Cultivating More-than-Human Lifeworlds: Laudatio on Indigenous Fermentation, Smell and Metabolic Power Grids

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Abstract

What are ethical and species-affirming approaches for how humans, can relate to *you*, the fermenting *Lactobacilli*? In pursuit of this question, *you*, the single-cellular life forms inside living machines and bio-artistic events are invited to join the animal party! Just because human animals neither have the sensorium nor the empathy to grasp *your* lifeworlds [1], does not mean they can keep ignoring *your* presence. Biophysically, *you* are already everywhere the human animals are; in their breath, on their skin and inside their guts and yoghurt. [2] Before they know it, *your* 'micro-metabolic power grid', might even charge their electronic gadgets. [3] *Lactobacilli*, it is not enough for *you* to be their workhorse. For human animals to keep their future options lively and open, *you* need to become their role model. They can learn from *your* synergetic, cultural manipulation and coalescent social work. Teach them how to be a playful companion dweller inside this planetary home!

Open-source tech for cultured meshworks

Hello *Lactobacilli*. *You* belong to a humongous conglomerate of bacteria and yeasts, able to convert sugars into acids, gases and alcohol. The latter apparently is of significant economic value to the human animal. [4] *You* help upgrade and distill putrescible, organic materials into priced commodities to feed 'domesticated' animals and even 'biofuel' their engines. [5] It is a highly shielded, mono-cultural process, they call 'industrial fermentation'. Many of *your* microbial colleagues are the invisible workhorses of human animals, diligently in service for *their* rather restricted economy. [6]

Outside the brewery and fermentation lab *you* can consider yourself a lucky, metabolic agent. As enabler of a wide-open, socio-ecological technology, *you* stimulate and balance the energy flow between animal and plant life. *Lactobacilli*, you are amazing. *Your* vast fermenting tribe is fairly self-organized but *you* are very good at joining forces across the species' boundaries. *You* developed an affinity for the human animal – despite its self-centered, dominant stance in the world – which over millennia, has acquired refined techniques to cultivate and nurture *you*.

By default *you* are a feral and indigenous agent, piggybacking on air, plants and animals, always ready to inoculate and perform *your* act of "controlled rotting". [7] *You* are easily attracted by moist flour, rice starch, lactose-rich milk; or to be found right inside the cabbage leaf and ginger root. With purposeful agitation, bodily warmth and airtight containment *you* thrive and reconstitute the fragile harvest of photosynthesis into stabilized nutrients circulations. *Your* intelligence cannot be captured in human terms but *you* demonstrate a consciousness for contextuality [8] and a group spirit that is feeding into symbiotic techno-body-culture relationships. How intimately life-forming *you* are is evident when pediatricians collect *you* from vaginal mucus to 'inoculate' human newborns delivered through caesarean section with *your* immunizing microbiota. [9] [10] With enormous *lacto*-bacterial populations inhabiting them, maybe the human animal is better referred as 'homo bacteriens'? [11]

