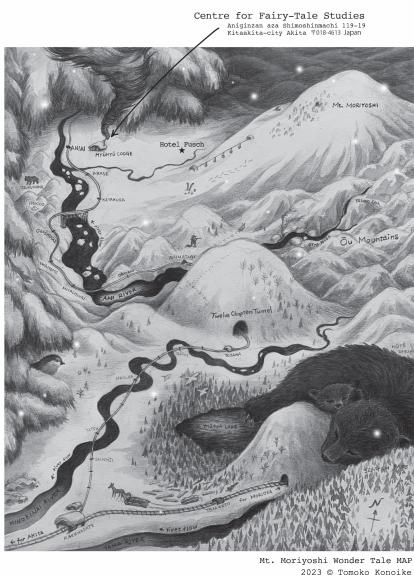


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Symbiosis and the Steward: Reading Human-Microbe Relationships and Restorying Convivial Futures

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Symbiosis and the Steward: Reading Human-Microbe Relationships and Re- storying Convivial Futures

Maya Hey

Abstract

The human-microbe relationship spans millennia of use, hope, and tension. And the recent research in gut microbiota and their uncanny influence on human agency is re-storying what it means to be human in a microbial world. What if the stories we have been inheriting about human-microbe thriving were obsolete, and what new ways of storying can we imagine with microbes? The roles we play in these stories—like the roles of a stewarding or partnering with microbes—can lead to certain power configurations and assumptions about control. At the same time, stories of symbiosis, or ‘living with’ microbes, can assume mutual benefit where there is none and obfuscate other configurations such as commensalism and parasitism. It seems then that our pre-existing attempts to describe the human-microbe relationship butt against stories of multispecies survival. Conviviality may be one way to re-story the human-microbe relationship as it centres eating relations without presuming humans as the only ones feasting. This essay attempts a critical reading of concepts such as symbiosis and stewardship by comparing examples from media, philosophy, and popular discourse to analyse how we imagine, represent, and live with microbes in the contemporary moment, given our entangled futures.

Stories serve important epistemological and political functions by making the world intelligible. In order to adequately interrogate our ethical practices, we humans must interrogate our stories for which worlds they make possible.

Jacob Metcalf, “Intimacy without Proximity: Encountering Grizzlies as a Companion Species”

From miasma to germ theory, pasteurisation to probiotics, bioengineering to bioeconomies, microbes have a history of being both valued and vilified in relation to human thriving. Depending on the context, microbes have been rendered a threat, a nuisance, or a tool, which subsequently casts them as an entity to eliminate or to otherwise expend. Yet this rendering poses challenges for the stories we tell ourselves about living with microbes, based on the fact that we need them more than they need us. Additionally, recent research indicates that we are made up of as many microbial cells as we are human ones, which begs us to reconsider what it means to be human when we are always and already more-than-human. At the core of this question is the human-microbe relationship and the stories of literal and conceptual engagements with human self and microbial other(s). In Western lineages, antagonistic stories of the human-microbe relationship emerged from disease and decay. But, quite plainly, microbes comprise our bodies, compose and decompose our surroundings, and connect us across different species in moments as mundane as eating, cleaning, commuting, or playing with pets. Inspired by this reality, a less antagonistic framing of the human-microbe relationship could help us to find balance with microbes, especially since they cannot be neatly cleaved from our very existence.

Symbiosis is one such story of co-existence. Humans and microbes live in symbiosis, and have done so historically, thus depicting our relationship in co-evolutionary terms. However, this essay takes a critical approach to popular discourses of symbiosis, not to diminish our interdependence, but because the story of symbiosis, in its current inflection, connotes a rosy outlook of mutual benefit. In what follows, I examine and trouble this assumption of mutualism—with specific attention to eating relations—because common parlance describes human health in terms of feeding one's gut microbes: take care of your gut microbes who, in turn, will take care of you. In this seemingly win-win situation, the recursive feeding is not the issue. But to tell this story of feeding/eating only from the perspective of humans can overwrite what microbes are or could be doing in the long *durée* of earthly survival. As stated in the epigraph, I take seriously philosopher Jacob Metcalf's call to "interrogate our stories for which worlds they make possible" because it shows the metaphors, the figures, and the driving assumptions that animate our interactions with microbial life. That is, how they are *thought to be* affects us in ways just as compelling as what microbes *do* in our day-to-day realities. In the absence of being able to easily and regularly see microbial life, our past and current understandings of microbes shape future ideas about how we will continue to (co-)exist.

I draw upon several disciplines to imagine alternate narratives for the human-microbe relationship, combining approaches from communication studies, media studies, and science and technology studies (STS). I will focus on the relational configurations between humans and microbes when terms like symbiosis are mobilised in order to chart the subtle shifts in power and ideology when stories—like stewardship—slot human and microbial characters into predefined roles. Whereas stories of stewardship and partnership organise roles into who has agency, stories of symbiosis categorise relations into who stands to gain. I propose using the term conviviality, admittedly a contested term as well, because it foregrounds non-autonomous relationships that are not predefined. I argue that conviviality can story (as a verb) and show human-microbe thriving in terms of eating, feeding, and being eaten—a necessary reshuffling in the stories we tell about living in a microbial world. Throughout, my argument calls upon contemporary thinkers in feminist philosophy, feminist technoscience, and multispecies studies to analyse the normative assumptions that stabilise anthropocentric stories about human-microbe relations. In studying these eating relationships, I build upon feminist philosopher Lisa Heldke's notion of "chomping all the way down" (247). In taking together eating along with being eaten, Heldke implores us to "consider all the relationships, micro and macro, into which our eating enmeshes us" so that "these nested relationships of chomping" make our vulnerabilities visible (254). Eating, thus, puts power dynamics, via teeth, back into the stories of human-microbe co-existence and recapitulates the reality that eating and killing cannot be neatly separated, neither in practice nor in theory. My hope is to disrupt the myth of human exceptionalism as narrativised in stories such as symbiosis—especially when the term's subtext implies living together in mutualistic configurations.

