Feminist Fermentation Reading Session

Thursday April 4 2019, 10:00-13:00
Hacktiris, Rue Paul Delvaux straat 3 (6th floor)

Accompanying Sara Manente's installation:
Wicked technologies, wild fermentation
at Constant_V

A funny thing happens during the fermentation process. A mono-cellular organism, way below the threshhold of human sight, meets another, as if by pure chance. This encounter creates a reaction, which results in growth. Slowly, more and more micro-organisms join, bubbling and interacting, until finally reaching a critical mass, which is when the media they are in is transformed in a visible way. The result is flavor and nutrition. These micro-organisms are different from one place to the next, creating different flavors and textures locally (the same fermented cabbage will taste differently in different climates). This local particularity on one hand, and the interaction where a process that seems insignificant grows, bubbles up and becomes visible on the other, form the basis of Microcultures. This metamorphosis can be applied socially: A social action, or an idea, meets another, and little by little, while growing in volume and presence, they start generating a social and a cultural wealth. This logic, of life that is in constant movement and change, can be perceived on all levels (culinary, conceptual and social).

MICROCULTURES - ZINE

AVIV KRUGLANSKI et al.

AIMEE BATING (2017)

Plasmodial Improprieties, Octavia E. Butler, Slime Molds, and Imagining a Femi-Queer Commons

12-31-88

We find true colony organisms rare and fascinating
Here they are the exception
There, perhaps, the rule.

Slime molds— much unicellular life behaves this way—which means it isn't always unicellular.

Not everything is as fully differentiated (plant or animal) as we would expect.

@ Most slime molds are made of amoeba(like?) parts that feed seperately. Then, when food supply is exhausted, they come together, crawl to a suitable place as a multicellular "slug." There it builds a "tower" of its own cells— of itselves, and a few at the top produce spores which scatter on the wind from the fruiting body (tower). Is it an @ individual? with parts mobile? Is it an aggregate— many individuals? Is it a mating group?

— A Portugese Man-o-War is a colony acting as a single animal.

→ Many species of angler fish have females who swim free and males who attach permanently and are sustained by the host female. A female might carry more than one male.

— And the various colony insects exist as haplo-diploid or solely diploid organisms

Consider: Aggregate multi-individuals arise or can develop intelligence as units. Never as individuals.

Slime mold speculations. "Notes on Organisms," December 31, 1988. Box 83, Folder 1625, Octavia E. Butler Papers, Huntington Library, San Marino, California.

The slime mold defies Linnean taxonomization, as it cannot be easily categorized as animal, plant, mineral, or even fungi, leaving contemporary scientists to relegate the hundreds of species of slime molds to kingdom Protista, a kind of catchall kingdom of "others." Unsettling scientific classification, the slime mold even belies strict adherence to grammatical rules. In writing about slime mold, one can slip between singular and plural forms at every reference with due cause, as both cellular and plasmodial slime molds exist alternately as singular and plural, depending on how and when you're counting. Wondering whether slime mold is best characterized as an aggregate of individuals, a mating group, a swarm, or a single organism, Butler meets the question of pronouns with an admirable openness, queering and querying the limiting politics of either individualism or collective action. Describing the fruiting body as "a 'tower' of its own cells—of itselves," Butler bends grammar to accommodate this alien ontology, asserting the organism's nonconforming, decentralized organization. Butler's methods constitute queer science studies approaches. By fully recognizing the alien possibilities of this life-form—by insisting that not all unicellular life is always unicellular, and by meeting slime mold morphology in between singular and plural in its grammar—Butler demonstrates a remarkable openness to non-normative biological organization. She does not look to figure the slime mold out. She seems excited to follow it off the script of 1980s evolutionary biology to other possibilities. In slime, she looks for a model of life that could be, rather than life that already is. It is a speculative fabulation, drawn from life unruly.

While slime molds may offer some alternative to ways of organizing, there is reason to pause the celebration of the liberatory potential of the social amoebae. Innovators and entrepreneurs have folded slime molds into the workforce as experimental bodies, picked up for their efficiency and utility, but not for their queerness. If we hear an echo of the Oankali collective in Butler's note on slime molds, we would do well to remember that the Oankali, though far advanced in communicating across species lines and pushing beyond human notions of individuality and collectivity, were not without their coercive aspects. As "gene traders," the Oankali roamed the universe as scientific prospectors, mining for genetically valuable material. One of them, Jdahya, explains: "We do what you would call genetic engineering. . . . We *must* do it. . . . It is part of our reproduction, but it's much more deliberate than what any mated pair of humans have managed so far. . . . We're not hierarchical, you see. We never were. But we are powerfully acquisitive. We acquire new life—seek it, investigate it, manipulate it, sort it, use it" (Butler [1987] 1997, 39). The Oankali may claim to be nonhierarchical, but they approach the universe through frameworks of usability. As gene traders, they inhabit a capitalist, colonialist mindset of mergers and acquisitions in which "the merge" never quite takes place across even footing.

Deterritorializing Extraction: Bioaccumulation and the Planetary Mine

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Two independent technical developments have transformed the metal mining industry in considerable ways: the increasing share of waste materials in the feedstock of metallurgical operations has partially transformed metal extraction into a recycling industry, and the employment of microorganisms in the extraction of metals from mineral ores has rendered metals mining a biologically based industry. Increasing industrial interest and research activity in the application of biotechnologies to the extraction of metals from waste, particularly electronic waste, intimate a potential intersection of those two processes, destabilizing further the analytical distinctions between extraction and manufacturing, biologically based and nonbiologically based production, waste and resources. This combined deterritorialization of metal extraction requires a theoretical deterritorialization: rethinking extraction beyond extractive industry narrowly defined and the role that nonhuman forms of life play in the production of value in nonbiologically based (extractive) industries. This article is a first step toward outlining the effects of such developments on understanding extraction. It begins by reflecting on the effects of recycling on the spatiality and materiality of the mine and then it proceeds to examine the productive role of microorganisms in mining, the limits of biomining, and the biotechnologies that have developed to transcend those limits. The conclusion draws out theoretical implications of those ongoing lines of deterritorialization and their combination on understanding the spatiotemporality of extraction and the active involvement of nonhuman nature in the production of value. *Key Words: biomining microbes, recycling, subsumption of nature, value, waste.*

The Real Subsumption of Biomining Microbes

In 1947, studies of acid drainage from the bituminous coal mines of the Pittsburgh seam in West Virginia demonstrated that iron oxidation, the process responsible for metal mobilization from sulfide minerals, involved microbiological processes (Ehrlich 1998). The first microorganism recognized to promote iron oxidation, a sulfur- and iron-oxidizing mesophilic bacterium, was isolated and characterized in 1951. It was named *Thiobacillus ferrooxidans* (renamed *Acidithiobacillus ferrooxidans* in 2000). Three years later, researchers at Brigham Young University found *A. ferrooxidans* in copper mine drainage from Kennecott's open-mine pit in Bingham Canyon, Utah, and by 1958 Kennecott had patented its use to extract copper from low-grade, run-of-mine ores. Several other microorganisms were discovered in the following two decades and their commercial potential was demonstrated by the late 1970s (J. A. Brierley 2008; see also Norris 1997). Advanced research in molecular biology and nanobiotechnology has since produced dozens of species of biomining microbes living in mixed communities and capable of mobilizing metals from sulfidic ores under a wide range of environmental conditions (Rawlings 2002, 2005; Rohwerder et al. 2003).

The metabolic capacities of microbes have their own rhythms, however, and those do not coincide with the rhythms of the labor process (the valorization of capital). Thus, although microbes transcend spatiotemporal limits associated with extraction of metals from low-grade and complex sulfidic ore, they produce new ones. This problem is common to all industries that depend on nonhuman processes in the production process.

2009).

To speed up the bioleaching process, mineral biotech companies and mining companies have developed technologies to accelerate the microbial metabolism by engineering the leaching environment.[8] Despite their diversity, those technologies demonstrate a drive toward thermophilic bioleaching, or what amounts to annihilation of time by heat. Bioleaching at high temperatures enhances microbial activity, which increases and accelerates metal extraction rates and ultimately reduces the excess of production time over working time.

et al. 2008). The problem is that the high temperatures necessary to conduce economically acceptable rates of metal extraction curb the growth of certain strains of microbes and might even kill some populations—a problem that is exacerbated by the fact that the most significant source of heat generated in leaching environments is the microbial metabolism itself. Over

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In stepping back to the nineteenth century, we arrive at a critical period in which Western science was exploring the world on new scales, using cutting-edge technology to investigate biochemical processes at the microscopic level. This period, in which the science of microbiology was established, has its roots even further back in time, beginning in 1675, when Anton van Leeuwenhoek first observed unicellular organisms, a finding that served as a great clue in the mystery of the fermentative mechanisms that have been mused upon all the way back to Aristotle.[iii] After centuries of dispute over the exact nature of fermentation and the entities that provoked it, microbiology as we now know it finally reached the point of institutionalization in 1905. In that year, Robert Koch, the father of germ theory, was awarded the Nobel Prize for Physiology or Medicine for his work linking tuberculosis to a particular type of bacteria.[v] However, Pasteur intervened between these two historic events. Originally trained as a physicist and chemist, Pasteur now comes to mind as one of the most prominent figures in microbiology and bacteriology. And for good reason. One may define Pasteur's career by his response to a centuries-spanning debate about whether disease and rot are spread through the contagion of mobile living beings or whether, instead, these are the results of spontaneous generation. In this debate and related ones, Pasteur was committed to the power of living, moving microbes, and he conducted numerous experiments in the latter half of the nineteenth century to prove this hypothesis.[vi] Some of the first of these microbiological experiments found Pasteur working with French vintners, beer brewers, and vinegar-makers, who were eager to understand why certain batches of their products were fermenting properly and yielding the desired results, while other batches produced only spoiled, sour slime.[vii] Pasteur's work to understand the desirable sort of fermented foods helped him draw the connection between contamination by microbes and infectious disease, and as a result, mark clearly and in a way that seemed absolute the line between good microbes and bad ones. By 1859, he had already directly bound fermentation to infectious disease, writing, "Everything indicates that contagious diseases owe their existence to similar causes [as those in fermentation]".[viii]

Science and technology studies and histories of science have illustrated that all scientific developments reflect the cultural contexts in which they were made, and indeed sociologist Bruno Latour has already shown that pasteurization, the process that made Louis Pasteur a household name, only seemed to be a sudden discovery, and in fact was the result of the confluence of other sociological and political factors.[ix] The political and economic projects of nineteenth century Europe shaped this breakthrough, and continue to shape our contemporary understandings of the interaction between microbes and human bodies. Pasteur discovered the process as a result of a commission by the Emperor Napoleon III to prevent wine spoilage, a threat posed to one of the burgeoning food industries of France at the time. Modern nation-states like France required standardized food production in order to expand export trade in the industrial capital system, while they also needed to identify and eradicate sources of disease among livestock, crops, and workers and soldiers. In order to achieve all of this, the organisms that challenged the mechanic reliability of the State's living sources of wealth needed to be named and made visible, before they could be defeated. In order to ensure public recognition of these threats, and to shore up the support necessary to dominate them, scientists and political figures purposefully incited public fear of microbes based upon germ theory.[x] To institutionalize this fear, the European and American governments enforced hygiene through public policy.[xi] Without "general laws" concerning bacteriology, which Robert Koch provided and Pasteur seized forcefully, and without the subsequent infrastructure provided by the state, the "increased circulation of goods and people" required by growing global capitalism would not have been possible to maintain.[xii]

Indeed, the relationship between microbiology and the interests of the capitalist state continues to be articulated in terms of control of microorganisms for the sale of industrial products. Ironically, the food and drug industries are now using microbiology research to market indigenous knowledge of fermented food preparations, in order to ameliorate some of the physically weakening effects of the extreme hygiene that followed from germ theory. Some studies have found that one way to address the ill-effects that hyper-sanitation has had on the human immune system and digestive system, is to follow the example of the almost innumerable groups, including the peoples of Egypt, the Balkans, India, Palestine, southern Africa, and elsewhere, who consume foods fermented with lactic acid-producing bacteria.[xiii] Since the U.S. Supreme Court patent case of *Diamond v. Chakrabarty* granted rights to privatize microbial life,[xiv] companies have gained the power to own microorganism strains and patent fermentation-related processes and technologies, thus providing an avenue for microbiology to earn its keep and yield some profits. To aid in this, the marketing branches of commercial firms have shifted the terminology from "lactic acid bacteria" to "probiotics," from "fermented foods" to "functional foods." This shift in terminology thus indicates not only the survival of cultural fears of the microbe, but also the ideological privileging of the mechanistically utilitarian; in other words, only when microbes are controlled through the techniques of laboratory and factory science are they safe. Moreover, this shift is explicitly linked with the standardization and commodification of foods, even in the food science and nutrition research literature, in which the glorious future of lactic-acid bacteria (again, now "probiotics") lies in the development of increased shelf life and the proliferation of fermented foods into packaged "energy bars, cereals, juices, infant formula and cheese, as well as disease-specific medical foods."[xv] The framing of fermented foods as functional foods blurs the line between the home-based processes that humans have used to their advantage for millennia[xvi] and what nutritionist Marion Nestle calls "nutriceuticals," or unregulated supplements that claim to bear the benefits of nutritious foods through the vehicle of highly technologized, packaged commodity drugs.[xvii] Just as industrial research into food fermentation has led to the privatization of microbial life and of community-based practices, so too the commodification of fermented foods into functional foods that are marketed globally and sold from the shelves of corporate grocery stores threatens to circumscribe access to those who cannot afford these products, by increasing standardization and regulation of microbial life. Through this process, Western individualism in the pursuit of capital protection continues to be reified, obfuscating the interdependencies between people and microbes.