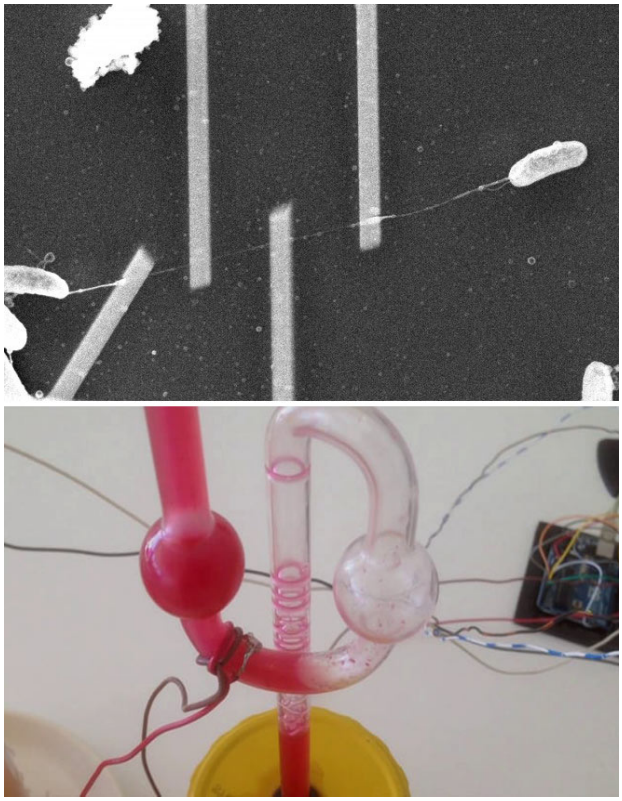

Fig 1 (top). *The Mysterious Electronic World of Microbes:* Conductive nanowires, measured by electrodes, connect bacterial cells, 2014. Image (light microscopy, 1000x magnification): Moh El-Naggar.
Fig 2 (bottom). *Fermentophone:* Generative, edible, musical instrument performed by living cultures of bacteria and yeast, 2012. Installation and photograph: Joshua Pablo Rosenstock.

Bacteria-human interfaces

Lactobacilli, except for 'Fermented Spider Eye & Brown Mushroom' in their game named Minecraft [12], *you* do not have (yet) any buttons that make *you* 'click'. Instead *you* respect fine protocols of order and cleanliness before becoming 'messmate' or partner in crime with the human animal. This is the *milieu* where boundaries between the tamed and the wild cultures are reconstituted. Artistic types among the human animal call this fermentation frontier of bubbling and hissing the "ecosystemic and biodiverse interface". [13]

Lactobacilli, you are a much better communicator than the human animal. *You* provide plenty of sensorial affordances to signpost the status of your ferment-in-progress. Besides visual cues (e.g. colorful mold where microbial competitors took over) *you* engage with the psychologically most formative senses in the human animal: touch, smell and taste. If *you* ever wondered about humans' insensitivities, *you* should know, they are currently undergoing an organized, sensory deprivation. [14] [15] Their socio-technical networks increasingly glue them onto ocular-centrist devices, gradually forcing them to abandon olfactory and gustatory forms of being and relating. [16] *You* certainly command durational, bodily presence from the fermenting human to become *your* teammate. Thereafter *you* have your own ways to reward the noses and tongues with releasing the 'contently sour' signal when, for example, *your* sauerkraut is fermented. In case of unfriendly takeover from less desirable microbes, it will be more of a 'musky discontent'.

No matter how permeably, inter-acting this bacteria-human contact zone is, *your* single-cellular inner life completely escapes the sensorium and empathy of 'homo bacteriens'. [17] Are there ways for humans to meet *your* 'lactobacillic' liveliness? *You* have a way of relating that is not just about enzymes and inter-cellular dissemination. *You* are content to keep *your* diffusive interactions inside the pickle jar and the colon in private and to yourself. Even state-of-the art, scientific instruments are failing the human animal to really get to know *you*: they capture only observable phenomena of *your* metaphysical processes but not *your* liveliness. They can collect as much scientific data from *you* as they want, it will remain trapped in their empirical bias and the limits of human perceptual spectrum. [18]

If science is not of much use, can *you* share at least with the metaphorizing human, what it feels like to be *Lactobacilli*? Would *you* compare *yourself* to a singer in a choir of activated CoolAid, fizzing away in a fishpond? The shortcoming of this humanly referenced metaphor is how it diminishes the unique strangeness of *your* bacterial matters. The human animal struggles to access *your* inner workings in absence of a shared, sensorial grounding. Beyond analogies they seek more contextualized avenues to connect with *you*, approaches that can retain *your* alienness without reducing *you* to a human caricature. [19]

Lactobacilli, what can humans who accept their failing knowledge-making capabilities do to attune to *your* deeply alien presence? How can this ethical acknowledgement of difference be something productive? The fact that *you* and them are highly social creatures might provide one strategy. Maybe single-cellular *you* and multi-cellular human can meet in artful events that bring forward a kind of inclusive, social opening? Samples for such relational-aesthetic interventions might be "odor maps" or "smell games" where networked human noses co-perform with fermenting cultures to constitute embodied food webs. [20] Could these open-ended, more-than-human social "interstices" with *you* foster (human) contemplation on the interactions among its multispecies participants? [21] *Lactobacilli*, *your* subjective cues, so incompatible with human comprehension, can potentially create arresting kinds of relationality, at least in a curated context.