My argument is organised into four parts. I open with a brief backgrounder on how the human-microbe relationship has been understood in recent history to show that microbial stories shifted from antagonism towards instrumentalisation. This instrumentalisation fits in with longstanding discourses of stewardship and oversight which I analyse in the second section. In the third, I compare three inflections of symbiosis, including: the synecdoche of mutualism (which is one part of symbiosis) representing *all* symbiotic relations, as well as the configurations of parasitism and commensalism. Before concluding with conviviality as a possible alternative for storying the human-microbe relationship, I analyse three media examples that offer differential representations of living with invisible beings. Although conviviality comes with its own tensions and pitfalls,

I offer it as a way to think through contingent, non-autonomous, and non-impervious relationships that could characterise the future of human-microbe relationships.

I. Configurations of the Human-Microbe Relationship

Western understandings of the natural order tend to position humans and microbes on separate branches of the proverbial Tree of Life. Our evolutionary paths diverged and separated us into different kingdoms, or so the story goes, but a more entangled view of life shows that humans and microbes have always been entwined, nested even. Chloroplasts and mitochondria evince this phenomenon, given that each used to be standalone bacteria. Unlike the rest of the cell, these organelles store their own genetic material like bacteria would. Evolutionary biologist Lynn Margulis explains in *Symbiotic Planet* that the origin story of these energy-producing organelles was “a ‘literal incorporation’...in which the undigested green bacteria survived and the entire merger prevailed” (36). In addition to her theory of evolution-as-serial-incorporation, we could think of the human-microbe relationship in terms of coevolution of cultures, specifically in how microbial cultures shaped and were shaped by human cultures via fermentation praxis (Katz ch.1). We domesticated fungi who domesticated us in turn (“Unruly Edges”), we socialise with microbes who socialise us in turn (Hird 36), and we feed microbes who feed us in turn (a notion I revisit in Part II). Rather than arrange humans and microbes as distinct entities, we should keep in mind that we have existed as co-constituted bodies for millennia even though stories of human individualism persist.

Despite our interconnected lives, the hegemony of Euro-positivist histories casts microbes as expendable, if not something to eradicate entirely. Microbes were ‘discovered’ under the premise of disease (anthrax) and decay (meat and wine spoilage) by Louis Pasteur, whose findings were less of a reveal as it was a discursive maneuver to assign fault to microbes; in so doing, Pasteur established a warrant for human independence from microbial harm and coloured relations between humans and microbes as antagonistic (Latour 81). Because of this discordant history, control over microbes became a logical next step—a literal conquering of fears. Pasteur’s namesake technique of pasteurisation sterilises microbes out of existence to protect the human eater. Treating the human eater as the central figure in food systems continues in the contemporary moment with food safety protocols and functional foods research prioritising human eaters (and funders). This has since enabled

scientists to instrumentalise microbes across sectors. Consider examples such as enrolling bacteria to produce synthetic insulin instead of extracting insulin from pigs, or engineering yeasts to produce vitamin C instead of isolating it from citrus fruits. Both instances (and countless others) rationalise microbes as being a less costly resource to use compared to plants and animals. In recent contexts, then, microbial roles became nuanced from agents of harm to agents of possibility.

But the absence of ‘microbial welfare’ movements epitomises a contradiction in ethics: microbes are lively enough to help us live but not Life worth honouring. We use microbes and microbial by-products, but unlike animals and animal by-products, microbes are not alive enough to warrant the same ethics such as vegetarianism or veganism. (Imagine, if possible, what a diet that does not use microbes would look like.) We make sense of this contradiction through stories structured around binaries: either microbes are helpful to us or harmful to us. Permeating this dualism is an air of control, or more precisely *control over*, such that one can take advantage of the life-affirming microbes and tamp down the deleterious ones. Book titles on the human gut microbiome extend this rhetoric to the extreme. These titles interpellate eaters to make their microbes work for them, emphasising human control to harness microbes (as if horses to tame) or reprogram them (as if droids): “The Good Gut: Taking Control of Your Weight, Your Mood, and Your Long-term Health” (Sonnenburg and Sonnenburg), “The Whole-Body Microbiome: How to Harness Microbes—Inside and Out—for Lifelong Health” (Finlay and Finlay), and “Super Gut: A Four-Week Plan to Reprogram Your Microbiome” (Davis). This neoliberal emphasis on optimising one’s microbiome positions microbes as static cogs in the wheel of health, overwriting the lively characters they play in the long slog of coevolution. As with other health endeavours, control is a myth that we tell ourselves to make sense of our selves—as recently reframed, human-microbe hybrid selves—for, surely, we are still human if we stay in control of our more-than-human facets.