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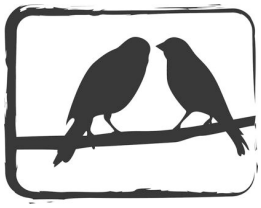

Compost Politics: Experimenting with Togetherness in Vermicomposting

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ABSTRACT Emerging from the question of how to live together with our planet, more-than-human approaches to interspecies relations have often presented 'cozy' versions of conviviality (Whatmore 2002; Haraway 2008; Hinchliffe 2010). This was usually set against a (supposedly) exclusionary politics of nature, in a move that betrayed a still largely humanist ethics. From the focus on friendly companions, to the attention to practices of care or living-together, the notion of companion species and their entanglements with humans has been polarized towards a pleasant and 'nice' version of coexistence. But, dealing with composting, it becomes clear that relations with the environment are never so neat and clean. What are, then, the modes of being together with the 'dirty' side of the 'green'? What practices emerge at the mundane interstices of the 'big picture' of a functional ecology? Wasting, eating, rotting, consuming, transforming and becoming-with are brought together in a variety of ways in practices of composting-with earthworms. Reporting on our own and others' attempts to 'live-together' with earthworms, this paper tracks the non-relations and asymmetries of the transformations of more-than-human materialities inside (and outside) domestic composting bins. We argue that the example of living-together with dung earthworms sheds light on the interplays between attachment and detachment (Candea 2010), shifting the notion of conviviality from a green and comfortable 'democratic collective' (Latour 2004) to a messy, yet constantly productive and on-going coexistence.

How to Read this Paper

This paper is a *guide* to *vermicomposting*.

By and large, vermicomposting consists in employing earthworms to break down organic material (generally kitchen waste) into fertile soil called compost. Those who write vermicomposting guides and who want to help the beginner with composting often start from long personal experience, and merge this with expert and scientific advice and telling facts: they address the reader as "you", they describe their own experiences, and they make propositions about what makes good vermicomposting practice. Throughout this text, we will similarly shift between these voices and modes of addressing the reader. In a way, vermicomposters who write guides or advice do so in an ethnographic mode: they observe and take part in a set of practices, and they come up with a description of them. Learning from them, we will bring together our ethnographic fieldwork with the attention to practices of

vermicomposters.[1] The structure and content of guides, as well as their advisory mode, also inform our writing. In this sense, this article is to be read as an alternative guide to vermicomposting that is specifically calibrated to an academic audience. While its structure is similar to that of other guides, and the questions on which it rests echo questions that any vermicomposter is familiar with, the responses that this guide offers are attuned to the sensitivities of academics working in and around the more-than-human.[2]

This paper is an *experiment in writing*.
While writing this article we realized how much work goes into bringing different genres together. Drawing inspiration from academic articles, vermicomposting advice, and our own experiences calls for a careful merging of different styles: we want to inherit the genre of guides while at the same time appropriating it for our case and our questions. To do so, we start from the questions that are usually found in vermicomposting manuals, and we address them both as vermicomposters and as academics. But merging also involves separating: in this sense a large part of the work of relating to the academic literature is cut out from the guide, and presented in the voices (one per section, marked in bold and followed by an * in the text) that make up the glossary at the end of the paper. These voices can be read both as a glossary, moving back and forth every time you encounter one in the text, and as a conclusion. A guide does not end or conclude at the end of the page, but it implicates the practices and realities it describes in its own fabric. What this has to offer to academic writing, we think, is the opportunity to rethink the work our articles can do and to engage in the practices also, crucially, outside of the text. This experiment in writing interrogates our style: what kind of politics and interventions can guides configure and articulate? We argue that taking guides* seriously can allow us to experiment with different ways of doing politics.

This paper empirically explores *questions of togetherness*.
Throughout the paper we will show how composting is about relations and, more specifically, about togetherness. We argue that composting shifts what togetherness might come to be. In response to calls for new kinds of ethics, politics, and normativities for the time of the 'Anthropocene,' [3] we thus attempt to rethink togetherness through vermicomposting. Vermicomposting is about doing togetherness in a way that is neither detached nor engaged. While detachment can be a 'good' practice and engagement can have 'bad' outcomes, the "implicit normative distinction"[4] between the two still seems to be attributed on the basis of a

[1] Beginning in 2011, we both devoted part of our time to composting with earthworms and ethnographically studying it.

[2] Bruce Braun, "Environmental Issues: Writing a More-Than-Human Urban Geography," *Progress in Human Geography* 29, no. 5 (2005); Jamie Lorimer, "Moving Image Methodologies for More-Than-Human Geographies," *Cultural Geographies* 17, no. 2 (2010); Sarah Whatmore, *Hybrid Geographies Natures, Cultures, Spaces* (London: Thousand Oaks, Calif.: SAGE Publications, 2002).

[3] Kathryn Yusoff, "Aesthetics of Loss: Biodiversity, Banal Violence and Biotic Subjects," *Transactions of the Institute of British Geographers* 37, no. 4 (2012); Bruno Latour, *Politics of Nature : How to Bring the Sciences into Democracy* (Cambridge, Mass.: Harvard University Press, 2004).

[4] Matei Candea, ""I Fell in Love with Carlos the Meerkat": Engagement and Detachment in Human–Animal Relations," *American Ethnologist* 37, no. 2 (2010).

kind of relation, rather than on what that relation can do. This seems to suggest that there are normative guidelines for togetherness 'out there.' That there is *only one* (correct) way to separate good from bad. That this is what needs to be done with goods and bads, to *separate* them. By contrast, vermicomposting offers space for conceiving of detachment and engagement differently. The togetherness that is done through vermicomposting has a lot in common with Isabelle Stengers' concept of cosmopolitics. Vermicomposting is political, we suggest, in the sense that it involves and brings together multiple different entities and activities. In "politics as usual" where generality and disinterested good will prevails, the political is "besieged with dramatic either/or alternatives"[5] that aim to resolve differences in a common, detached good. By contrast, cosmopolitics, as envisioned by Stengers, makes space for a slowing down of the construction of this common world in order to "create a space for hesitation regarding what it means to say 'good.'"[6] Building on Stengers' work, we propose that in vermicomposting, instead of cosmopolitics, we do *compost politics*. While this opens up a similar space for slowing down and allowing politics to hesitate, it also allows for the specific practicalities and dirty, fleshy attunements that constitute composting with earthworms.

Getting Started

How to set up the bin?

The container in which composting takes place is called a compost bin. A variety of containers can be outfitted for use as bins, but commercial bins are especially simple to use and assemble. To keep the bin separated from the ground, legs (or a tray used as a base) are fixed to the main collector tray, to which a tap is attached. This will help in collecting excess fluids, which can be used as powerful plant fertilizer. The main tray is the next layer added: here the worms will crawl and live. A number of other trays can be placed one on top of the other, to facilitate the activity of the worms and the collection of the compost. Finally, a covering lid closes the top of the wormery, keeping the light out and the smells inside. The bin is ready to use in a matter of minutes.

At this point, to begin composting, you must add the bedding and the worms. Generally, commercial bins come with a block of dried coconut fibre that needs to be soaked in warm water. This is supposed to be enough to get your worms started. Still, worms can be upset by the change of environment, or by the loss of the complex microbial environment that they were accustomed to up until they move into your bin. In this case, they might try to leave the bin; to resist your attempt at bringing them together. To facilitate the settling of the earthworms into their new setting, some soil from a potted plant or a garden can be added, together with soaked newspaper torn into small pieces. According to some experts, the paper creates a good airy and moist environment, and the soil transplants a lively soil biota composed of microorganisms that will help the worms break down organic matter and adjust to life in the bin.[7]

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[5] Isabelle Stengers, "The Cosmopolitical Proposal," in *Making Things Public: Athmospheres of Democracy*, ed. Bruno Latour and Peter Weibel (Cambridge, MA: MIT Press, 2005), 1002.

[6] Stengers, "The Cosmopolitical Proposal," 995.

[7] And it works! While Filippo had troubles with keeping his worms in the bin the first few days, Sebastian, who had added paper and soil, did not experience this.

Assembling* the bin is about bringing a number of active elements together. These elements can easily come together or resist your attempts at assembling them. To avoid that, specific entities need to be combined, and others need to be separated. In this sense, assembling is not only about merging, but crucially also about separation; it is about making a specific togetherness and avoiding others. While it involves worms with microbial organisms, food scraps, and a device for extracting valuable fertilizer, it is also about keeping the bedding separate from the fluid tray, and the food scraps from the kitchen, and the worms from your floor.

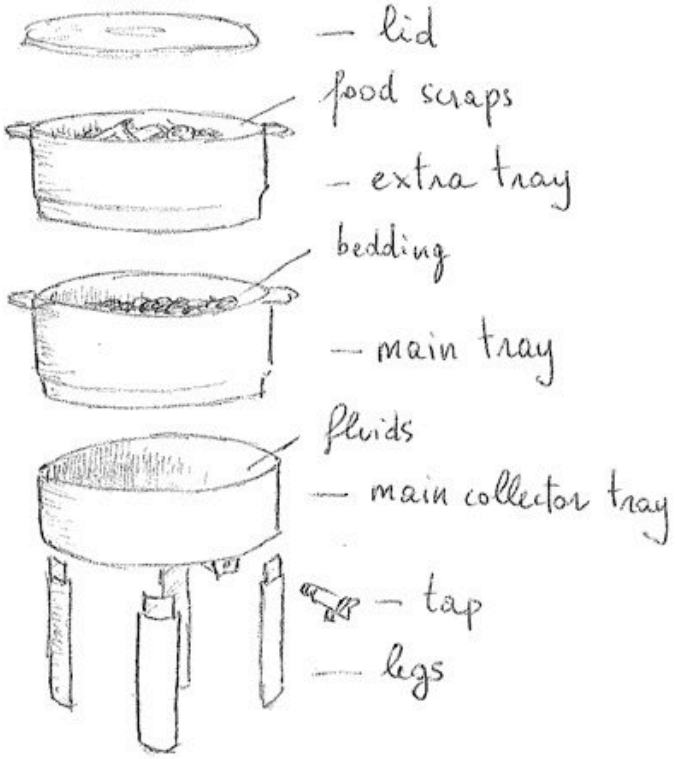

Figure 1 *The various parts of the bin to be assembled. Drawn by the authors.*

The combination and composition of heterogeneous elements is a strategic part of setting up the compost bin. When you keep a bin with decomposing waste in your kitchen you want it to be well closed, keeping moulds, bacteria and undesired smells away. The walls and lid of the wormery make it possible to keep your worms and food scraps in the kitchen. The bin is at once an apparatus for separating and for togetherness. Yet, while assembling the bin is central in keeping things apart *and* in bringing them together, containment and assemblage are not sufficient for vermicomposting to work. Togetherness is not only about the kinds of associations, alliances, and compostions that can be made. A working bin is more than just the sum of its parts, and it is more than a forced co-presence. As guides often put it, this is only the first step to vermicomposting: to compost is a process and setting the bin is the starting point,

but by no means the end of the process. Following the advice of vermicomposting guides, we will have to go beyond the making of the togetherness of these entities.

How does Vermicomposting Work?

> Your goal for your worm bin is to put waste in and get (vermi)compost out, thereby recycling the nutrients. To do this, a complex series of events must take place.[8]

The kind of togetherness that vermicomposters seek is not merely done by putting things together, nor is it about containment, spatial proximity, or intimacy. Instead, the togetherness is a complex on-going set of processes and doings that are largely (but not entirely) in the hands—or, better, guts—of your earthworms. Everything passes through the earthworms' guts, and, as Darwin noticed (1881), produces fertile castings that enrich the soil.[9] Passing through the guts encompasses an embodiment and a transformation. Composting is about merging the worm's eating and thriving with your disposal and casting-off of food waste. And it is about merging the worms' castings of digested material with your acquiring of fertile soil. This processual togetherness is not harmonious (more on this later), yet it cannot be simply forced. Instead, vermicomposting amounts to a precarious composition of different, yet potentially converging, activities and processes.

How does this happen? The guides will tell you that all sorts of bacteria, fungi, molds, and arthropods partake in the decomposition of your food waste. Next to the worms, numerous other critters are consuming and breaking down organic matter in your compost pile. Psychrophilic bacteria are the first to arrive. Then, as the temperature increases because of their activity, mesophilic bacteria follow. The latter release carbon dioxide and increase the temperature, paving the way for thermophilic bacteria. Then, as the temperature lowers again, it's the turn of actinomycetes and fungi. And of the earthworms.[10]

It is these entangled metabolic activities of diverse organisms in the bin that makes composting possible. The relations between these organisms are complex: "Over time, a large number of organisms in soil and litter have evolved different types of mutualist relationships with microorganisms."[11] For this reason, scientists focusing on earthworms came to call the system of relations that takes place in these cases an "external rumen:" like the rumen in ruminant animals such as cows, it is a space characterized by complex mutualist relations that help the processes of digestion. The worms have their own external rumen in the bin, since

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[8] Loren Nancarrow and Janet Hogan Taylor, *The Worm Book: The Complete Guide to Worms in Your Garden* (Berkeley, Calif.: Ten Speed Press, 1998), 25

[9] Charles Darwin, *The Formation of Vegetable Mould, through the Action of Worms, with Observations on Their Habits* (London: John Murray, 1881).

[10] This account is taken from Cromell 2010:32-3. As the aim of the guide is to offer a pragmatic overview of the processes that occur in the bin to help vermicomposters, the process is simplified and generalized. A trace of this is in the authors' use of the term actinomycetes, prior to their reclassification as actinobacteria. Cathy Cromell, *Composting for Dummies* (Hoboken, NJ: Wiley, 2010).

[11] P. Lavelle and *et al.*, "Regulation of Microbial Activities in Functional Domains of Roots and Invertebrates," in *Microorganisms in Soils: Roles in Genesis and Functions*, ed. F. Buscot and A. Varma (Berlin: Springer, 2005), 294.

they (like the cows in their rumen) have mutualist relations with other organisms that help them to decompose and to digest organic matter. The term external rumen makes evident the importance of other organisms that partake in this process and, simultaneously, extends the bounded body of the worm. In this sense, it evacuates metabolic processes of a clear-cut subjectivity: is it the worm that digests? Or the microflora in its guts? Or the more diverse external system of mutualists that settle in your bin? Here, the term external rumen highlights the role of the bin as a digestive tract as a decomposing tool.

