Fermentation and More-than-Human Health: How to Speak of/to Soils and Other Aliens?

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There are many valuable insights to be gained from these accounts of human-microbial relationships in gardens of Finland, Sardinia, and Iceland. The people we encounter through these articles engage in complex relationships with microbial life in the form of Kombucha SCOBYs, compost heaps, bokashi and other strange liquids that accumulate at the bottom of bokashi buckets, Effective Microorganisms (trademarked as EM), kefirs, and JDAM indigenous microbial solution. These human-microbial performances (Ingram 2011) in the garden and beyond inspire me to reflect on three interconnected themes that I see as relevant in these emergent probiotic engagements with soils and the world of microbes: anthropomorphism, doing good with microbes, and health *as* ecology. Following Lorimer (2020) I call these human-microbial engagements probiotic, because they pose an alternative to the older framing of microbes as enemies and pathogens that need to be contained, eradicated, and controlled through regimes of hygiene and antimicrobial medicines.

Anthropomorphism

Microbial worlds are us, in us, and fundamentally alien to us. As Filippo Bertoni (2022) reminds us, since small beings had first become visible to the human eye with the invention of microscopes in the 17th century, their complexity, evolutionary importance to life on the planet (Margulis 1998) and their weird alien character have had the potential to "defract our view of the world in an always shifting kaleidoscopic multitude of alternatives" (Bertoni 2022). While the exact workings of microbial worlds remain a frontier of post-genomic sciences within ecology, medicine, and soil science for example, people who work with fermentation and composting are already engaging these alien intelligences. It may be fair to say that probiotic practices have successfully challenged anthropocentrism, the idea of a bounded pure human body so central to biomedicine, but have a harder time going beyond anthropomorphism, or thinking of other beings and entities as if they had human qualities. In pro-microbial communities across the world, and in the papers assembled here, anthropomorphism abounds. We learn of bokashi being "happy and contained," bacteria become "buddies," some microorganisms seem "nice and tolerant" and others "overbearing and demanding." Elaine Ingham, the inventor of compost tea ferments for gardeners, speaks of "mafias" and "bad guys" taking over the soil if toxins and synthetic fertilizers are applied to soil (preface to Lowenfels and Lewis 2006). Even posthumanists cannot help but to think of microbial communities and soils as caring, tolerating (our mistakes), communicating with us, and understanding us. My own entry into research on fermentation as world-making practice has been mediated by the Indian natural farming guru Subhash Palekar (Münster 2021). Palekar, who is at the forefront of teaching microbial consciousness and

symbiotic thinking to small-scale farmers and gardeners, relies heavily on anthropomorphic metaphors: mulching the soil is like putting on a sari (Indian female dress), nitrogen fixing bacteria are "contract workers" for God, and cow rumens are "factories" for producing beneficial bacteria. In this context it has been interesting to learn that Icelandic composters hardly relate to the world of microbes in their compost heaps, and instead cultivate affection for critters they can see. Soil meso-fauna seems to require less metaphorical work in representing nonhuman worlds. Composting moves their gardening practice beyond anthropocentrism, but can they also go beyond what might be called "eucaryotecentrism" (thinking with and relating primarily to multicellular organisms—eucaryotes—of plants, fungi, and animals). Microbes truly push the limits of multispecies methods. If anthropomorphism seems to me the last contradiction in breaking through to microbial worlds, the price we pay for communicating with and acting on microbial communities is a reminder of our human limitations in relating with other species and entities on their own terms.

Doing Good

Among the many images that will stay with me from reading the articles located in the garden is "knocking with your feet": the custom and idea in Sardinian hospitality that the ideal guest should have to use their foot to knock on the door of their host because they are carrying too many gifts of food and drink to be able to ring the doorbell or knock with their hands. Hosts, we learn, must reciprocate, and shower their guests with even more food and gifts upon departure. I was touched by this romantic image not only because I currently live in a country where guests can be expected to bring and consume their own drinks, but also because this image beautifully captures the idea of mutually beneficial generosity in fermentation and composting. Microbial communities can be tremendously generous guests, or hosts, depending on perspective. I have already mentioned their superpower in fixing (making available) nitrogen, an element that is crucial to all life but notoriously unavailable to plants because of its triple electron bonds. Bacteria in the root zone of plants (the rhizosphere) can break open nitrogen, fix it into a salt, and thus provide it to plants. Plants, in return, release sugar compounds into the soil, sharing the gift of their own superpower (photosynthesis) to attract and nurture microbes. The soil care communities we learn about in this special issue tap into and act upon the generosity and mutuality of microbes to build a better world above ground. I learned from these articles that people who work with microbes often marvel at their generosity and abundance. In composting and bokashi fermentation, microbes transform waste into beneficial materials that enhance soil fertility, break down unwanted waste, and contribute to the health and well-being of a wider multispecies collective. Two of the articles describe this work as ontological politics or as nurturing alternative ontologies. All three articles follow feminist philosopher of science Maria Puig de la Bellacasa's work on soil as bioinfrastructure and matter of care (2014, 2017). Fermentation and other soil care practices become thus part of a hopeful politics of enacting sociality based on care, collaboration and "being the revolution" (Gibson-Graham