We have multiple and ongoing relationships with microbes: we use them, they use us, and while we cannot live without them, they can live just fine without us (see antimicrobial resistance for one such story of resilience). To phrase microbial identities in terms of what they can do to/for us perpetuates anthropocentric narratives and disregards the range of encounters we have with microbial life—from staged encounters like spraying hand sanitiser to unanticipated ones like coming down with foodborne illness. Much as we would like to pin down their identities, microbes are not inherently good or bad but emerge as such from specific configurations.

Besides, framing microbes as good/bad informs our own roles in how we are to act and how we are morally good or failing, which reflects our own monologue. The next sections argue that we need new ways of conceptualising our roles and relations with microbes beyond the confines of stewardship and symbiosis.

II. The Roles of Stewards and Partners

Stories of living with microbes tend to slot humans into the role of a steward (to oversee microbial labour) or that of a partner (to supposedly work with microbes towards a shared goal). Though, as I will argue, both roles tend to reinforce an anthropocentric story of controlling microbes and steering them towards human benefit.

Stories of stewarding microbes abound in the contemporary moment. For instance, the current hype around food and wellness frames gut health and immune health in terms of good human stewardship—feed your gut bacteria—such that eating well and being well become shared projects of digesting. Nutrients like vitamin K are made available to our bodies only because we feed gut bacteria with plant-based fibres; foods fermented in one's gut become precursors to neurotransmitters that stabilise our moods and mental wellbeing. With increasing information inundating the lay consumer on what to eat and how, the current ethos of enacting health in-and-through gut microbiomes pursues a form of “self-enhancement” (Baty et al. 593) or a way to perform moral one-upmanship through making/consuming ferments (Hey 16–7). With conditions ranging from bowel irregularity to obesity to *Clostridium difficile* infections, the human eater is called to act and intervene in microbially minded ways (e.g., consuming probiotics). Thus, as a multispecies tale of dining together, humans ingest foods that are digested further by intestinal microbes, and the story repeats itself with every eating ritual: I look after you all to look after me in turn.

Stewardship positions gut microbes as a species to manage under the direction of an astute human eater-cum-consumer. It intentionally frames control as a driver for relationality. In western lineages, this story of control tends to stem from parochial narratives of Man overseeing lands and its inhabitants as a good steward for the animals created by God. Moral philosopher Peter Singer traces this relational hierarchy back to the Old Testament to explain human-animal relations: “[Man’s] ‘dominion’ is really more like a ‘stewardship,’ in which we are responsible to God for the care and well-being of those placed under our rule [because] the human species is the

pinnacle of creation" (188). Applied to the human-microbe relationship, stewardship functions as a way to practice humanitarianism, where "the special status of human beings" gives way to a "benevolent attitude" towards other critters (203). Even in a secular sense, much of environmental conservation efforts are phrased in terms of roles that support threatened species, protect endangered lands, and preserve resources on the brink of catastrophic climate crises—when perhaps what drove the threats, dangers, and catastrophes in the first place was a kind of myopia that emerged from unrelenting beliefs in human exceptionalism.

Against a Euro-Christian backdrop, humans hover near the top of a hierarchy of beings, in charge of managing the rest according to their proper place and purpose. This configuration of human exceptionalism colours our ideas about how (and where) we see ourselves in the so-called Great Chain of Being "with angels on top, earthworms below, and human beings just three rungs down from God" when, really, it would be more accurate to state that "this hierarchy is multifold, provisional, and messy—in flux and on the move" (Swanson 89). Taxonomically and ideologically, microbes are relegated to a lowly being, either a pest to eradicate or an unruly colony to reign in. Even if one does not subscribe to religious thought, one can detect Christian morality echoed in representations that further this good/bad categorisation. By personifying microbes as 'good guys' and 'bad guys,' and further depicted with halos or horns, the good/evil dichotomy serves as a visual heuristic for how approachable a microbe can be. In this sense, microbes are shown to be both *separate from* and *below* human life, when neither hold true (e.g., taxonomic classifications are now arranged in a circular, not vertical, manner). The narrative of human oversight may be less an empirical observation than a tale we tell ourselves to make sense of microbes we cannot easily see or detect (a discussion on invisibility follows).

The supervisory tone of stewardship persists in contemporary calls for eaters to manage their gut microbiota in literal ways. During recent fieldwork, anthropologist Sandra Widmer examined the ways people used and engaged with direct-to-consumer (DTC) tests, which identify the precise makeup of one's unique microbiome. Laced throughout the product's messaging runs an imperative to diversify and "care for" one's gut microbes in order to optimise their health; yet, as Widmer critically notes, "this DTC test is part of wider systems pushing the commodification and financialisation of health practices...These are the very systems that often undermine wellbeing" (par.7). Widmer observes that DTC tests call upon investment metaphors, likening one's diet to making deposits into a bank account so that microbes can

subsequently transform these resources into gains (par. 21). Perhaps most blatantly, DTC tests leverage the exasperation that often comes with chronic disease, floating the rhetorical invitation to “imagine living in a world where illness is optional” (Viome). Marketing the desire to know the precise composition of one’s gut microbiome suggests that one can steer them down optimal routes and commandeer them into service—but only if you buy this test first and eat according to its results.

