founded in 2017 by Manuel J. Domke with the mission to make open-source hardware available for the german and european market. SHAZAM! That said, this Open Source module was designed by Sam Cusumano of Electricity for Progress. From my understanding, Sam designed this biodata-sonification module for Data Garden, who would go on to crowd fund it as the Midi Sprout. Which evolved into the Plantwave. Other artists and musicians have also taken Sam's Open Source code and schematic to make their own modules. One amazing Eurorack module is Instruo's Scion.

Hooking up electrodes* to the Mycelium yielded crazy results, more than what I had anticipated would happen. The Mycelium clearly prefers the dark, does not at all appreciate being subjected to UV light. Lights out = lovely, calm bio-electrical activity.

Electrodes:
Electromyography is an electrodiagnostic medicine technique for evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed using an instrument called an electromyograph to produce a record called an electromyogram. An electromyograph detects the electric potentialgenerated by muscle cells when these cells are electrically or neurologically activated. The signals can be analyzed to detect medical abnormalities, activation level, or recruitment order, or to analyze the biomechanics of human or animal movement OR create music! ;)
Biomedical Sensor Pads, disposable electrodes that can be used to measure EEG, ECG and EMG levels. these little pads are perfect for short-term monitoring of Neurofeedback and Biofeedback purposes.

1. Stamets, Paul. Mycelium Running, Ten Speed Press, U.S.A. 2005 (p. 45, caption to figure 60)
2. Kile, Meredith (September 13, 2013). "How to replace foam and plastic packaging with mushroom experiments". Al Jazeera America.

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