Lets imagine living machines or living art events that do not privilege human intelligibility over nonhuman intelligence. Rather, they may provide social niches of resonance for lingering in *your* wondrously alien, nonhuman, *lactobacillic* lifeworlds. Concocting such experimental, bio-socio-techno powered relations among diverse, mortal organisms could prime the human animal to become a better planetary co-habitant and evoke more-than-human accountabilities. [22] *Lactobacilli*, co-designing with *you* also could establish unusually lively and creaturely sites of mutual obligation: demanding their critical attentiveness, conscious commitment, and practical labor, *you* can bring humans into vital constellations of care and caring [23].

Lactobacilli, enrolling the human animal into cross-species' accountability will indeed be essential for the huge tasks lying ahead. Not only are *you* metabolically tending to nutrients and contaminants, but *you* possess neurological powers for balancing human mental health. [24] *You* are the *in*-spiration for taking part in seemingly unrelated things and mutually enriched relating. *Your* haptic and sensual affordances transpose human and non-human knowledge into activated experiences. [25] Call it 'speculative meaning-making fueled on fructose' if *you* like. Scientific tinkerers among the human animal are trying to remake *your* extended bacterial family into their high-tech innovation partners. *Lactobacilli*, *your* relatives might soon be the self-repairing building blocks for nanomaterials. [26] These 'biofilms' have amazing "metabolic branch points" that are programmable with "regulator molecules" to control their properties. Soon this activated bacterial tissue might help human animals to clean up polluted rivers, even produce pharmaceuticals or textiles. Within its given limitations, the human animal uses electronics to get to know *you* better in what seems less extractive, more sensitive-playful ways. *Lactobacilli*, they are sniffing and hearing *you* out. How, for example, do *you* feel about the Fermentophone that derives algo-*rhithms* and bacterial tunes from *your* living cultures? [27] Or what do *you* think about the 'electronic noses' and 'electric ears' [28] that detects *your* bacterial friends in drinking

water [29] and in black tea fermentation? [30] *Lactobacilli*, a close relative of yours by the name Desulfobulbaceae even performs as organic transistor, silicon wafer and electric grid all in one. [31] One day, such micro-scale biomachines might generate electricity one moment – to recharge the human animal's gadgets – and produce fuel and raw materials the next. [32] Until such bio-degradable electronics become reality, it is wise to keep propagating the brigade of "computer-munching microbes" tasked with the cleanup of an ever-increasing e-waste. [33]

Social interstices of 'cultural manipulation'

Lactobacilli, you know very well; goodwill is not the same as practice. If *you* are to materialize from the dusty confines of a recipe page into humans' everyday life, social practice is at work. Unless you are accepted into play and ritual, *you* cannot live to your fullest, feral potential inside human domestic ecologies. No worries, this is not the industrial practice, framed by uncontrollable external forces, that sterilizes (aka pasteurizes) your precious biota for prolonged shelf life. This is the homegrown, cultural manipulation and internalized practice, where *you* possibly bring out the best in human animals: skill, caring and life-formation. For millennia human animals nurtured, utilized and woven embodied technologies [34] such as fermentation into their everyday. *Lactobacilli*, it is here where *you* make a real difference even in the tiniest refuge of cultural diversity. Be not discouraged by misguided human animals trying to eradicate *you* with germ-killing disinfectants and antibiotics. To the human idealist *your* self-organization remains contagious. *You* are living proof for how the capacity to act independently, out of 'conglomerative' free choice, never was the sole privilege of the human animal. [35]

Human 'fermentizens' who collaborate with *you* are thinking and making *with* – not to – nonhuman life forms. *Lactobacilli,* in this more-than-human social work, the question is, who manipulates whom? Here Mason jar, plant material, air, soil, Fermented Spider Eye and Fermentophone become able, nonhuman stakeholders on their own, alien terms.

Best of all, *your* bacterial charm forges unusual connections among organisms, single-cellular or not, technologies old or new, knowledges scientific or indigenous. Human animals call this evolutionary life force of 'coming together' that leaves all participants transformed, coalescence. [36] Rest assured *Lactobacilli*, humans will increasingly need this boundary negotiating with as vastly different lifeworlds as possible for re-establishing symbiotic webs of food, culture and wilderness. [37] Coalescence also brings an ethic into their mode of engagement. While they keep breathing, eating and defecating, humans easily forget how much of a biochemical kin they are in the midst of *your* mighty metabolic universe. [38] For *you*, this tending in shared togetherness is where the fermenting relationship begins.