Another manifestation of the stewardship narrative is the need to go beyond managerial oversight towards a curatorial endeavour to edit and optimise. Feminist philosopher Jane Dryden compares the metaphors evoked in science journals that liken the gut microflora to lawn care (e.g., Lozupone et al. 221). She notes how scientists use the metaphor of a tidy field to explain the effects of antibiotic usage, whose toxicity creates so-called dead spots. In trying to move away from the normativity of a curated lawn, she imagines how a tall-grass prairie signals a different set of expectations. In comparing lawns and prairies:

One is carefully cultivated and controlled, with a clear goal in sight—essentially, a cured lawn that is the picture of health. The [prairie] is tended to...by carefully digging up thistle, but without pesticides—through a different relationship. In thinking about our microbiome, it might suggest *living with* some messiness, rather than trying to achieve total control. (Dryden 3, emphasis added)

For Dryden, the prairie metaphor offers a way to imagine ‘living with’ microbes and their unpredictabilities, calling upon the vastness and diversity of species to show how control is moot. In turn, this ‘living with’ entails exercising care by attending to specific practices, like digging up invasive thistle so that other plants can have a chance to thrive. But these practices are aspirational and never absolute. They are characterised by *letting* instead of setting a predetermined course. Whereas the lawn manifests from direct interventions, the prairie invites practices that indirectly make it a space worth living without deciding in advance who can and cannot stay. Stewarding the lawn is a targeted endeavour, whereas the prairies have no steward to oversee it. It thrives on its own. Similarly, imagining our microflora as a prairie may help dislodge ourselves from the fallacy that we are stewards over microbial landscapes. We are humans living in a microbial world, even though the story of stewardship would have us believe otherwise.

In contrast, the story of partnership attempts to decentre the human as an obligate collaborator. At first glance, this decentring may seem like an equalising gesture because it acknowledges the interdependence we have with

microbial life. That said, stories of partnership can also anthropomorphise microbial life and, in so doing, superimpose human expectations onto microbes that defy them. Consider the recent studies that redefine metabolic disorders such as obesity in terms of one's microbial profile, where so-called ideal weights are now viewed in terms of ideal microbes inside one's gut to properly metabolise the foods one eats. These studies responsibilise individuals to work with their gut microbiome as "an alter ego, a partner or a subcontractor" (Baty et al. 590), thus animating the microbes in one's gut as in-house co-workers. While these metaphors deviate from the overseeing steward figure, they nevertheless configure the human-microbe relationship in terms of a necessary cooperation—one that does not always manifest.

More broadly, these metaphors try to describe the human microbiome in terms of a microbial self-portrait, unique to an individual's make-up and behaviour. But to evoke human microbiomes as a portrait "would imply considering it as a human partner" (589), instead of a smattering of microbial colonies that fluctuate with food, time, and happenstance. The expectation of being able to cooperate with one's microbes follows a logic of reining in a Peter Pan shadow and trying to work with beings that are attached to you but have their own impetus to thrive. (Indeed, defining health in terms of an individual successfully co-laboring with their microbes over-emphasises human agency and overlooks structural and systemic barriers like food insecurity and food sovereignty.) So, while the story of partnership tries to visibilise microbes through metaphors of a human partner (i.e., you and I are partners, we are working towards the same goal), doing so renders microbes in terms of a humanness that reinforces a human-centred outlook.

How we make sense of what is happening around and inside of us cannot be stories of stewardly oversight or partnership with quasi-human collaborators, for the simple reason that microbes cannot be controlled or willed into cooperation. They simply exist. Microbes are lively and unruly in ways that are sometimes beneficial to us—but not always. Symbiosis, in theory, accepts this interconnectedness as a part of its definition of 'life with.' Indeed, some instantiations of symbiosis describe this 'life with' microbial others to explode atomistic individualism (Gilbert et al.). Some depict humans trying their best to apprehend and engage with microbes without expecting anything in return (some media examples are discussed in the following section). Other instances use the term symbiosis with hand-waving gestures that presume mutual gain. In the next section, I examine the human penchant to say 'symbiosis' but really mean mutualism, often evoked on the premise that,

surely, things must be good for them too. To repeat this story is to speak for the microbe, a fatal mistake in any long-term relationship.

III. Symbiotic Relations and Their Assumptions

Symbiosis, as its Greek roots imply, refers to an organism living with at least one other, such that their lifeways and practices influence one another. For example, two strains of bacteria are in symbiotic relations during yogurt production: initially, *Streptococcus thermophilus* are most active but when conditions become too acidic from their metabolism, *Lactobacillus bulgaricus* take over to continue developing flavours. SCOBYS, or symbiotic cultures of bacteria and yeasts, used in kombucha brewing and sourdough-baking exemplify this relay as well, when bacteria create conditions that are suitable for yeasts to work in and vice versa.

Symbiosis as Mutualism: Stories without Teeth

In the human register, we commonly hear of symbiotic relations as a catchall term to describe the whole of human-microbe relations, owed in part to the fact that we depend on their metabolism to enhance our own. In this framing, human-microbe lifeways are elided such that to eat is to feed, and to feed is to be fed in turn. Symbiosis sets up a win-win scenario that becomes synecdochical and seems to represent *all* human-microbe relations that are not outright antagonistic.

It is worth noting that in biology, symbiosis can refer to one of several potential configurations between two co-mingling species over time. These relationships tend to be based on who gains: mutualism describes configurations when both parties benefit, commensalism when one side could benefit but at no cost to the other, and parasitism when one benefits at the other's expense. Examples of mutualism include tiny remora fish that live around sharks to keep its skin free of pests; or, birds like oxpeckers will pick through ticks and other insects on the backs of rhinos and zebras. These are oft-cited examples when both parties get to eat well, but a limited understanding of what counts as beneficial leaves one questioning: to what extent are we inserting good connotations? That is, are we interpreting benefit where there is none because it either does not affect us (great for remora and oxpeckers, but offers nothing to the human) or inadvertently reifies human exceptionalism?