After you have assembled the bin, the heterogeneous entities described above will begin to break down your food scraps meaning that the process of composting, and decomposing has begun. This is what the kind of togetherness that you need to achieve in vermicomposting is about: **decomposing.*** But this very specific composition of different activities and entities does not happen in a void, and needs the attention and maintenance of the vermicomposter.

How to Maintain the Bin?

Even if the worms do the digesting, you will still have to arm yourself with patience and dedicate a lot of attention to your wormery to keep the decomposition and the composting going. Vermicomposting advice dwells on how to maintain your bin in an "optimal condition." This requires you to pay attention to a number of issues. Guides will tell you that temperature, moisture levels, pH levels, aeration, light, and food types and quantities are some of the key aspects a vermicomposter will have to be particularly attentive to. Above all, you will have to add your leftovers to the bin. But not all waste will do the job: the food scraps you feed your worms should adjust to their preferences. Knowing what to feed your bin requires tinkering. As we learned from our own experience and from guides, variety, moderation, experimentation and adaptation are key to a thriving compost bin. Conducting our experiment, we found inspiration in lists of good and bad food, such as the one below.

> The more variety in ingredients, the better the vermicompost. Try not to overload your worm bin with fruit and vegetable skins, which may attract vinegar flies. Also, avoid lots of salty food waste, which will dry out the poor little worms. Everything in moderation! Worms are known to have food preferences (really), so experiment to see what your red wigglers prefer. Here's a hint: sweet mushy stuff like melon, pumpkin, and squash is popular at my house.
>
> - Other good additions include
> - Raw or cooked vegetables
> - Coffee grounds and filters
> - Tea and paper tea bags
> - Stale bread and grain products
> - Ground-up eggshells
> - Fruit rinds and cores
>
> Add citrus in very small amounts so the bin doesn't become too acidic.[12]

[12] Cromell, *Composting for Dummies*, 158.

Every guide will offer lists of foods that are preferred and foods that are better to avoid or limit. While the main points are similar, the lists can vary a lot. For example, a different guide tells us that it is better to avoid or limit "Citrus, meat and bones, garlic, heavily spiced foods such as many Asian and Mexican dishes, hair, dairy products: milk, yogurt, or butter, eggs, fresh green wastes and fresh manures, poisonous plants, oils."[13] The reasons for the recommendations vary, just as much as the recommendations themselves. From the risk of changing the pH of the soil, to the risk that the foods will "turn rancid and smelly as they decompose" and "attract undesirables such as houseflies or vinegar flies," to the likelihood of increasing pests and infestations (more on this later), to the possibility of having food scraps left behind because the worms prefer other foods, to the danger of coating the skin of the worms with grease and suffocating them. Eating and feeding happen in the complex environments that develop in the bin, and eating and feeding help to shape those environments.

As a vermicomposting human, you will have to pay attention to these environments, and try to balance them in the face of their dynamic changes. "Monitoring your worm bin is essential in keeping track of living conditions. You'll know when a problem is occurring, so you can take corrective measures."[14] The temperature should be kept between 15° and 25° C, isolating the bin from the cold in winter, and from the heat in summer (hardly ever a problem in the Netherlands). The moisture level should also be adjusted according to the humidity outside of the bin. "Moisture levels in bins should be kept between 70 and 80 percent. This is the optimum moisture for worms."[15] Or, more simply, if the bin has condensation on the insides of the lid, leaving the bin open during the day will lower the moisture level. Also the pH level should be kept in check and be adjusted according to the kind of foods that the worms are eating: a neutral pH like seven would be the best condition. Adding egg shells or specific additives could help keeping that in check after a particularly heavy feeding. Furthermore, the bedding should be kept well aerated and dark.

And, of course, there is the harvesting: when your compost is ready, you will have to take it out of the bin in order to use it while making sure the worms are kept in the bin. Different methods can be used to do this: from hand sorting, to screening the compost. Light and water can be used to push the worms to take refuge in different parts of the bedding, allowing you to take out the compost. Some commercial bins have a system of trays that pile up, allowing you to easily take the lower tray, filled with compost, and leave the worms crawling on the top layer. Also, some vermicomposters (especially those that do it on a large scale) will use another method, known as the 'death method': they simply kill or remove all the worms and replace them each time they want to extract their compost.

It is now clear that what goes on inside the bin is not autonomous and cut off from what goes on outside of it. The box, while it holds some things together and separates others is also a membrane that allows the exchanges between your kitchen and the wormery to take place and keep the metabolic processes of your worms' external and internal guts going. The guides stress that vermicomposting is basically a process to obtain compost. An on-going process, since it is aimed at recycling food waste. While you will have to set it up at some point, the digestion and decomposition will go on as long as you need it, thanks to the

[13] Nancarrow, *The Worm Book*, 55.
[14] Nancarrow, *The Worm Book*, 61.
[15] Nancarrow, *The Worm Book*, 62.

attention you dedicate to it. The care you put into your bin has a crucial role in your composting. **Maintaining*** the bin is the form that care takes in vermicomposting. If assembling the bin only takes a few minutes and decomposing is what the worms and the organisms in their external rumen do, there still is a lot of work for the vermicomposter. While the decomposition processes happen without you eating and digesting the food scraps, you still take part. Guides give advice on assembling the bin and bringing all the necessary entities together, and teach how crucial the worms' metabolic activities are. Yet, they also call you to action, reminding you how the worms are not independent but rather rely on your care.

Troubleshooting

Why are the worms trying to escape?

Figure 2 *Escaping worms. Photo from Wikimedia commons.*

From one day to the next, close to 20 worms had left the bin on Sebastian's balcony in Amsterdam. In the darkness of the night, they crawled out and ended up on the tray that he kept underneath the wormery. As usual, he had given them food; he had let them breath during the day by leaving an open space between the lid and the box; and earlier in the week he had created little pockets of air by scooping around the soil. So, why did they escape?

Why did the worms leave the bin? As one of the websites offering vermicomposting advice suggests: "This is probably just about the MOST common vermicomposting question out there!"[16] While such questions ask about reasons, their relevance for the vermicomposter is a pragmatic and empirical one. They are aimed at solving the problems that instigated the worms' leaving the bin by focusing on the specificities of the situation at hand. Mind you: the problem is not about the worms that left the bin—who were probably already desiccated by the time you found them. Rather, the question unfolds the problems that triggered the earthworms to leave. This marks a shift away from issues of containment and control that the question animating this section of the article seems to raise. Acting on the bin is necessary to adjust the adverse conditions and bring the wormery back to composting, preventing more worms from dying. But this event cannot be generalized: guides cannot offer a general rule on what to do. Rather, they present some suggestions and some variables that are likely to influence the situation and let you try out which course of action to take. It could be the kind of food, or the quantities, or the pH, or the moisture, or any number of other factors; or combinations of different factors, or even unpredictable or imperceptible ones. To decide what to do and keep the worms from leaving, the guides suggest, you will need to *know* your wormery, your worms and their needs. But *how* to know a compost bin and its more-than-human residents? The on-goingness and complexity of the processes that take place in the bin make the work highly variable and contingent. **Knowing,*** in other words, emerges as a process, the outcome of which cannot be apprehended in advance, as it hinges on the provisional and makeshift adjustments you engage in. So what does that look like?

The dead worms that had left Sebastian's bin were removed from the scene. Some of them, however, were still alive. These were placed back inside the bin. The problem here was not necessarily that some individual worms had left the bin, but that there was a risk that some of the factors listed above may cause more worms to do so. Checking the soil, it turned out that Sebastian's bin was very moist. This may have been what made the worms leave. An answer to this could have been to keep the lid open (but only during the day when there was light to keep more worms from leaving) to let in air. Another answer would have been to reduce the amount of feed with high concentrations of water (cucumber is a good example), since this will also make the soil moist. A third option, which was the one followed in this case, would have been to do nothing: to wait and see if the worms adapt and settle. Which sometimes they do.

In this scenario, a scientific answer that establishes the exact cause for the worms leaving is neither necessary, nor viable. What suffices is a heuristic way to address the problem and make sure worms do not keep leaving the bin. As we saw, the guides suggest that you maintain an "optimal condition." From the escaping worms, we learn that this is not a stable state, but a provisional and makeshift adjustment. This instability opens the space for a kind of knowing that is on-going, one that is never complete and exhaustive, but always redone. Vermicomposters will never find the perfect and infallible instruction for vermicomposting. More likely, they will find out, in time, what their worms like, what they do not like, how (or if) to adjust to temperature and feeding changes, and how to tinker with the soil so that the bin does not become infested with parasites (more on this later). As a vermicomposter, you will find, that is, a fluid recipe that can be changed and modified to adjust to different contexts,

[16] Red Worm Composting, "Why are my worms trying to escape?," accessed 13 December 2012, http://www.redwormcomposting.com/general-questions/why-are-my-worms-trying-to-escape/.

problems and situations. Here, the guides are crucial, together with an endless list of blogs, online guides, forums, videos and instructions of various types. But, most of all, as in the majority of DIY fields, experience plays a crucial role, since it best adjusts to the contingencies. Together with experience, mistakes, attempts, educated guesses, lucky strikes, and failures are integral aspects of knowing your bin. Knowing emerges in vermicomposting, once again, as a set of practices, multiple and contingent. In other words: you may not *know*, but rather *become attuned* to your worms. Compost politics is neither assimilation through identity nor the dream of harmony but rather a mutual domestication of multiple and different activities.

Knowing, in this specific sense, becomes an essential tool in vermicomposting: you will need to become attuned to the preferences of your worms, and to the changes in the bin, in order to adjust to them. Without the tinkering the worms will all leave the bin or die. In practice, this knowing takes the shape of a co-constructed, mutual, on-going and dynamic effort to attune your caring with the activities of the worms. Still, one that is not reciprocal in any egalitarian way, but rather sensitive to differences. 'Learning to speak worm,' here, means learning to become attuned to the subtleties of the worms' relation with the wormery, with the food, with the bedding, with their environment. And food is a language that worms understand. It is a 'language,' but one that is not inflected in words, sentences and grammar, but in the utterance of practices, in the less codified tinkering of everyday life.[17] It is a language shaped not in the mouth but through guts. More than learning to *speak* worm, you'll have to learn to *feed* worm. And, simultaneously, the worms will not learn to speak back to you, but to *eat* your leftovers. Knowing, here, is about feeding, caring, and maintaining the bin.

As we could see, freedom and control are not necessarily what is at stake. The point is not to know how to contain and control your worms, but it is to know how to feed them well. In the example above, you need to know what may have caused the earthworms to leave, not in order to control them, but in order to better *care* for the wormery. Tinkering with your bin, you are changing the conditions of the soil, and can try to make it more or less acidic, more or less moist, filled with this or that kind of food scrap. What is at stake is not the freedom of the worms, but the on-going metabolic activities of the bin.[18]

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[17] And, in this sense, it reminds us of Wittgenstein's approach to language as *language game*. Ludwig Wittgenstein, *Philosophical Investigations* (Chichester: John Wiley & Sons, 2009).

[18] In this sense caring for the wormery is mindful of the lessons learned in analyzing eating, but also of similar lessons drawn from reflections on mastery as transcending ideas of control and care within Amerindian anthropology. Carlos Fausto, "Feasting on People. Eating Animals and Humans in Amazonia," *Current Anthropology* 48, no. 4 (2007); Annemarie Mol, "I Eat an Apple. On Theorizing Subjectivities," *Subjectivity* 22, no. 1 (2008).

How to Deal with Infestations?

Figure 3 *Red mites infestation. Photo courtesy of http://r4wormcompost.files.wordpress.com.*

Filippo was away for a few weeks and asked some friends to drop by and give some leftovers to the worms. But when he came back, it became obvious that the food scraps his friends brought had not fed the worms, but the mites that lived in the bin. An explosion of brownish spider-like creatures covered every surface of the bin. While mites were present in the bin also before this event, the population grew so much over a short time that there was no other alternative but to put the bin straight out on the balcony, to avoid having the infestation spreading around the kitchen.

Mites, ants, nematodes, flies, slugs, rodents, and all sorts of critters can be attracted by the bin and settle in it. This was also the case for both of us: Filippo had mites and Sebastian had his bin swarming with nematodes. How to deal with these, and how they interact with the bin are crucial questions. While they are considered 'unwanted,' this is not simply about deciding who should stay and who should go away once and for all: practically, such a decision would not be easily enforced. Hermetically sealing the bin would not help the composting; more likely it would stop it. As a vermicomposting website puts it: "for the most part you don't need to get too stressed out about mites in your bin. Be assured, they are there to serve a function, and may simply indicate that your system has shifted out of balance somewhat."[19] Generally, then,

[19] Red Worm Composting, "A mite is a mite is a mite is a mite not quite," accessed 13 December 2012, http://www.redwormcomposting.com/worm-composting/a-mite-is-a-mite-is-a-mite-not-quite/

they are part of a healthy compost bin and of the worms' external rumen; without the complex ecosystem of soil bacteria, nematodes, mites, and fungi the worms would not be able to decompose organic matter. Eliminating all the other entities from the wormery, then, is not the solution:

> The worm bin is an amazing, complex habitat, with hundreds or thousands of decomposer species all working together to turn your kitchen scraps into fertilizer. And you thought you just had a bin of redworms! Not true—redworms are greatly outnumbered by other macro- and microscopic organisms. All these organisms are decomposers and beneficial to the ecosystem—so don't fear any newcomer you may find in the bin—in all likelihood it's just another one of your redworms' friends.[20]

However, when, as in the example above, there is an infestation, some of the decomposers stop being friends and become parasitic. Something needs to be done, but what and how? To answer this question we should consider more closely the kind of activity that goes on in the bin, and how that merges with the effort of the vermicomposter in caring for it.

As with the worms that left the bin, the problem with infestation is not one of control, but of maintaining and feeding. As we saw, all kinds of human and nonhuman activities and practices are brought together in and around the wormery: the worms' metabolic processes and eating, the external and internal organisms' chemical processing and decomposition of organic matter, your adding of food scraps and checking the conditions of the soil, and even the mites' infestation and thriving in the bin. Vermicomposting is a multiplicity of practices and metabolic processes that articulate and complicate the boundaries between the different transformations that go on in and around the bin, between insides and outsides, and even between humans and nonhumans.

