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 you 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 reconsti-

![Image](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.

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tute 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]
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 ‘mousy 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_ diffuse 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_ metabolic 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 creatively 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 _inspiration_ 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- _rhythms_ 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 Desulfohribusaceae 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 Fermentophage 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, knowledge 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 pyrolyzed, 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 biodiverse 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 interacting 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 altering when transition 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 alieness.

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References

19. Pasek, ibid.
32. Marlow, ibid.