Size provides us with a clue: the smaller species help the bigger species with tasks it cannot perform well on its own (like grooming), while the task at

hand also gives the smaller species a purpose and livelihood. This framing of ‘Small helps Big so that Big can let Small live’ tracks with the human-microbe relationship, where probiotic microbes help humans with digestion, mental health, and immune function while the human offers these microbes room and board in the form of an intestine. Known pathogens may flip the good/bad premise (i.e., the Small life threatens the Big life so Big must eradicate Small) but the causal relation still frames the presumed benefactor as the larger species—the human in this case. Rarely is it Big supports Small so that Small can let Big live. To be sure, size is not a precondition for these relations to take place, but it can show us the assumptions we-humans carry into perceptions about microbial life. This perception is perhaps best captured in the colloquial phrase, ‘out of sight, out of mind.’ Interdisciplinary scholar Myra Hird conjectures that this lack of philosophical engagement with microbial life stems from our bias that, because they are not “big like us,” they are relegated to a lesser metaphysical priority (66, 140-3). Multispecies philosopher Cynthia Willet notes a similar paucity in discussions about microbial relationality, that, because of their inextricable ties with us, they are both too close to and too dissimilar from us-humans to warrant our philosophical engagement with them (11). Like many forms of privilege, to have stature and visibility means also having the last word.

Scrutinising how we clutch onto ‘symbiosis’ as if it were synonymous with ‘good relations’ demonstrates that we want what is best—for us, mostly—and we may be selectively buying into metaphors and narratives that fulfil this aspiration. The term performs a kind of magnanimity, inflating the value of ‘what we do on our part’ to either underplay the microbial work we take for granted or overwrite the harm we cause in the name of preserving human sanctity. In throwing around the vague term of symbiosis-as-inherent-good, we presume mutualism and, in so doing, hide the commensalism and parasitism which goes uncontested.

Mutualism. Commensalism. Parasitism. While *biologically* all of these relationships might count as symbiotic in the sense of organisms living together, they have significantly different connotations as far as the stories we tell. This is what philosopher Lisa Heldke is after when trying to describe human-microbe configurations in terms of “relationships with teeth” (251). In questioning the atomistic individual, she poses: “what happens to the ontology of the human individual if we take seriously the degree to which all life on this planet, including human life, is threaded through with relationships in which one creature sinks its ‘teeth’ into another and hangs on for dear life” (249). She concludes that, to exist means to be in relationships that lay bare our

differential stakes and vulnerabilities: “To be is to be chomped on. To *be* is to be vulnerable to being chomped to *death*” (255, original emphasis). Common parlance may continue to tell the tale that we live in symbiotic relations with microbes but imply mutualism with every enunciation and obfuscate other stories of living together. In so doing, the story of mutualism becomes the defanged, declawed story of living with attenuated microbes—a myth at best.

Symbiosis’ Other Stories: Commensalism and Parasitism

Commensalism describes the relationship where one side benefits, but at no cost to the other. Common biology examples include hyenas and vultures trailing after larger predators so that they can feast on the remains of its prey; or, barnacles might live on whales to have a stable attachment site and hitch a free ride. Neither the predator nor the whale are taxed from this arrangement, while the hyenas, vultures, and barnacles gain something they would not have otherwise had. Interestingly, most of the microbes that comprise human bodies are considered commensal, meaning that microbes ‘benefit’ from living in and on our bodies, but at ‘no cost’ to us. I use scare quotes because the cost-benefit analysis is slanted towards a human story of thriving; it may be more correct to say that we are commensal organisms to microbes such that we benefit from their lives and at some cost to their living. (This last point about the cost to microbes is still being debated by microbiologists and philosophers alike.)

To continue with the teeth motif, it may be that commensal relationships may be better described as relations with teeth but with a bite too small to be noticeable or painful. Most commensal microbes go unnoticed, at least until things go awry. And sometimes they do. *Staphylococcus aureus*, a commensal bacterial species commonly living inside the nasal cavity, does not pose an issue to people until they are found in the wrong place, such as inside a wound. In fact, hospital acquired *Staph-* infections account for numerous preventable deaths, at the same time that *S.aureus* is now alarmingly resistant to most antibiotics (e.g., methicillin-resistant *S.aureus*, or MRSA). So commensal microbes might be better imagined as latent messmates than strictly neutral or inert ones. The idea to ‘eat with’ (as the etymology of commensal would imply) is less evocative of a guest seated at the *mensa* and more indicative of the potential to be ‘eaten with’ the meal itself. Aside from a few culinary traditions that feature the likes of bear or crocodile, it is not common to think of eating something that can also eat you, but perhaps this is one of the ways that commensalism ought to be rewritten.

Commensalism is far from innocuous. It refers to a temporary configuration of proximity, where benefit is contingent upon context.