In this sense, there are no general guidelines for **compost politics.*** The situations differ and so do the remedies, and it is not always possible to grasp the situation. This becomes clear in the case of the mites. Sometimes, the mite population in your bin can increase dramatically: the convergence of the various activities, processes and metabolisms is disrupted. The coexistence does not work anymore. What to do in this case? Some guides suggest that "There is really no need to worry about them because mite population blooms are cyclical and will decrease naturally with time. They are the types of mites that eat dead decaying organic material just like the other beneficial organisms in the worm bin, so there is usually no need to take action against them."[21] Other vermicomposters have more radical solutions to infestations: "Heavily water, but do not flood, the worm beds. Mites will move to the surface, and worms will stay below the surface. Use a hand-held propane torch to scorch the top of the bed and kill the mites. This procedure may be repeated several times, at three day intervals, if needed."[22]

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[20] Vermiculture Canada, "Other organisms in the bin," accessed 20 December 2012, http://www.vermica.com/articles/other_organisms_in_worm_bins.htm

[21] Happy Ranch, "Mites," accessed 20 December 2012, http://www.happydranch.com/articles/Mite.htm

[22] New York Worms, "Dealing with mites in earthworm bins," accessed 20 December 2012, http://www.nyworms.com/earthworm_mites.htm

The composition of the different activities and (metabolic) processes in vermicomposting is not pre-given; it is an achievement. Crucially, although such convergence can be articulated in so many words in guides and manuals, this is not a discursive achievement: it is about practical tinkering, about handheld propane torches, acidic pH levels, rotting cucumbers, infesting mites and earthworms' guts. It may be about intervening in the bin, killing mites, risking the balance of the wormery. But it may also be about not intervening and letting the infestation run its course. In vermicomposting, you will have to practically maintain the bin and tinker with it to keep it in an 'optimal condition,' but this activity plays out, intervenes and interferes with other on-going activities, like decomposing, feeding, and maintaining.

Knowing exactly what goes on in the bin is neither necessary nor possible. And caring for the bin is not the same as controlling it. Instead, to learn to become a vermicomposter is to learn to become attuned to different ongoing and makeshift processes. These will never converge into a single, common one. At best, they can be tinkered with to make them coexist, if only temporarily. They can be adjusted, constantly, to try to fit vermicomposting. This becomes clear when we reflect on how the different senses of eating and feeding are foregrounded.

From Food to Compost

Feeding: between eating and composting

In vermicomposting **feeding*** is crucial. This entails making good decisions about which foods to use, but equally important is the question of how to feed the worms. For example, the size of the portions and the frequency of the feeding require careful planning. "Plan on feeding your worms about half their weight in food scraps per day. When starting a new bin, offer just a handful of food until they get acclimated and start digging into your provisions. As a general guideline, feed your worms when the majority of the previous food has disappeared."[23] Another aspect concerns how feeding takes place. The food might be cut in smaller parts, to facilitate the decomposition: one guide asks "to chop or not to chop?" the food you feed the worms. In a short time you will learn how to care for and prepare the food. Through our experiment, we learned that saving, sorting, chopping and handling our food scraps quickly became an everyday routine, like preparing our own food. The difference is that the worms' meal is made of what we would otherwise have thrown away. Potato peel, rotten tomatoes, mouldy bread, egg shells: these are the kind of things that we would prepare for our worms to eat. For the vermicomposting human this is not food, but food waste.

To say that vermicomposting is a practice through which *food* is shared between humans and worms would, in this sense, be misleading. The stale and mouldy bread that we occasionally fed our worms was fed to our worms precisely because we no longer wanted to eat it. The worms, however, did not mind the mould, or the egg shells. Similarly, the worms did not excrete what for them was "fertile soil" but waste matter, worm castings. As a vermicomposter, you may use the worms' casting for growing plants. And you may use it to grow new food.

[23] *Composting for Dummies*, 157.

> Vermicompost, which is what you get when food scraps and bedding are processed by worms, is one of the main reasons people start keeping worms. To some gardeners, using casting or vermicompost to fertilize the vegetable garden completes the cycle.[24]

What happens in vermicomposting is thus a series of transformations by which food may be turned into waste and waste may be turned into food. This conjures an image of a closed cycle, one that is completed once your food waste has been used to produce new food. The image of a 'cycle,' however, is misleading. In fact, it is too unitary and does not account for non-convergences, differences, and imperfect encounters. If it is true that you can use the compost to grow new vegetables, it is also true that a number of transformations go on in composting, and nothing 'comes back,' nothing is 'the same.' Eating, feeding and composting are transformative and always involve changes, that, although small, require specific solutions to specific problems. And so each moment in vermicomposting can be distinct from the next one, and require different approaches. For this reason tinkering and attending to differences and specificities is crucial in vermicomposting. As much as the bin is not about containment, so too composting is not necessarily about closing off cycles.

Conclusions, in the form of a Glossary

ASSEMBLING – Guides always begin with the assembly of the bin. To host vermicomposting effectively, the wormery needs to have certain characteristics and bring many different entities together—whether you are using a commercial bin or building your own. *Assemblage* is a term that has been gaining weight in social sciences, and rightly so since it can do important work. But the avenues through which it came to its current popularity are complex and we will not delve into their histories.[25] Here, we will focus on what it does in our vermicomposting case.

At first sight, talking about the assembly of the bin seems to be fairly trivial. After all, we have all assembled things: you get the pieces, follow the instructions, and put them together. But, attending to what goes on in the assembly of the bin allows us to complicate the centrality of human action. It is not only the vermicomposter that merges worms, bacteria, plastic trays and bedding together: the act of bringing entities together is *diffused* in the bin. The bedding, the soil, the microflora and the bin do much of the togetherness of worms and humans, as do the food scraps in your kitchen. They are not just inert pieces that you put together. Without all of them, you could not achieve the togetherness that is needed to compost. This is a classical insight in STS.[26] So assembling is not only about bringing entities together and shaping alliances that work. It involves more than the strategic association of heterogeneous things: the actions of and relations between the various entities that come together is also part of assembling.[27] Simultaneously, we learn that doing togetherness also involves separating.

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[24] Nancarrow, *The Worm Book*, 95.

[25] For a good overview of the Deleuzean origin of the term and its potential misconceptions, see John Phillips, "Agencement/Assemblage," *Theory, Culture & Society* 23, no. 2-3 (2006): 108-109.

[26] See, for example, Michel Callon, "Some Elements of a Sociology of Translation: Domestication of the Scallops and the Fishermen of St Brieuc Bay," in *Power, Action and Belief: A New Sociology of Knowledge?*, ed. John Law (London: Routledge, 1986).

[27] This suggestion has travelled less easily than the idea that agency is not exclusively human. In a sense, even in Latour's own more recent work this has been overlooked by giving precedence to a more

Adding the worms to the bin is also keeping them away from the kitchen. It is also about their relation with the bedding and the bacteria in the soil. *More than one and less than many,* as Marilyn Strathern and Annemarie Mol would have it.[28] All sorts of relations and actions are part of the togetherness of the bin, reminding us that assembling does not work if it merely responds to an additional logic. Thus, assemblage is important for achieving togetherness, but it is not the end of the story.

DECOMPOSING – The togetherness that is sought in vermicomposting is not simply about putting things together. It also has to do with compost. This requires a complex set of metabolic processes, most of them involving earthworms' digestion decomposing food scraps into organic matter. The entities that populate these processes proliferate. Not only are there earthworms, but also their guts, their gizzards, their whole digestive systems, their complex physiology, their intestinal flora and fauna. Even more so: the worms' digestion is stretched not only inside their guts and bodies, but also outside, in the bin, together with a number of other organisms and entities. This is one of the biggest challenges of considering decomposition: it questions the boundaries of subjects and objects, of inside and outside, of one action (e.g. eating) and another (e.g. excreting). It spreads the activity of decomposing among different and heterogeneous entities and through diverse activities and processes. In this sense, it reminds us of Judith Butler's work on gender: "My argument is that there need not be a 'doer behind the deed,' but that the 'doer' is variably constructed in and through the deed."[29] In the case of decomposition, this is true in a very fleshy way: it is about the transformations of food waste into compost and into the bodies of worms, and a vast array of other organisms and entities. Simultaneously, the deed is not clear-cut either, but it is itself the merging of other processes. We have called this a composition, but the term is not precise. It is not merely about putting together different entities and activities, but concretely about decomposing and all the kinds of processes that go into that.

This offers us a first clue towards the lesson that vermicomposting can teach us about togetherness and its politics. Starting from evoking the "modernist clash with nature" represented in James Cameron's *Avatar*, Bruno Latour offers a manifesto for a different 'politics of nature': a *compositionist* one.[30] He chooses composition because

> it underlines that things have to be put together (Latin *componere*) while retaining their heterogeneity … Above all, a composition can *fail* and thus retains what is most important in the notion of *constructivism* (a label which I could have used as well, had it not been

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linear understanding of assembling. This is clear in his suggestion to 'reassemble the social': while his use of assemblage there is diffused and involves nonhuman agencies, the action of reassembling that the sociologists are called to undertake still figures a subject that is in control and that simply puts things together. For a similar exploration of the limits of *association*, see Filippo Bertoni, "Soil and Worm: On Eating as Relating," *Science as Culture* 22, no. 1 (2013).

[28] Marilyn Strathern, *Partial Connections* (Savage, Md.: Rowman & Littlefield Publishers, 1991); Annemarie Mol, *The Body Multiple : Ontology in Medical Practice* (Durham, N.C.: Duke University Press, 2002).

[29] Judith Butler, *Gender Trouble: Feminism and the Subversion of Identity* (New York: Routledge, 1990), 142.

[30] Bruno Latour, "An Attempt at a 'Compositionist Manifesto,'" *New Literary History* 41, no. 3 (2010).

> already taken by art history). It thus draws attention away from the irrelevant difference between what is constructed and what is not constructed, toward the crucial difference between what is *well* or *badly* constructed, *well* or *badly* composed. What is to be composed may, at any point, be *de*composed.[31]

Up to now, Latour's composition fits very well with what goes on in the bin. But he pushes his claims further, aiming to embrace the task of finding universality. "From universalism it [compositionism] takes up the task of building a common world; from relativism, the certainty that this common world has to be built from utterly heterogeneous parts that will never make a whole, but at best a fragile, revisable, and diverse composite material."[32] Here is where we play the Stengerian card of the idiot, and slow down behind Latour. Instead of the universalism and grand narrative of composition, we put forth the decomposition that animates the vermicomposting bin. This is precise, located in practices, and it requires a lot of effort to travel outside of vermicomposting circles. But, simultaneously, it is more true to the dirty and messy practices and politics it is involved in. This allows it to reinvent and reshape politics in terms of the practices and matters (*of concern* and *of fact*) that are involved in it, avoiding the opposite move which characterizes a call for the Latourian "Parliament of Things."[33] In this case, as we will see, the concerns of eating, being eaten, and feeding will ground a different kind of politics from the democracy of the compositionists.[34] A politics that diffuses activity among heterogeneous entities and processes, encompassing fluidity and transformation, and grounding this mutability in the asymmetries of eating.

MAINTAINING – The importance of going beyond bounded notions of humans and nonhumans (and earthworms, and guts, and eating) becomes clear when considering the maintenance of the bin. At first sight, the division of roles seems simple: the worms do the digestive and transformative work of composting, while you assemble and take care of the bin and keep light, moisture, and feeding routines in check. But this division is only superficial. The worms and you become attuned to each other, and to the special environment that is the compost bin. Your worms become worms-with-wormery and you become human-with-wormery: their activities and yours need to become entangled and non-reducible, if they are to succeed. If you don't adjust your feeding to their preferences, they will not thrive; if they don't adjust to the bin, they will die somewhere on the floor of your kitchen. Still, this muddying of boundaries is not a flattening, nor is it easy. It takes work, and it can always produce friction, and lead to failure. In this sense, Latour's rendition of Callon's "generalized symmetry" is not helpful here, since it gives the impression of a flat set of relations.[35] The need to make space for asymmetry in

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[31] Latour, "An Attempt at a 'Compositionist Manifesto,'" 473-4.

[32] Latour, "An Attempt at a 'Compositionist Manifesto,'" 474.

[33] Latour, *Politics of Nature*.

[34] See also Anders Kristian Munk and Sebastian Abrahamsson, "Empiricist Interventions: Strategy and Tactics on the Ontopolitical Battlefield," *Science Studies* 25, no. 1 (2012).

[35] This problem is more connected to a frequent misreading of Latour, since he explicitly says that "ANT is not, I repeat is not, the establishment of some absurd 'symmetry between humans and nonhumans.' To be symmetric, for us, simply means *not* to impose a priori some spurious *asymmetry* among human intentional action and a material world of causal relations." In Bruno Latour, *Reassembling the Social*

maintaining the bin remind us instead of Fausto's presentation of the Amerindian category of mastery: "One of the important features of this relation is its asymmetry: the owners control and protect their creatures, being responsible for their well-being, reproduction and mobility. This asymmetry implies not only control but care."[36] But our bin is not in Amazonia: what transporting this category of mastery to our bins does for us is to do away with the assumed distinction between control and care. And, simultaneously, it rids us of the normative division between 'good' engagement and 'bad' detachment, following Candea.[37] In this sense, various explorations of care on the farm have already taken steps towards dirtier normativities emerging with caring practices.[38] The practices that go into the maintenance of the bin, then, allow for —at least – a partial evacuation of the cozy language of love and passion, while still sharing in some of the language of care. We do not love the worms, and probably few vermicomposters do.[39] Or maybe we do. But if we do, we do not love them in the sense of a comfortable love, a passion that is easy and does not make demands on us. If it is love that inspires our care, it is a love that is about asymmetric relations, about profound differences, about irreducible otherness. Care might need the language of love, but of a love that is dirtier and not easy. In this sense, the first step to take to avoid homogenizing our stories into comfy and cozy ones is to refuse all-encompassing normativities, both the 'bads' and—especially—the 'goods.' Only in this way can we be true to the mantras of companion species: "partners do not precede their relating; all that is, is the fruit of becoming with."[40]

KNOWING – The advice offered to vermicomposters often involves calls for knowing the bin and its contents. But, while knowing your worms is crucial to be able to tinker with them, it is not severed from other practices in an obvious way. It is neither an objective, detached, and absolute knowing, nor one that involves engaged judgement, control, and containment. Instead, knowing the bin is a situated and makeshift set of hands-on practices. Since it is concerned with the tinkering and caring that maintaining the bin involves, the kind of knowing that emerges from vermicomposting advice is a *knowing in practice*. In vermicomposting, knowing is maintaining the bin and feeding the worms. It resembles the kind of knowing where an attention to practices allows us to "spread the activity of knowing widely."[41] Doing this displaces the familiar dichotomy between knowing subject and known object. The polarities that characterize knowing in the bin have to do with the care taker and the cared for, the

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(Oxford, UK.: Oxford University Press, 2005), 76. Still, this is a misreading that he seems to facilitate with his work in *Politics of Nature,* and that requires, for us, a more careful treatment.