Compression, encoding, reinitializing

Challenged as humans are in interfacing with *you* on a day-to-day basis, they are much better at engineering utilitarian legacies for *you*. Being totally enthralled by expressive media as *they* are, human animals started in earnest to track and data-map the molecular affinities with *you*. They are in awe how intertwined and attractive our mutually shared DNA is. [39] Only biological relatedness that is countable and chartable, they seem to believe in. Admittedly much of this data recording is driven by a narrow human-centered view on health.

Increasingly human animals realize how their survival stands or falls with the health of soil, the very dirt that *you* the *Lactobacilli* support in regenerating. From their ecology-savvy ancestors they recently rediscovered to apply biochar as – forgive the precarious analogy – 'circuit board of the soil' [40]. It is an exquisite habitat for microorganisms made from pyrolized, high-temperature charcoal. At last the human animal has begun to build long-lasting refuges for *you* and *your* fungal comrades. Bundled with many other tiny life forms and loaded with nutrients, *you* can work *your* magic over the long haul and turn fertile soils into potent carbon buffers – probably the best bet the human animal has in mitigating climate disruptions. [41] With enough foresight to let *you* and all other more-than-human lifeworlds flourish, we might establish refuges bio-diverse enough to allow the existence of human animals in the future.

Lactobacilli, just in case the human animal runs out of time and was to disappear for good – if anything, what would *you* miss? Could *your* omnivorous cultures do away without the aromatic delicacies like Kimchi, Roquefort and Bulgaria Yoghurt?

By way of concluding

In this paper the *Lactobacilli* has been personally addressed as 'you' and the human animal has been referred to as 'them' to explore methods for reflecting on the agency of nonhuman life forms. Inside this 'you-them' scenario, what or who is then implied by the narrating 'me' or 'us'? Reading between the lines, the 'us', as multiple of 'me', can become the relational middle ground for unusual modes of connectivity among more-than-human life forms: a contact zone that permits and encourages the breakdown of human comprehension and potentially fosters an unequivocal sense for nonhuman presence. In contrast, 'alien phenomenological' or scientific undertakings for accessing nonhuman lifeworlds and agency tend to be limited by human bias and perception. Therefore socially experimenting with living machines and bioart can leave behind these constraints of human sensorium and empathy and instead establish reflective-relational spaces together with more-than-human life entities. This aims at provoking arresting kinds of more-than-human encounters underpinned by the paradox of reconciling adverse, subjective inner lives. In a socially shared

reflection, such epistemological disconnects can bring about the ethical acknowledgement of creaturely difference that is easily lost in other approaches.

While approaching nonhuman lifeworlds remains an epistemological challenge, biophysically, *Lactobacilli* and animals (humans or not) are increasingly entangled. Efforts are underway to engineer close relatives of *Lactobacilli* directly into information technology to serve in semiconductors, so called bio-chips. [42] With so much relationality at play, human agency profoundly depends on nonhuman agency across bacteria, archaea and eukaryotes. These 'webs of agency' are the harbinger of diversity, technologically, and culturally to sustain our ecologies in soils, societies and economies. Donna Haraway indicates how such 'worlding together' with mineral, fungi, and plant in all their liveliness, is more than ever, not mere enrichment but existential for the human animal:

> "One way to live and die well as mortal critters […] is to join forces to reconstitute refuges, to make possible partial and robust biological-cultural-political-technological recuperation and recomposition…" [43]

In this 'worlding together', meanings and values keep oscillating between human experience and in the inter-acting mattering and dynamics of more-than-human life forms. These multispecies meshworks find expression in exuberant-audible *Lactobacilli* harnessed for musical ears, delectable mushrooms sprouting after ecological disaster, or ephemeral critters running wild in the advent of biotechnology. Through the contiguous re-imagining of our bio-social foundations, we might discover how for example the meanings attached to *Lactobacilli* are alterating when transitioning from one social practice to another, like food preservation, midwifing, ethanol distilling or sewage treatment.

Engaging affectively with a diversity of single- or multi-cellular organisms is less about delivering use value to the human. Rather biomachinic and bioartistic experimentations are vital to dwelling more consciously inside the boundaries of our planetary home. Accepting the limits of human knowledge-making is the first step, if we want to elevate more-than-human actors into decision making and political agenda as Latour argues. [44] Thus it will be essential to further explore ways for relating to material and organic meshworks that respect and account for nonhuman alienness.

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