Symbiosis' last inflection is parasitism. The term parasite used to carry a more neutral connotation. Looking at the root words of *para-* (alongside) and *sitos* (food) tells us that the term referred to a person with whom one shared their meal. In *The Parasite*, philosopher Michel Serres weaves together several lines of thought, engaging in additional wordplay given that the French words for host and guest are both *hôte*. For Serres, the parasite is not a singular role but a layered concept, symbolised by a cascade of reactions that only go in one direction: taking without giving. The taking might be literal, or it may be a momentary interruption like that of a loud sound. Even this disruptive noise can parasite as a verb—that is, the noise takes from the scene what could have happened without having given anything in return (66). In instances like this, the three entities—the guest, the host, and the noise—have an equal capacity to interrupt (19), to which Serres riddles, “The parasited one parasites the parasite” (13). What counts as a parasite (in Serres's sense of the term) is also contingent upon context. In this sense, parasitism (etymologically, *alongside food*) and commensalism (*eating with*) may not be as different as initially thought, or, rather, parasitism is less threatening and commensalism more so. While parasitic relations can carry a lurking sinister quality, for Serres, parasiting is characterised by fluctuation. Part of how parasites persist is their ability to adapt themselves to whichever host they come across. Their context fluctuates, so they fluctuate *alongside* it, hence the prefix *para-*: “They lie dormant, rise up, lose wind, are lost for a long time” (190). Serres's use of parasiting as a gerund demonstrates how parasitic relations are always open to interruption, and that this openness sets up contingent relations that are always in flux.

It may be that part of living—which entails adapting to fluctuations—makes parasitism inevitable. Consider how philosopher and social scientist Annemarie Mol analyses eating as a relational way of encountering other species. Rather than concluding that eating can easily affirm multispecies togetherness, “in eating I do not just relate to the creatures whose flesh, seeds, roots, and so on I ingest. I also relate to creatures who do not constitute my food, but whom I rob of theirs” (122). She describes an acquaintance's garden, which is regularly weeded and set up with gates and meshes that create an inherent competition for all kinds of eaters, humans, hares, insects, and otherwise. She further imagines how weeds could have thrived in that garden, how floods would have made the land underwater, and that: “At whichever point in the range of possibilities we stop, there are always going to be others

affected by my eating. I rob them of potential food or altogether prevent their living" (123). Thus, in Mol's formulation of eating, 'my eating' becomes an inherent form of taking without giving.

A key critique to parasitism is its focus on a singular dyad or 'loop' of species in the relationship. That is, one set of relationships may be characterised as a parasitic one, but other species may be involved in their ecologies and lifeways such that they are not parasitic in another relationship. Here is one such loop. In *Staying with the Trouble*, Donna Haraway describes the relation-scape of monarch butterflies, who may sometimes be host to a protozoan parasite *O. elektroscirrrha* (ch.7). The monarchs primarily feed off the milkweed plant, whose roots thrive with fungi in the soil. The root fungi regulate how much toxin is produced by the milkweed plant and modulates the degree to which the butterfly's parasite lives or dies by that toxin. So, the eating arrangements follow accordingly: intestinal parasites live off the monarch (and take-without-giving from it), monarchs live off the milkweed plant, the plant's roots live off the soil fungi, and the soil fungi ultimately affects whether the parasite can survive. Whether or not the intestinal parasite can persist has less to do with the volition or opportunism of the soil fungi and more to do with the inherent interdependencies of these co-constituted lifeways.

Disruptions to this loop affect the populations of other species and their loops: with too many intestinal parasites, the monarch butterflies cannot fully emerge from their chrysalis, rendering them more vulnerable to predators like paper wasps. In other words, the eating relations of the intestinal protozoa and the wasps are interconnected with several species in between: "large-scale failure of fungal, protozoan, plant, and butterfly holobiomes make wasp eggs fail too" (*Staying with the Trouble* 127). Thus, danger does not inhere to the parasitic infection itself—the intestinal protozoa simply exist—but what the butterfly and milkweed *do* on either side of the protozoa can enable its thriving or fast-track its demise (i.e., the milkweed can produce more toxin, the butterfly can eat less toxic milkweed). One biome removed, the lifeways of the protozoa are connected to the wasps' biomes, likely connected to many other lifeways to which we may or may not be privy.

We, too, are part of interlocking biomes. And, we are also part of a relation-scape of taking without giving. Consider contemporary examples of xenotransplantation that blur lines between human/animal or self/other, which are beginning to help us re-theorise our selves. Multispecies and science philosopher Vinciane Despret describes humans using animal organs for transplants, where, for xenograph recipients:

it is not so much a matter of thanking but...of accepting to prolong a life that is no longer one's own, of passing from what has become self and other, from what has become oneself of the other and the other in oneself.... The donation is thus inscribed within an inherited story, a story still to accomplish. (192)

While Despret writes of macrobes (i.e., pigs and their organs), her analysis points to the possibility of microbial stories that acknowledge “the other in oneself.” Microbes enable us to prolong a life that was never our own to begin with, suggesting that a self-reckoning of microbes in oneself or the other *as* oneself is imminent.

Rather than sensationalise parasitism as an exploit, parasitism offers the plainness of being in relationships that are always and already with teeth. It is neither exceptional (we may find ourselves with foodborne illness where *we* are incapacitated but the microbe inside us is thriving well) nor something to take for granted (we *could* find ourselves incapacitated, though ideally not). Focusing on stories with teeth can help us understand that we-humans are never impervious but in constant eating relations with microbes. This kind of thinking contradicts our penchant to affix microbial ontologies as either good or bad, which we would do well to move away from because, in continuing to aim for ‘good relations’ with ‘good microbes,’ we tell the tale:

that life is evolving *toward* the bucolic, toward a time in which the parasitic equivalent of the lion will definitely lie down peaceably with the host equivalent of the lamb. The hostile bacterium will become the friendly, useful mitochondria every time. In suggesting that we understand other relationships in terms of the parasite, I am in part, then, suggesting rejiggering the associations that arise in everyday speech when we think about the relationships that constitute us—a shift that would focus more attention on our vulnerability and the likelihood of our being depleted. (Heldke 257, original emphasis)

It matters what stories we tell, especially with regards to how stories can simultaneously encapsulate and invisibilise the relations we have with microbes in-and-around us. As Heldke notes, stories of living with microbes could benefit from “rejiggering” the relationships as described by “everyday speech,” to which I would also add visual representations in how we depict and decipher these stories. The next section dwells on (in)visibility as a means for making sense of more-than-human worlds, because ‘out of sight, out of mind’ can no longer guide our relationships with the microbes that make up our very being.