[36] Fausto, "Feasting on People," 333.

[37] Candea, ""I Fell in Love with Carlos the Meerkat.""

[38] Hans Harbers, "Animal Farm Love Stories," in *Care in Practice. On Tinkering in Clinics, Homes and Farms*, ed. A. Mol, Ingunn Moser, and Jeanette Pols (Beilefeld: transcript Verlag, 2010); John Law, "Care and Killing. Tensions in Veterinary Practice," in *Care in Practice. On Tinkering in Clinics, Homes and Farms*, ed. A. Mol, Ingunn Moser, and Jeanette Pols (Bielefeld: transcript Verlag, 2010); Vicky Singleton, "Good Farming. Control or Care?" in *Care in Practice. On Tinkering in Clinics, Homes and Farms*, ed. A. Mol, Ingunn Moser, and Jeanette Pols (Bielefeld: transcript Verlag, 2010).

[39] In fact, Sebastian is not particularly keen on touching them, while Filippo drove his bin out of the house, and slowly led his herd of worms to extinction with his travels.

[40] Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2008), 99.

[41] Mol, *The Body Multiple*, 50.

feeder and the fed. What emerges from vermicomposting resembles more practices of domestication: knowing is a kind of mutual *attuning*.[42] Mutual, here, does not mean homogeneous or symmetrical, though, but involves an uneven, heterogeneous and irregular reciprocity, a coexistence more than a communion. Knowing as maintaining and feeding intimately connects to the engagement of the composter in keeping the compost bin going, but also the relations of worms with soil and decomposing matter and of the microbiome of the bin and the guts of the worms. If you don't 'know your bin', you won't be able to keep composting going. Knowing your bin is a pragmatic need in composting: you have to understand *how to* tinker with it, and what to adjust, in order for the composting to go on.

COMPOST POLITICS – Vermicomposting is complex: the coexistence of heterogeneous and disparate processes and entities may bring about problems. To the vermicomposter, this begs the political and normative question 'what to do?' Through hands-on experience, we learn that there is no univocal answer to this question. There is no 'natural' answer, no moral guidelines 'out there.' Still, composting is possible. "In some ways, trust and interest, even for very different stakes, could be shared."[43] The agreement that Vinciane Despret talks about when exploring ethological research, like the convergence that happens in your bin, is an achievement—one that is achieved also, and crucially, through disagreement. You, the worms, the microbial fauna of the bin do not 'want' the same thing.

With different stakes come different politics. Freedom and democracy are not to be contested in vermicomposting. It is not free will and intentionality. It is compost. It is worm manure. At least for the vermicomposter. For the worms it mainly plays around eating (in the extended sense discussed above). In this sense it is not so much disagreement that characterizes the bin, as the materially heterogeneous and tangibly different practices and activities that make vermicomposting possible.[44] In this sense we take seriously Stengers' suggestion that "the 'cosmopolitical' proposal, as I intend to characterize it, is not designed primarily for 'generalists'; it has meaning only in concrete situations where practitioners operate."[45] This asks us to attend to the specificities of the 'concrete situation' we work with, in

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[42] The category of 'domestication' is a particularly complex one. *Molly Mullin, and Rebecca Cassidy, Where the Wild Things Are Now: Domestication Reconsidered* (Oxford: Berg, 2007). In our use the term is closer to attunement. Vinciane Despret, "The Body We Care For: Figures of Anthropo-Zoo-Genesis," *Body & Society* 10, no. 2-3 (2004); Nigel Thrift, "From Born to Made: Technology, Biology and Space," *Transactions of the Institute of British Geographers* 30, no. 4 (2005); Candea, ""I Fell in Love with Carlos the Meerkat": Engagement and Detachment in Human–Animal Relations; Karen Michelle Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham: Duke University Press, 2007).

[43] Despret, "The Body We Care For," 116.

[44] This shifts the response from a more dialogical language—the one of disagreement [cf. Jacques Rancière, *Disagreement: Politics and Philosophy* (Minneapolis: University of Minnesota Press, 1999)], translation [cf. Eduardo Vivieros de Castro, "Perspectival Anthropology and the Method of Controlled Equivocation," *Tipiti Journal of the Society for the Anthropology of Lowland South America* 2, no. 1 (2004)], democratic deliberation and diplomacy (cf. Bruno Latour, *Politics of Nature*) —to one that is done in practices, as we shall see.

[45] Stengers, "The Cosmopolitical Proposal," 994.

this case composting. So, in compost politics, instead of cosmos, it is compost that "refers to the unknown constituted by these multiple, divergent worlds and to the articulations of which they could eventually be capable."[46] The multiple, divergent worlds that are articulated in vermicomposting are the worlds of earthworms, their external and internal digestive processes, the mites, the nematodes, the decomposing kitchen waste, the vermicomposter and the other worlds we unfolded in this paper. The limits of the language of *translation* and *diplomacy* that is proposed as a path to 'controlled equivocation'[47] or to 'civilized practices' in cosmopolitics become clear when dealing with contexts in which human and nonhuman boundaries are muddy. In the dirty and messy togetherness of compost, constructing a common world is not about bridging differences, bringing about similarity, understanding and agreement. The togetherness of the bin is political, in that it calls for assembling, arranging, composing, separating, and working *with* others. But the commons of compost are divergent, heterogeneous, profoundly different: if compost was a common world, the waste would be waste, not food. The castings would be manure, not soil. The politics of compost are grounded in these differences, and still they come together in vermicomposting notwithstanding—better even, *thanks to*—these divergences. What this can mean for our politics of nature is that we cannot dream of simply or easily "bringing nonhumans into politics."[48] We need to reinvent politics after the divergent relations and varied practices in which humans and nonhumans are already together, so closely and variously that distinguishing between them is not obvious.

FEEDING – The convergence that takes place in compost not only involves different actors, but also a multiplicity of practices: agreement is neither necessary, nor possible if it is conceived as a reduction of differences. But disagreement and heterogeneity can still come together and somehow work. Feeding offers a good way to shift how we think of this divergent togetherness. In fact, it is never one-sided. It always comes with divergent bodies, practices and desires—very divergent in the case of vermicomposting, since we feed the worms with what we would not eat. You feed your leftovers to your worms and they feed on it. The worms' feed gets eaten and decomposed. With its transitive and intransitive senses, feeding holds all of this together as it describes both the activity of the vermicomposter and the worms. As Strathern points out, feeding, just as eating, "seems to be a general way of articulating the entailment of all kinds of entities in one another."[49]

In this entailment, the object can be enacted in some practices as waste, in others as feed, in others as food, and in others yet again as compost. These multiple enactments are ongoing and they need to happen simultaneously for vermicomposting to work. In this sense, then, feeding/eating, with its transformative and relational character, allows us to

[46] Stengers, "The Cosmopolitical Proposal," 995.

[47] The connection between Viveiros de Castro's "controlled equivocation" and Rancière's disagreement within the frame of cosmopolitics follows from Marisol de la Cadena's proposal for an "indigenous cosmopolitics." A proposal, we suggest, that remains within a discursive realm because of the specific kind of (human-centered) politics with which it works. Eduardo Vivieros de Castro, "Perspectival Anthropology and the Method of Controlled Equivocation"; Jacques Rancière, *Disagreement: Politics and Philosophy*; Marisol De La Cadena, "Indigenous Cosmopolitics in the Andes: Conceptual Reflections Beyond 'Politics,'" *Cultural Anthropology* 25, no. 2 (2010).

[48] As a growing number of scholars seems to be suggesting, especially after Bennett (2010).

[49] Marilyn Strathern, "Eating (and Feeding)," *Cambridge Anthropology* 30, no. 2 (2012): 11.

conceptualize the togetherness as a patchwork, as a composite of differences that do not necessarily require a common world. Our worms and us, the vermicomposters, eat and feed/are eaten and fed by transforming and transubstantiating matter into food/waste, but we do it crucially differently. The togetherness of our bin is in friction, and yet brought together by the on-going processes of eating, feeding and decomposing without reducing this friction, but relying on it. The divergences of feeding, eating, and being eaten push us outside of a constricting Western naturalism.[50] The food/waste that you/the worms feed can simultaneously be *the same* object, and *not the same* object. The reality of the compost bin is not pre-given, but rather emerges from practices and processes, otherness and difference are not conceived as self-identity.

Feeding/eating brings different activities and diverging 'desires' together. In so doing, it allows for multiplicity and practices to come together in on-going events.[51] Through the compost politics of vermicomposting, different bodies, desires, and practices are kept different and in tension rather than being resolved through what would be considered the 'common good.' It is in this sense that vermicomposting allows us to push the notion of animal companions beyond the assumptions of intimate, straightforward and innocent relations, of cute and domesticated pets, and closer to that of Haraway's notion of companion species. The experiment with vermicomposting shows that the notion of companionship can signal something less cozy, more complex, and yet all the more interesting, especially if we stay close to the troubling sense of togetherness that the etymology of the term offers. From the Latin *cum panis*, with bread, can signal something very different when the bread shared is not the same. If the togetherness of eating and feeding brings differences together it does so not in making them similar again, or in resolving them in a common world, but in the transformation and destruction that digestion and decomposition involve. Simultaneously, though, the asymmetries found in your bin are not normatively already denoted as positive or negative. Feeding unsettles the "implicit normative distinction between engagement and detachment"[52] that Candea criticized. But the feeding that takes place in the wormery goes even further. It does not simply show how detachment can also, in some practices, be a useful strategy for shaping relations. And it does not remove the problem of normativity either. Rather, it amplifies it. In this sense, we can appropriate what Strathern writes of eating in Melanesia: "Food itself is the result of others' feeding, hence eating in general exposes the eater to all the pleasures and hazards of relationships."[53] In feeding and eating the normative question becomes vital, shifting the possible answers from the general to the particular, to the provisional time of practices.

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[50] Matei Candea, Alcayna, and Lys Stevens, "Internal Others: Ethnographies of Naturalism," *Cambridge Anthropology* 30, no. 2 (2012).

[51] In this sense we push Strathern's framing of Vargas' comment further: it is Eating more than Having that characterizes a metaphysics—if such a material semiotic position can engender a metaphysics at all—"of ecology rather than ontology." E Vargas, "Tarde on Drugs, or Measures against *Suicide*," in *The Social after Gabriel Tarde: Debates and Assessments*, ed. Matei Candea (London: Routledge, 2010); Strathern, "Eating (and Feeding)," 12.

[52] Candea, "I Fell in Love with Carlos the Meerkat," 243.

[53] Strathern, "Eating (and Feeding)," 9.

In eating, there are no ethical guidelines 'out there' for the politics of the compost (or cosmos). It is not your intimacy with your worms or your detachment from them that will guarantee the success of your vermicomposting experiment. It is not the kind of relation, be it one of engagement or detachment, which is normatively charged. It is what this relation does, what it enacts. It is how its togetherness is achieved in specific and provisional moments that becomes the appropriate site for the normative question. Only your tinkering, your on-going effort to interfere with the decomposition in such a way as to compost your leftovers, can impinge on the 'good' or 'bad' result of your bin. Appropriating Strathern's quote, we can say that, in vermicomposting, "what one never knows is whether [feeding] will be to positive or negative effect. The [bin's] future well-being will bear that information."[54]

GUIDES – This entry is purposefully the last one of the glossary, although it was the first one of the text. It is so because it allows us a reflection on our writing style. Experiments in writing are not like the kind of experiments that take place in labs. They do not bring about matter of facts. They merely try things out, stretch metaphors and styles, and provisionally do things differently. They, at times, might succeed and seduce more readers. But, what this experiment with the style of guides does, for us, is something different. Guides work by offering heuristic notions, exemplary cases, and pragmatic answers. Still, these generalizations, examples, and solutions can only work in so far as they are practically enacted in hands-on experiments and concrete situations. They do not address *why* questions; instead they move from asking *how* to asking *how to*. In this sense, guides take seriously the position of Leibniz that Stengers embraces in cosmopolitics:

> Leibniz wrote that the only general moral advice he could give was 'Dic cur hic' – say why you chose to say this, or to do that, on this precise occasion. … The question of responsibility is thus divorced from the definition of truth. Responsibility is not a matter of who is being 'truly' responsible, it is a matter of concern, and, as such, open to technical advice.[55]

Technical advice is what you can get from a guide. This is not only divorced from truth, but also from knowledge as an aseptic thing that happens in the mind and is cut off from the fleshy and dirty world of practices. Instead, it deals with knowing in practice: knowing by experimenting, tinkering, and getting your hands (and kitchen) dirty. A knowing that confuses objects, subjects, and the directionality of action. While it is always open to criticism and improvement, it also evokes a different form of politics: one that, to us, proved to be particularly relevant when dealing with the problems of compost politics. But also, crucially, one that is open to transformations and appropriations.