2014). While I agree that fermentation and composting have strong ontological effects of placing people within a web of mutually nourishing life, my work on Indian natural farmers has also taught me a good deal of skepticism about the inherent goodness of soil care ontologies in a world where soil is part of unequally distributed land ownership, ideologies of nativist belonging, and has to stand up against loud voices of alarm that see productivist agriculture as the only viable option for feeding the world. As Anna Krzywoszynska (2020) reminds us, in capitalism, soil microbes are put to work according to the same extractivist logic that earlier made microbial life invisible to agriculture.

Health as Ecology

The articles on Sardinian permaculturalists, Finnish bokashi connoisseurs, and Icelandic compost enthusiasts show how microbial engagements spill from the garden to the kitchen and span at least three domains of health and ecology: waste, food, and soil. Composting and Bokashi transform kitchen and garden waste into a valuable matter, dry toilets do the same for human excrement and all contribute to closing circuits of energy and nutrition and break the cycle of capitalist waste production. Fermenting sauerkrauts, kimchis, kefirs, and kombuchas produce foods and drinks that nurture microbial diversity in human guts. Composts and ferments also contribute to the work of ecological repair either through bioremediation or by nurturing and enriching soils degraded by extractive practices and chemical inputs. Fermentation teaches us to pay attention to the blurred boundaries between waste management, food production, and health. Fermentation and composting are enactments of new facts of life that make the idea of individual organisms and bounded individuals that live *in* an environment untenable. Relations precede the contingent and dynamic formation of symbiotic assemblages called bodies or soils. Symbiosis, of course is not just mutuality, but also encompasses predation and commensality (eating along without harm or benefit). Donna Haraway, building on Lynn Margulis, speaks of holobionts "polytemporal and polyspatial knottings" that engage other holobionts in "complex patternings" (2017, M26). I am interested in what these new understandings and the associated practices documented in these articles can do to revisioning health and wellbeing. Fermentation and microbial thinking open a door to thinking health *as* ecology and not just as (human) health *and* ecology. Thinking health and holobionts together marks a fascinating shift in perspective where speaking of health or wellbeing depends on arbitrary cuts in deciding whose functional integration matters and whose doesn't. If bodies are rethought as "nested ecosystems" (McFall-Ngai 2017, M65), then health also must be reenvisioned without reference to bodies and organs. In assessing the health of complex systems, like soil (Harris, Evans and Mooney 2022), where do we seek balance, diversity, connectivity, and emergence? Which heterogenous assemblages should be restored to a healthy state? If we think of health as more-than-human health, we need to answer questions about value and valuation. Take the case of soil health. Soil is the ultimate challenge of thinking health without a body. It is impossible to establish a clear understanding of healthy soil without

thinking about valuations such as productivity or fertility. Soil is poor or rich, healthy, or toxic only in relation to other species' needs. For garden vegetables, nitrogen rich soil, rich in organic matter, are considered healthy; wildflowers, by contrast, regard sandy, nutrient poor soils as healthy. If we could ask them, would microbes even care about their symbiotic functions in an ecosystem? This brings me back to the alienness of microbial worlds. Bacteria and archaea are deep-time life forms, that developed long before plants, fungi, and animals. And they will certainly outlive us.

The articles I had the privilege commenting on bear witness to the remarkable renaissance of pro-microbial relationships in European societies and scholarship in the past few years. Already the introduction to this special issue shows how advanced the social study of fermentation, microbes, and pro-biotic practice has become. The social study of microbes can now build on an impressive literature at the intersection of science and technology studies, feminist philosophy, anthropology, geography, and varieties of multispecies studies. The empirical case studies located in the garden invite us to let the microbial turn challenge our capacity to represent microbial multitudes (and to communicate with them); to nurture our ambitions as "radical gardeners" (McKay 2011) to transform above-ground society; and to allow our fascination with microbial becomings to challenge the idea of health as distinct from ecology. There would be so much more to unpack in these rich studies, they really come knocking with their feet.

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