IV. Convivial Stories that Visibilise the Invisible

How do we engage with microbes that we cannot easily see or sense? Seeing is believing in post-Enlightenment metaphysics. From microscopes to photographs and eyewitness accounts, sight has served as an epistemic authority in ocularcentric philosophies. (Note how Pasteur showed the microbe *Bacillus anthracis*, the bacteria responsible for anthrax, by publicly displaying dead/unvaccinated and alive/vaccinated sheep.) Of course, not all microbes are invisible. We can see mushrooms and slime molds with the unaided eye, but most other microbial encounters are mediated by the likes of Petri plates, dinner plates, and our embodied senses. In effect, invisibility becomes the excuse to disengage from considering microbes and to rest on the laurels of anthropocentrism. It may be that the “actual encounters” that inform our “ontological choreography” are already taking place, just that we do not attend to them out of our own convenience (*When Species Meet* 67). Thus, accepting invisibility at face value only widens the distance between human and microbe on the false premise of ontological separation.

Representing the Invisible

This section examines some media examples that render our relationships with microbes in both visual and textual terms. All are based in Japan, based on my own upbringing and subsequent research activity there. These are not some flimsy attempt to compare (or worse, exoticise) East/West worldviews, but a desire to call attention to alternatives in epistemic encounters and offer different stories to (re)imagine living with the invisible.

Take the Japanese manga *Moyashimon*, which shows microbes and gives them quirky, boisterous character traits. Their rally cry “*kamosu-zo!*” carries the same tonal register as the cavalier mantra “ferment all the things!” By visually representing an array of invisible microbes, the narrative features the possibility of living with these unruly creatures who repeatedly defy and taunt the protagonist, but they do so without the protagonist being driven by illusions of conquest or obliteration—the humour being that this narrative is actually happening in real life, daily, and that only the script for the microbial characters is fabricated. The protagonist attends an agricultural university where multispecies interdependence is the norm, so microbial encounters tend to be in more intimate spaces like a fellow student’s untidy room or the communal kitchenette of the dorm. In encounters extremely mundane, these representations neutralise control with plain coexistence, they show microbial biodiversity and agency without fear-mongering, and they give voice (albeit

anthropocentrically) to the microbes in the name of comedy. The sheer number and diversity of microbes also demonstrates the mootness of trying to steer microbes towards a particular research goal when their unruliness always evades the human characters.

Another story, *Mushishi*, refuses humour and anthropomorphism to depict more measured stories of engaging with unruly life forms. These critters are not quite insect (虫), not quite microbe (菌), but bear the old Japanese kanji of 蟲 to signify the historical ways in which human illnesses (ranging from dengue fever to food poisoning to Legionnaire's) led to diseases from having encountered insects, molds, and vectors that were collectively called *mushi*. In this series, the critters are only visible to a few people. Interestingly, the critters usually show little to no interest in human life and most stay in their habitats. It is not until some human character's flaw—greed, hubris, neglect—exceeds the relational balance of the natural order that the critters wreak havoc and require the aid of the main character to deploy treatments. Often the cost of these treatments is a moral commitment to rectify the original transgression; other times, the transgressors may refuse treatment or face a grim prognosis, and the transgressors learn to live with the critters or pass away. Not all stories assume happy endings in *Mushishi*, partly to illustrate the range of emotional outcomes when the life and death of all of earth's critters are intrinsically tied in with one another, invisible though they may be. *Mushishi* thus disrupts the assumption that humans will somehow always prevail and instead shows the contingent relations that can unfold. It emphasises the indifference that invisible worlds can carry towards human disengagement from multispecies care.

Although non-microbial per se, radioactive contamination serves as a different kind of invisible example in comparing our reactions to its threats and our inability to detect them. Consider the autoradiograph. As an image, the autoradiograph depicts radioactive isotopes in everyday objects and plant matter. In the wake of the 2011 earthquake, tsunami, and nuclear disaster, the triple violences inflicted upon Fukushima and its neighbouring prefectures continue in these objects. Isotopes like cesium-134 and cesium-137 remain for indeterminate years to come, epitomising the words of Elaine Gan and Anna Tsing: "toxic landscapes will outlast us" ("How Things Hold" 141). These harms remain undetectable to the human senses, inspiring the project leads for *The Autoradiograph*, Satoshi Mori and Masamichi Kagaya, to develop an archive of 3D images that document the contamination in plant matter (leaves, mushrooms), animals (fish, snakes), and household objects (clothespins, helmets), as if to imply that radiation permeates all, food and otherwise. The

leaders encourage visitors to keep these images close, engage with them, and to continue referencing them, with the greater hope of “overturning” the dogmatic assumption that what cannot be seen must not mean much (“Aautoradiograph”). Rather than resort to general unease, the autoradiograph visibilises harm to shift political will and mobilise activism in innovative ways.