[54] Strathern, "Eating (and Feeding)," 11.

[55] Stengers, "The Cosmopolitical Proposal," 188.

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Currently, more than half a million microbial strains (that is microorganisms that are grown on a nutrient medium), which have been collected in various countries, are distributed throughout the world every year by the culture collections that are members of the World Federation of Culture Collections alone, mostly for the marginal costs of distribution (Dedeurwaerdere et al. 2009). Another example, from the field of human biological materials, is the case of Huntington's disease, a major neurodegenerative disease. In the 1980s, research into this disease was greatly enhanced by the collection of human tissue in regions of the world where it is highly prevalent (Conneally 1984). A world-wide collecting effort, and subsequent research, allowed the genetic location responsible for this disease to be identified. The results of this research are now being used in the development of improved diagnostic tools.

Nevertheless, the relatively frictionless exchange of biological materials within a global commons, which prevailed during the early days of modern life sciences, now seems to be reversed. More and more biological materials are enclosed behind national and privatized fences, or only accessible under very restrictive license conditions. For instance, recent research on avian bird flu has been hampered by countries, such as Indonesia refusing to provide access to samples of the H5N1 virus (WHO 2007). In this case, the Indonesian government feared that foreign companies would acquire the rights to any vaccine which might eventually be developed, without proper guarantees of low-cost access to this vaccine for developing nations. After an agreement in 2007 (World Health Assembly 2007) to start negotiations to define the terms of references for fair and equitable sharing in any possible profits, Indonesia resumed sharing the H5N1 avian influenza virus samples.

More generally, the implementation of access and benefit-sharing (ABS) obligations at the national level has led to the adoption of quite restrictive access measures in several developing countries, probably as a reaction to the excesses of bio-prospecting and patenting by developed countries (Safrin 2004). These access procedures can lack transparency and be quite complicated, involving lengthy delays in obtaining genetic materials (UNEP/CBD/WG-ABS/5/3 2007, 12–13). Another case of increasing restrictions on the access and use of microbial materials concerns the distribution of microbial strains by public culture collections. A major breach in the traditional sharing practices is the introduction by some collections of restrictive licenses. Some of these even forbid distribution to other public culture collections of basic taxonomic reference materials, such as type strains acquired from another culture collection (Dedeurwaerdere et al. 2009).

One of the major factors that has contributed to these increasing threats to enclose the global commons in biological materials is the emergence of the global intellectual property regime during the 1990s. [illegible] protection since 1991 [illegible]

p. 391

TOM DEDEURWAERDERE
'Self-governance and international regulation of the global microbial commons: introduction to the special issue on the microbial commons'
in International Journal of the Commons Vol 4. no. 1 Feb 2010 pp. 390-403

El carácter gastronómico, patrimonial y colectivo de la fermentación nos permite hablar de ella literal y metafóricamente, así como relacionarla con algunos discursos disruptivos: materializa una "simbiosis entre especies y coevolución, accesibilidad y biodisponibilidad, preservación y transformación, futuro y supervivencia – que se relaciona con la biodiversidad, por ejemplo, y finalmente, con la reducción del daño y el cuidado. Tanto de una misma como de otras", señala Lauren Fournier.

Fournier (Regina, Canada, 1989) es comisaria, escritora, artista e investigadora. Es autora de "Fermenting Feminism", un programa artístico mutante centrado precisamente en el potencial simbólico y material de este proceso. Iniciado en 2017 con el Laboratory for Aesthetics & Ecology, "Fermenting feminism" ha tenido hasta ahora cinco citas diferentes con proyecciones, sesiones de escucha, exposiciones colectivas, reuniones experimentales, una publicación de autoría colectiva y coeditada y un festival de performance con piezas de Regina de Miguel, Leila Nadir, Zoë Schneider, WhiteFeather Hunter o Sarah Kantrowitz, entre otras.

La fermentación es un proceso natural de enriquecimiento en que la "madre" procrea, re-genera, alimenta, cuida y se *autoreplica* o actualiza. En sus versiones física y figurada, esto es para Fournier una forma de acercar los feminismos contemporáneos transnacionales. Su interés principal estriba en la doble capacidad de conservar y cambiar, "esta capacidad de preservar, retener y honrar el pasado y al mismo tiempo transformar, tomar nuevas formas y configuraciones". Con las referencias a la "madre" y a la alimentación volvemos al hogar en un sentido reivindicativo como espacio no colonial de cuidado y protección, de tiempos lentos, de legado matriarcal, del "hazlo con otras" y de liberar procesos.

Fournier reconoce las ecologías *queer* de la fermentación pura (*wild fermentation*) de Sandor Katz, autor de "Fermentación Pura: el sabor, el valor nutricional y el arte que encierra la elaboración de alimentos vivos" (Chelsea Green Publishing, 2003), como un punto de partida en su práctica. "En contraste con el uso de cultivos comprados, preenvasados, quizás producidos en serie o muertos para fermentar bebidas y alimentos, la fermentación pura fomenta el uso de bacterias y levaduras preexistentes en un entorno determinado para integrarse en el recipiente de fermentación dado y servir como catalizadores para la fermentación". Según la comisaria, la tensión que se produce entre ese recipiente y su exterior en términos de receptividad o absorción es importante para entender la política feminista inherente a esta práctica. El fermento activado huele, suena y burbujea, desbordando el continente: está vivo.

Marta Alvarez Guillén 'Fermentación y feminismo. Conversación con Lauren Fournier' in Magazine 2019

Fermentation revisits the theoretical underpinnings of how we operate as humans in a microbial world. As with grapes that ferment into wine and take on new meanings (e.g. hospitality, sociability, religious symbolism), fermentation is a transformational process in both matter and meaning. Fermentation — which relies on invisible and multiple communities that work together — can also provide cues for agitating the social order around us. In a broad sense, the cultural shifts apparent in the #MeToo movement (i.e. making visible the horrors of rampant sexual assault) and the LGBTQIA+ movement (i.e. extending rights and support to vibrant communities) point to a kind of social ferment that elicits public concern and a call to action. As both a metaphor and a material practice, fermentation has the potential for literal and figurative change.

Maya Hey and Alex Ketchum 'Fermentation as Agitation: Transforming how we live together' in *Cuizine* Volume9, Issue2, 2018
Food, Feminism, and Fermentation
https://id.erudit.org/iderudit/1055215ar

Maria Puig de la Bellacasa (2017)
"Matters of care, Speculative ethics
in more than human worlds"
University of Minnesota Press.

Time is not a given; it is not that we have or not time but that we *make it* through practices (Dubinskas 1988; Whipp, Adam, and Sabelis 2002; Frank Peters 2006; see also Wyatt 2007). Temporality is not just imposed by an epoch or a dominant paradigm but rather made through sociotechnical arrangements and everyday practices. If we want to think the possibility of a diversity of practices and ontologies, the progressive, productionist, anticipatory temporal

regime, although dominant, cannot be the only one, nor is it exempt from coexisting with other timescapes, as well as it comports tensions within a variety of timescales that comake and might contest each other.

The case for exploring (and enacting) alternative temporalities is made even more compelling by a renewed emphasis on temporal diversity in the social sciences and the humanities. Especially relevant for this chapter is interdisciplinary work marked by an ecological critique of linear and anthropocentric temporalities (Bastian 2009). Indeed, a diversity of eco-temporalities is revealed when multispecies, more than human, scales are considered (Schrader 2010; Choy 2011; Bird Rose 2012). These insights are of specific importance to research on human–soil relations and ontologies. Soil is created through a combination of the long, slow time of geological processes such as those taking thousands of years to break down rock—that Stephen Jay Gould qualified as "deep time" (1987)—and by relatively shorter ecological cycles by which organisms and plants, as well as humans growing food, decompose materials that contribute to renew the topsoil. Both micro and macro timescales at stake in ecological relations involve different time-frames than those of human lifespan and history (Hird 2009). This is not only a philosophical or scientific problem, it is an ethical and political one. In the words of Jake Metcalf and Thom Van Dooren, attending to time as materially produced, as lived time, draws attention to "ruptures in ecological time." This requires thinking of timescapes that could be "liveable for humans and non-humans alike" (Metcalf and Van Dooren 2012, v). This is a crucial task today, they affirm, when "ecological well-being depends on aligning the temporal dimensions of many beings, and the consequences of disruption and slippage between times" (vi). The emphasis on temporal diversity has implications for how we live together and how we belong in communities, that is, in creating "temporal belongings" for humans and nonhumans (Bastian 2014).[3] Whether we name this Epoch the Anthropocene (Zalasiewicz et al. 2011) to emphasize the impact of human technoscientific progress, or the Capitalocene (Moore 2014) to reflect the capitalist politics of *some* humans, drawing attention to the entanglements and frictions within more than human experiences and timescales has ethico-political, practical, and affective implications (Haraway 2015).

ideas from the perspective of Western thought, we discover that its basis is this requirement for transparency. In order to understand and thus accept you, I have to measure your solidity with the ideal scale providing me with grounds to make comparisons and, perhaps, judgments. I have to reduce.[3]

Accepting differences does, of course, upset the hierarchy of this scale. I understand your difference, or in other words, without creating a hierarchy, I relate it to my norm. I admit you to existence, within my system. I create you afresh. —But perhaps we need to bring an end to the very notion of a scale. Displace all reduction.

Agree not merely to the right to difference but, carrying this further, agree also to the right to opacity that is not enclosure within an impenetrable autarchy but subsistence within an irreducible singularity. Opacities can coexist and converge, weaving fabrics. To understand these truly one must focus on the texture of the weave and not on the nature of its components. For the time being, perhaps, give up this old obsession with discovering what lies at the bottom of natures. There would be something great and noble about initiating such a movement, referring not to Humanity but to the exultant divergence of humanities. Thought of self and thought of other here become obsolete in their duality. Every Other is a citizen and no longer a barbarian. What is here is open, as much as this there. I would be incapable of projecting from one to the other. This-here is the weave, and it weaves no boundaries. The right to opacity would not establish autism; it would be the real foundation of Relation, in freedoms.

Édouard Glissant, Poetics of Relation, 1997
p. 190

Critters interpenetrate one another, loop around and through one another, eat each another, get indigestion, and partially digest and partially assimilate one another, and thereby establish sympoietic arrangements that are otherwise known as cells, organisms, and ecological assemblages.

Sym-poiesis is a simple word; it means "making-with." Nothing makes itself; nothing is really auto-poietic or self-organizing. In the words of the Iñupiat computer "world game," earthlings are Never Alone.[2] That is the radical implication of sympoiesis. Sympoiesis is a word proper to complex, dynamic, responsive, situated, historical systems. It is a word for worlding.

Another word for these sympoietic entities is *holobionts*, or, etymologically, "entire beings" or "safe and sound beings."[3] That is decidedly not the same thing as One and Individual. Rather, in polytemporal, polyspatial knottings, holobionts hold together contingently and dynamically, engaging other holobionts in complex patternings. Critters do not precede their relatings; they make each other through semiotic material involution, out of the beings of previous such entanglements.

Mixotricha paradoxa is everyone's favorite critter for explaining complex "individuality," symbiogenesis, and symbiosis. Margulis described this critter that is/are made up of at least five different taxonomic *kinds* of cells with their genomes this way: "Under low magnification, *M. paradoxa* looks like a single-celled swimming ciliate. With the electron microscope, however, it is seen to consist of five distinct kinds of creatures. Externally, it is most obviously the kind of one-celled organism that is classified as a protist. But inside each nucleated cell, where one would expect to find mitochondria, are many spherical bacteria. On the surface, where cilia should be, are some 250,000 hair-like *Treponema spirochetes* (resembling the type that causes syphilis), as well as a contingent of large rod bacteria that is also 250,000 strong. In addition, we have redescribed 200 spirochetes of a larger type and named them *Canaleparolina darwiniensis*."[10] Leaving out viruses, each *M. paradoxa* is not one, not five, not several hundred thousand, but a poster critter for holobionts. This holobiont lives in the gut of an Australian termite, *Mastotermes darwiniensis*, which has its own SF stories to tell about ones and manys.

'Symbiogenesis, Sympoiesis and art science activisms for staying with the trouble' DONNA HARAWAY
pp. 25-28 in THE ARTS OF LIVING ON A DAMAGED PLANET, 2017
eds. TSING, SWANSON, GAN, BUBANDT

Every living thing has emerged and persevered (or not) bathed and swaddled in bacteria and archaea. Truly nothing is sterile; and that reality is a terrific danger, basic fact of life, and critter-making opportunity. Margulis gave us dynamic multipartnered entities like *M. paradoxa* to study the symbiogenetic invention of eukaryotic cells from the entangling of bacteria and archaea. Nicole King's laboratory has proposed the clumping and subsequent tissuelike formations of choanoflagellates in the presence of specific bacteria as a new model system for studying the symbiogenetic origin of animal multicellularity.[14] Margaret McFall-Ngai and her colleagues have proposed the necessary infection of juvenile Hawaiian bobtail squid by specific vibrio bacteria as a symbiogenetic model system to study developmental patterning, in this case constructing the squid's ventral pouch to house light-emitting bacteria, so the moon cannot cast its shadow over the hunting squid, thus alerting the prey below.[15] Other emerging model systems tuned to symbiosis and EcoEvoDevo in mammals include both mouse brain and immune system development responding to signals from gut bacteria.[16] Coral reefs are an immense model for studying holobiome formation at the ecosystem level.

The collaborations of critters are matched by the string figures linking disciplines and methodologies, including genome sequencing, imaging technologies, functional genomics, and field biology, which make symbiogenesis such a powerful framework for twenty-first-century biology. Working on pea aphid symbiosis with *Buchnera*, Nancy Moran emphasizes this point: "The primary reason that symbiosis research is suddenly active, after decades at the margins of mainstream biology, is that DNA technology and genomics give us enormous new ability to discover symbiont diversity, and more significantly, to reveal how microbial metabolic capabilities contribute to the functioning of hosts and biological communities."[17] I add the necessity of asking how the multicellular partners in the symbioses affect the microbial symbionts. At whatever size, all the partners making up holobionts are symbionts to each other. They are holoents.