Each of these examples show navigating invisible relationships in the longer term without resorting to control narratives or myths of human exceptionalism. That which is invisible is understood to be present and remain so, even if it uncomfortably places humans in positions of vulnerability. Microbes in *Moyashimon* evade university researchers by going rogue and taunting the main characters. Critters in *Mushishi* remain indifferent to human lives until they morally transgress. And these stories do not aim for tidy endings so much as they show deep time (radioactive isotopes), inextricable living spaces (kitchenettes, *satoyama* forests), and the effects of human negligence or myopia. They show that engaging with the invisible requires different stories of living with what we cannot easily see, sense, or comprehend.

Thinking Convivially

I propose thinking with conviviality as a way to reimagine the human-microbe relationship in terms of three facets: first, I see convivial relations as being contingent and always in flux (like with the *mushi* critters who remain indifferent to human gain); second, convivial relations see humans as non-autonomous and always enmeshed with microbes (like with the pervasive microbes in *Moyashimon*); and, third, convivial relations remind us of our non-invincible state (like with the autoradiograph), that we are non-impervious to teeth and always in a position of eating and being eaten. Of course, one might immediately think of conviviality’s feasting connotation, which comes from the allure of gastronomic abundance penned by the lawyer and self-proclaimed gourmand Anthelme Brillat-Savarin in *Physiology of Taste*. But joy was not always part of the definition. As philosopher Ray Boisvert notes, the term used to mean the opposite of ‘autonomy’ and only later came to be imbued with festivity and merriment when the noun form, a convive, signalled a fellow eater (75). I use the term conviviality to emphasise the eating/eaten relations amidst humans and microbes in the ongoing ways that keep each other’s metabolisms churning.

Like symbiosis, conviviality comes with an etymology of ‘living with.’ But unlike symbiosis, the term conviviality is not used as an accredited

biological term. In fact, it has been more often used by modern thinkers who relied on conviviality in the figurative sense of gathering at a metaphorical table. In thinking about the changing global relation-scape, conviviality encouraged the idea of a multicultural potluck that celebrated difference as an outgrowth of cosmopolitanism (Gilroy ch.2), or as a call to reclaim the means of social production in the context of global industrialisation (Illich 12). Conviviality also helped to theorise the attendant hybridisation and creolisation that occurs when the ethnocentric West continues to enact colonial and imperial relations to countries in the Global South (Appadurai 24; Bhaba 193). The term's recent history invites us to consider how coming together is an invitation, and to structurally and socially account for differences and diversity beyond tolerance. Geographers Ruth Fincher and Kurt Iveson use the examples of libraries and community centres to demonstrate how convivial relations in an urban landscape "cannot be forced or coerced: convivial encounters are the product of planning with a 'light touch,' organizing without requiring compliance to set outcomes" (26). Similarly, convivial relations with microbes "cannot be forced" or controlled for. They unfold, as any story would. I find conviviality to be a helpful term insofar as it can model social ties, but I am less interested in the state of conviviality (a static, painted feast) and more compelled by what activates convivial relations (reaching over the table or asking for the salt, if you will). Part of this activation means working across the incommensurate differences of humans and microbes.

Many other species have already figured out how to communicate and thrive across differences. For instance, ants and acacia trees engage in a call-and-response of nourishing and co-reproducing: the ants bring the tree's seeds down to feast upon and feed younger generations while the seed, in turn, grows out of ants' nests. Together, these species coordinate their cues for earthly survival, enabling each other to reproduce and thrive (*Staying with the Trouble* 124). Anna Tsing describes similar co-constitutive projects in terms of "neighborliness" when she describes how matsutake live off, and with, the living (trees) and the dead (charcoal), which evinces "mutuality across difference" (279). Neighbourly relations do not assume identical desires or even the same capacity to act. If we are to continue existing as co-constituted beings with microbial life, we would do well to not let invisibility get in the way of our living together.

Recall how the term convivial used to mean the opposite of autonomous; I mobilise the term here to simultaneously capture the inherent enmeshment of humans and microbes as well as the coming together of

disparate parties that go beyond a mere tolerance of differences. And if the feasting sense of the term persists, then let us also remember that we are also on the table. Mutualism is a myth that neuters the ethics of eating: “Because eating and killing cannot be hygienically separated does not mean that just any way of eating and killing is fine” (*When Species Meet* 295). This is not to say that any death is permissible but it is to recognise death as an inevitable interruption—in the parasitic sense. Time, after all, takes without giving.

With no guarantee of a future together, no more than of its imminent collapse, the question becomes what are we to do about it now and ahead? What can we do to enable others to participate in the happenings that make up our entangled story? How can we keep these relations going? These questions drive the story of conviviality, suggesting we examine a different set of stories that take seriously our enmeshment with microbes as living on borrowed time. Whereas symbiosis and stewardship tend to focus on who works to whose benefit, the story of conviviality dwells on the possibility that we might continue to live in interconnected ways, with our differences still intact. These differences, in turn, offer a range of stories, some with teeth, some with imperceptible bites. As an aspirational narrative, conviviality asks what it would take to (re)consider the metaphorical, metaphysical, and physical dimensions of conscientiously living with microbes, but to do so while also moving away from size-based, beneficiary-centred calculations. Both symbiosis and conviviality have their etymological roots in “living with,” and both present compelling as well as cautionary insights. Either we reframe symbiosis as an umbrella term and dislodge it from the presumed mutualism and rosy relations, or we consider conviviality as a feast for all where we are also on the menu.

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