Two transformative papers embody for me the profound scientific changes afoot. Proclaiming "We Have Never Been Individuals," Gilbert, Sapp, and Tauber argue for holobionts and a symbiotic view of life by summarizing the evidence against bounded units from anatomy, physiology, genetics, evolution, immunology, and development.[18] In the second paper, signaling "A New Imperative for the Life Sciences," Margaret McFall-Ngai and Michael Hadfield, with twenty-four coauthors, present a vast range of animal-bacterial symbiotic interactions at both ecosystem and intimate scales. They argue that this evidence should profoundly alter approaches to five questions: "how have bacteria facilitated the origin and evolution of animals; how do animals and bacteria affect each other's genomes; how does normal animal development depend on bacterial partners; how is homeostasis maintained between animals and their symbionts; and how can ecological approaches deepen our understanding of the multiple levels of animal-bacterial interaction?"[19]

Stories about worried colleagues at conferences, uncomprehending reviewers unused to so much evidential and disciplinary boundary crossing in one paper, or initially enthusiastic editors getting cold feet surround these papers. Such stories normally surround risky and generative syntheses and propositions. The critics are crucial to the holobiome of making science, and I am not a disinterested observer. Nonetheless, I think it matters that both of these papers were published in prominent places at a critical inflection point in the curve of research on, and explanation of, complex biological systems in the urgent times called the Anthropocene, when the arts for living on a damaged planet demand sympoietic thinking and action.

p. 29-31

Sharon Kinsman presciently asks:

> Because most of us are not familiar with the species, and with the diverse patterns of DNA mixing and reproduction they embody, our struggles to understand humans (and especially human dilemmas about 'sex', 'gender' and 'sexual orientation') are impoverished... Shouldn't a fish whose gonads can be first male, then female, help us to determine what constitutes 'male' and 'female'? Should an aphid fundatrix ('stem mother') inform our ideas about 'mother'? There on the rose bush, she neatly copies herself, depositing minuscule, sap-siphoning, genetically identical daughters. Aphids might lead us to ask not 'why do they clone?' but 'why don't we?' Shouldn't the long-term female homosexual pair bonding in certain species of gulls help define our views of successful parenting, and help [us] reflect on the intersection of social norms and biology?[3]

The variety of animal, plant, fungal and protoctist sex and reproduction that Kinsman refers to is diverse indeed: slime molds can produce more than 500 different kinds of sex cells; the average male blanket octopus is 2.5 centimeters long compared with his 1.8 meter and 40,000 times heavier female mate; green spoon worm larva become female in the absence of other female spoon worms; male angler fish attach to female bodies where they degenerate until their death; male seahorses fertilize eggs inside their bodies where they are gestated until birth; gray whale mating rituals involve two males and one female; mangrove fish have ovo-testes and fertilize themselves; male slipper limpets become female as they mature; star-shaped sea squirts meet on the ocean floor and send cells (including DNA) to each other through the blood supply they come to share; some kinds of whiptail lizards are all female, hatching unfertilized eggs that produce more females; female bronze-winged jacanas mate with up to four males and the males build nests, incubate the eggs and feed the chicks when they hatch; male sticklebacks also care for their fertilized eggs and offspring until they are independent; male Darwin frogs keep their tadpoles inside their vocal sacs until they develop into froglets; naked mole rat daughters help their queen mother stay infertile by smearing her with their urine; a hatchling turtle's sex depends on its temperature while it was in the egg; and leopard slugs are intergender (female and male) but fertilize each other's eggs.[4]

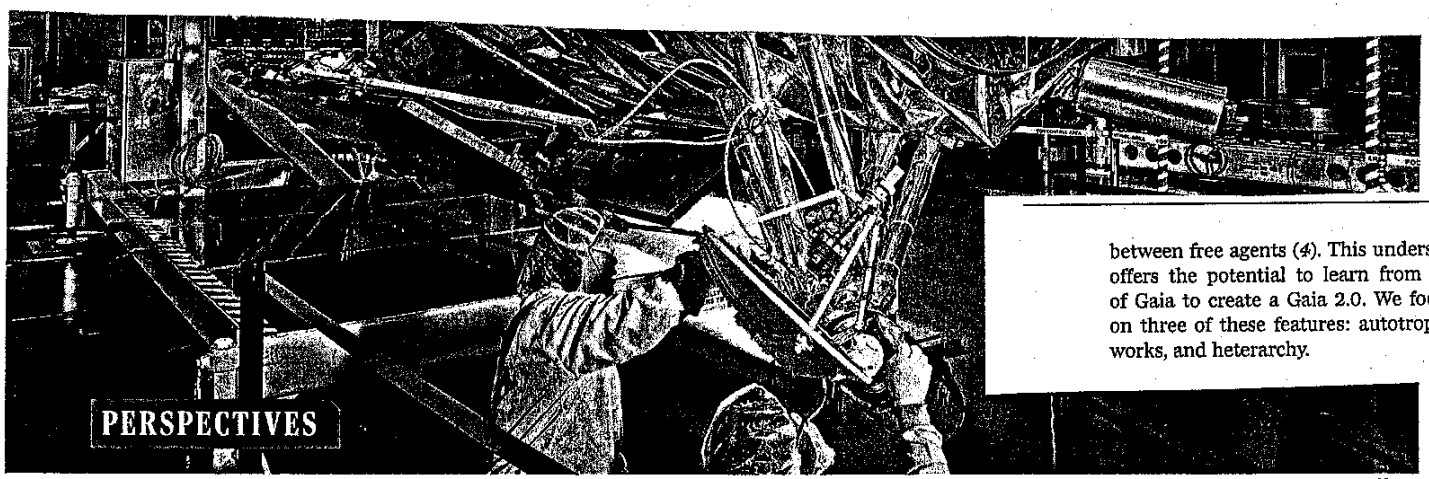
With Kinsman, I want to attend to the diversity of sex, gender, reproduction, sexuality and sexual difference within the kingdoms Animalia, Plantae, Fungi and Protoctista. But I also want to appreciate these issues from the perspective of Monera, a vast assemblage of organisms rarely included in discussions of the evolution and current practices of sex. We know especially little about bacterial sex and reproduction: yet within Monera, diversity meets its biological and human imaginative limits.

Post-mature discoveries and evolutionary theory's problem

The kind of generation of offspring with which humans are most familiar, mixis, has been studied since the end of the nineteenth century, by botanists studying plant fertilization and zoologists studying the fertilization of eggs with sperm. For Zuckerman and Lederberg, humans' discovery of bacterial sex was 'post-mature'. Scientists were surprised that it was not discovered earlier since: (1) the techniques used were available; (2) it was understandable at the time; and (3) its implications must have been capable of having been appreciated.[5] That discoveries can be post-mature necessarily speaks of the context of assumptions, beliefs and values in which the questions answered by the discovery are not viewed as important or relevant. 'Why', ask Zuckerman and Lederberg, 'was recombination in bacteria not perceived as a problem before 1946?'[6] Part of the answer lies in the fact that bacteria were first assumed to be tiny primitive plants: Ferdinand Cohen called them *Schizomycetes* or 'fission fungi'. Humans also find bacteria to be difficult experimental subjects: we might say, after Haraway, that the laboratory is not a setting within which we 'meet well' with bacteria. Observations of bacteria require humans to adopt the prosthetic aid of a microscope, and bacteria act differently in laboratory conditions than elsewhere: they are different actants in relation to the microscope, as Latour might say. Additionally, humans have traditionally conceived of bacteria as pathogens, of little interest and importance otherwise. Thus, it was not until March 1946 that Tatum and Lederberg observed sex in *E. coli*.

These first inauspicious meetings have had unexpected yet significant material and rhetorical effects. First and foremost, our attention has been focused on sexually reproducing species, and further, on identifying gender differences within species. For instance, Carl von Linné, the 'father of taxonomy', based his classification scheme on what he understood at the time to be gender differences between plants (of course, he did not use this term). The famous Linnean *Systema Naturae* was widely adopted and provided the blueprint for further animal and plant taxonomies, well into the twentieth century.[7] Social scientists, and feminist scholars in particular, are well aware that gender difference comprises one of the major axes (along with race, ethnicity, social class, age and disability) that humans use to make intra-differentiations amongst humans. Indeed, in public discourse, (some) women's ability to produce offspring through sexual reproduction has long counted as one of the most obvious signifiers of gender difference. Whatever social, political and economic changes might take place to alter women's position in society, sexual reproduction is seen as both immutable 'fact' and *cause* of structural differences between women and men. Of the almost countless references to female 'materiality' as sexual reproduction, my training as a sociologist secures Emile Durkheim's rendition as a particularly sharp thorn in my side. He writes, '...society is less necessary to her because she is less impregnated with sociability...Man is actively involved in it whilst woman does little more than look on from a distance'.[8] Not only does Durkheim remind his readers that it is female bodies that can be (passively) impregnated, but this impregnation is limited to fleshy materiality (babies). If male bodies are (actively) impregnated, it is with decidedly nonmaterial sociality.[9]

MYRA J. HIRD
The Origins of Sociable Life: evolution After Science Studies
2009
pp. 92-94
Palgrave MacMillan



PERSPECTIVES

SUSTAINABILITY

Gaia 2.0

Could humans add some level of self-awareness to Earth's self-regulation?

By **Timothy M. Lenton**[1] *and* **Bruno Latour**[2]

According to Lovelock and Margulis's Gaia hypothesis, living things are part of a planetary-scale self-regulating system that has maintained habitable conditions for the past 3.5 billion years (*1*, *2*). Gaia has operated without foresight or planning on the part of organisms, but the evolution of humans and their technology are changing that. Earth has now entered a new epoch called the Anthropocene (*3*), and humans are beginning to become aware of the global consequences of their actions. As a result, deliberate self-regulation—from personal action to global geoengineering schemes—is either happening or imminently possible. Making such conscious choices to operate within Gaia constitutes a fundamental new state of Gaia, which we call Gaia 2.0. By emphasizing the agency of life-forms and their ability to set goals, Gaia 2.0 may be an effective framework for fostering global sustainability.

At first sight, the potential for a successful Gaia 2.0 does not seem promising. Despite large-scale mobilization of scientists, activists, and citizens, large parts of the human population are indifferent to the Anthropocene, and many deny anthropogenic climate change (*4*). In addition, there is no proof that consciousness in this context is anything but the belated and retrospective realization that mistakes had been made and might be partially redressed. Indeed, the first formulation of the Gaia hypothesis (*1*) is almost exactly contemporary with what is now seen as the start of the Anthropocene (*3*). Furthermore, the examples of social. Darwinism, sociobiology, and dialectical materialism suggest that drawing political lessons from nature is problematic.

Nevertheless, it is important to have a second look at the connection between the original Gaia concept and a possible Gaia 2.0, because the original Gaia has many traits that were not detectable in earlier notions of nature associated with the development of Western civilization. Before the Anthropocene, Western societies saw themselves as the only conscious agents in a passive material environment. Today, they must cope with the brutal reactions of living organisms that are continually reshaping their surroundings, creating in part their own conditions for survival (*4*, *5*). Gaia thus establishes a new continuity between humans and nonhumans that was not visible before—a relation between free agents (*4*). This understanding offers the potential to learn from features of Gaia to create a Gaia 2.0. We focus here on three of these features: autotrophy, networks, and heterarchy.

The commercial Earth observation satellite WorldView-4 has been providing high-resolution imagery since its launch in 2016 from Vandenberg Air Force Base in California.

PHOTO: LOCKHEED MARTIN

September 13, 2018

NETWORKS

Gaia was built by adaptive networks of microbial actors that exchanged materials, electrons, and information (*10*), the latter through ubiquitous horizontal gene transfer. These microbial networks form the basis of the recycling loops that make up global biogeochemical cycles. Functional roles in these networks have been retained even when the taxa performing them were replaced (*11*). Therefore, sufficient biodiversity to provide functional redundancy contributes to the robust self-regulation of Gaia.

Microbial networks also created long-lived products that sometimes accumulated globally—notably oxygen in the atmosphere. This in turn facilitated an increase in the diversity of life and metabolisms and enabled the evolution of new levels of biological organization and connectedness (*6*), with new mechanisms of coordination. Humans and our adaptive social networks are the latest realization of this process.

In Gaia 2.0, horizontal transfer of information, functional diversity with redundancy, and distributed control will likely be important to a successful circular economy. The challenge is to support diverse, autocatalytic networks of human agents that can propel transformations toward goals such as sustainable energy, fueling the efficient cycling of resources. This is particularly challenging given a social and economic paradigm of short-term localized gain and relatively weak global, unifying, long-term structures to counteract this paradigm.

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Plasmodial Improprieties

Octavia E. Butler, Slime Molds, and Imagining a Femi-Queer Commons

AIMEE BAHNG

> I consider myself a creature of the mud, not the sky.
>
> DONNA HARAWAY

WHEN FEMINIST-QUEER SCIENCE STUDIES LOOKS FOR ALTERNATIVE models for being in the world that move beyond the human, we would do well to consider the work of African American science fiction writer Octavia E. Butler,[1] who dedicated her life to imagining worlds otherwise through the generic medium of science fiction.[2] This paper posits Butler as a black feminist philosopher of science, who used the genre of speculative fiction to formulate nonhierarchical socialities and even more radical onto-epistemological modes of living in common, often through feminist ideas of collaborative praxis and queer notions of kinship.

Drawing on my archival research of Octavia Butler's collected papers at the Huntington Library, I point to Butler's unpublished research notes on slime molds and other nonhuman organisms as an example of thinking beyond the human prior to the more recent turn to new materialisms. Butler's approach to slime molds and what she learns from them, I argue, model modes of engagement with other life-forms that come from practiced thinking with alien-human entanglements. While Butler has emerged as one of the most celebrated black feminist science fiction writers in the world, in this paper I argue that the imaginative possibilities her writing and research practices engender constitute an example of feminist scientific inquiry we could call speculative fabulation. Fabulation spans

the space between what speculative realists tend to position diametrically as the sheer ideation of the linguistic turn and the realism of matter (Bryant, Srnicek, and Harman 2011, 3; Meillassoux 2008, 5). It demands of its practitioners what Sara Ahmed might characterize as queer disorientation (2006). I interject Butler as a thinker who anticipates many of the recent critical moves beyond the human in feminist and queer theory, and I posit her literary works as theoretical interventions to these conversations that take into consideration histories of empire and slavery as phenomena at the planetary scale.

To begin, I focus on Butler's encounter with slime molds and how she begins to think about alternative ontologies and systems of organizing. Highlighting Butler's extrapolations from slime mold behavior to explore alien, human, and alien-human relations in her speculative fiction, I argue that Butler's fabulation of "xenogenesis" in her eponymous trilogy models an openness to the uncertain movements beyond the human that nonetheless foreground and stay attuned to power imbalances that too often narrow the possibilities of becoming. While Butler's thought experiment could be put into conversation with what Donna Haraway (2016) and Karen Barad (2007) respectively call "sympoiesis" or "intra-action," Butler's tale of xenogenesis suggests a deep imbrication of colonial modes of acquisition and genetic engineering as a science we have come to know in the US within the context of a capitalist, entrepreneurial mode of scientific research. Through a reading of Butler's fictional construct, I chase the implicit question: What would a feminist, decolonial genomics look like? Situating slime mold as a recurring player in feminist-queer science studies, I put Butler's research in conversation with Evelyn Fox Keller's work on slime mold reproduction and movement from the late 1960s through 1983. Together, Butler's notes and fiction provide a rich, alternative archive for feminist-queer science studies to examine as the field continues to focalize collaborative and collectivist frameworks for conducting science queerly.

But it won't all be utopian praise for slime mold. Starting from a moment of archival discovery, of thinking across time and space with Octavia Butler, this essay moves through some initial excitement about Butler's interspecies thinking to consider the more recent hype around and instrumentalization of slime mold in popular science as well as in speculative realist scholarship. While Butler's research into slime mold

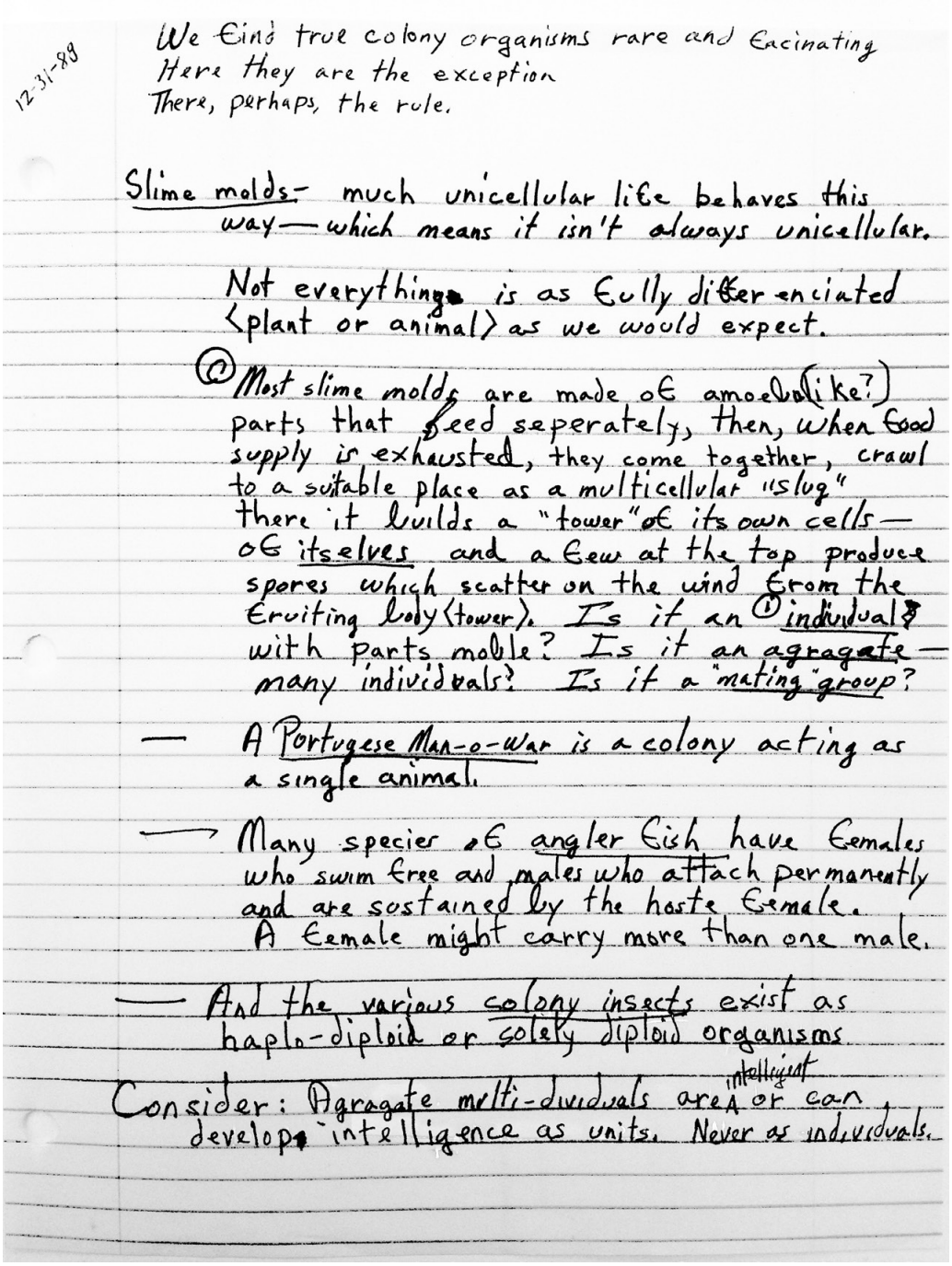
and other colony organisms indicates her interest in models of collective action, decentered modes of self-organizing, and systems of collaborative production, slime mold becomes, in the era of financialization and its attendant fields of probabilization and preemption, subject to more predatory forms of speculation. Swept up into a culture of optimization and risk aversion that celebrates its efficiency rather than its queerer characteristics, slime mold gets oriented toward models of competition when entrepreneurial technoscience asks it to perform spectacularized performances of problem-solving efficiency and adaptability.

In the final moves of the paper, I return to Butler and the slime mold, demonstrating how, despite her interest in its resistance to the atomizing proclivities of property, propriety, and privatization, she curbs her enthusiasm for colony organisms with a wariness around all-too-human systems of power that might confuse "emergence" for "colonization." Out of Butler's trepidation, I argue for the importance of keeping decolonial thought a part of feminist new materialist inquiry. Butler understands, on the one hand, that differentiation can fuel capitalist operations by cultivating the conditions for competition, and yet, on the other hand, that complete disregard for difference too often obfuscates power dynamics already in play even in the sympoietic moment. But first, let's join Octavia at the moment when she begins thinking about slime molds and other colony organisms.

The Impropriety of Social Amoebae

In Box 83, Folder 1625 of the Octavia E. Butler papers, housed at the Huntington Library in San Marino, California, a single note about slime molds surfaces (see opposite). Dated December 31, 1988, the note generally catalogs a number of colony organisms, such as the Portuguese man-o-war and the anglerfish. In multicolored pen on a lined index card, Butler has written: "We find true colony organisms rare and facinating [sic]. Here they are the exception[.] There, perhaps, the rule."

What is the "there" to which she refers? Not the soil through which slime molds travel (up to one centimeter per hour!), nor the sea depths where the female anglerfish "might carry more than one male" on her back. It is an elsewhere, a speculative space where someone—in this case, perhaps the most treasured black feminist speculative fiction writer of all time—can begin to imagine an otherwise. If "here" references a world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We find true colony organisms rare and fascinating
Here they are the exception
There, perhaps, the rule.

Slime molds- much unicellular life behaves this way—which means it isn't always unicellular.

Not everything is as fully differenciated (plant or animal) as we would expect.

② Most slime molds are made of amoeba(like?) parts that feed seperately, then, when food supply is exhausted, they come together, crawl to a suitable place as a multicellular "slug" there it builds a "tower" of its own cells—of itselves and a few at the top produce spores which scatter on the wind from the fruiting body (tower). Is it an ① individual? with parts mobile? Is it an agragate—many individuals? Is it a "mating" group?

— A Portugese Man-o-War is a colony acting as a single animal.

— Many species of angler fish have females who swim free and males who attach permanently and are sustained by the host female. A female might carry more than one male.

— And the various colony insects exist as haplo-diploid or solely diploid organisms

Consider: Agragate multi-duviduals are intelligent or can develop intelligence as units. Never as individuals.

Slime mold speculations. "Notes on Organisms," December 31, 1988. Box 83, Folder 1625, Octavia E. Butler Papers, Huntington Library, San Marino, California.

processed through the hegemonic filters of what some may call human civilization, Butler's "there" gestures toward other worlds: of slime molds and anglerfish, of organisms that belie taxonomic kingdoms, of life-forms and lifeways that elude our current frameworks. This note on slime molds, I contend, documents queer feminist science (fiction) in the making.

On slime molds specifically, Butler's note focuses on their queerness:

> Slime molds– much unicellular life behaves this way—which means it isn't always unicellular. . . .
>
> Most slime molds are made of amoeba(like?) parts that feed seperately [sic], then, when food supply is exhausted, they come together, crawl to a suitable place as a multicellular "slug[.]" [T]here it builds a "tower" of its own cells—of itselves[—]and a few at the top produce spores which scatter on the wind from the fruiting body <tower>. Is it an agragate [sic]—many individuals? Is it a "mating" group? (Butler 1988, emphasis in original)

Essentially an undifferentiated sack of multinucleated protoplasm, the cellular slime mold *Dictyostelium discoideum* has no brain, no central nervous system—and yet, in conditions of scarcity, it will swarm, intelligently reconfiguring itself into multicellular masses, working in tandem temporarily to proliferate, spread, and relocate to more generative sites. The slime mold defies Linnean taxonomization, as it cannot be easily categorized as animal, plant, mineral, or even fungi, leaving contemporary scientists to relegate the hundreds of species of slime molds to kingdom Protista, a kind of catchall kingdom of "others." Unsettling scientific classification, the slime mold even belies strict adherence to grammatical rules. In writing about slime mold, one can slip between singular and plural forms at every reference with due cause, as both cellular and plasmodial slime molds exist alternately as singular and plural, depending on how and when you're counting. Wondering whether slime mold is best characterized as an aggregate of individuals, a mating group, a swarm, or a single organism, Butler meets the question of pronouns with an admirable openness, queering and querying the limiting politics of either individualism or collective action. Describing the fruiting body as "a 'tower' of its own cells—of itselves," Butler bends grammar to accommodate this alien ontology, asserting the organism's nonconforming, decentralized organization. Butler's methods constitute queer science studies approaches. By fully recognizing the alien possibilities of this life-form—by insisting that not all unicellular life is always unicellular, and by meeting slime mold morphology in between singular and plural in its grammar—Butler demonstrates a remarkable openness to non-normative biological

organization. She does not look to figure the slime mold out. She seems excited to follow it off the script of 1980s evolutionary biology to other possibilities. In slime, she looks for a model of life that could be, rather than life that already is. It is a speculative fabulation, drawn from life unruly.

Butler's inquiries into slime molds and what she calls "multi-dividual units" coincide with some of the key questions she raises around human-alien relations as well as nonhierarchical social structures in her three novels *Dawn* (1987), *Adulthood Rites* (1988), and *Imago* (1989), which comprise the so-called Xenogenesis trilogy, collected in 2000 in a single volume titled *Lilith's Brood*. Descriptions of slime mold behavior often focus on its anomalous self-organizing, which requires systemic morphing between single-celled and multicellular forms:

> *Dictyostylium* has the remarkable property of existing alternatively as single cells or as a multicellular organism. As long as there is enough food around, the single cells are self-sufficient, growing and dividing by binary fission. But, when starved, these cells undergo internal changes that lead to their aggregation into clumps which, as they grow bigger, topple over and crawl off as slugs. (Keller 1983, 516)

The transformation of "self-sufficient" cells into aggregated clumps and slugs could well describe the bodies of the Oankali, the alien species depicted in Octavia Butler's Xenogenesis series. The Oankali, who arrive at a postapocalyptic Earth and "save" a small group of humans for the potential of their genetic material, are covered in head and body tentacles that function as sensory organs. In times of stress, they knot up into clumps. One might also recognize slime mold chemotaxis in the walls and floors of the Oankali ship, which Butler describes as a living organism that digests and recycles its inhabitants' waste and communicates with them through biochemical signatures and feedback loops. Indeed, Butler has often fabulated species that embody symbiogenesis, which highlights cooperation rather than competition in describing the organization and evolution of complex life (Ferreira 2010; Vint 2010).

In Butler's fictional world, acclimating to this alien ontology requires an active queering of human sexuality vis-à-vis the third-gender "ooloi" of the Oankali. The ooloi anchor the mating ecologies among male, female, and non-Oankali participants who enjoy the benefits of genetic therapy

and chemically stimulated pleasure. Lilith, who joins an Oankali family with an ooloi named Nikanj, helps Nikanj undergo the "internal changes" that humans might associate with puberty. Like a slime mold undergoing its transformation from unicellular to multicellular organism in a time of stress, Nikanj finds temporary relief in foraged food: "It drew its head and body tentacles into knots," Butler writes. "'Give me something else to eat.' [Lilith] gave it a papaya and all the nuts she had brought in. It ate them quickly. 'Better,' it said. 'Eating dulls the feeling sometimes'" (Butler [1987] 1997, 103). In fabulating the Oankali, Butler has drawn much from what could be considered slime mold's queerest properties: nondimorphic sexuality, trans-species chemo-tactile communication, and nonhierarchical sociality. In these ways, slime mold behavior itself speaks to femi-queer notions of collectivity and nonhierarchical social formations. Remarkably, researching slime mold behavior also leads directly to the very heart of feminist science studies in its emergence as a field.

In 1969, feminist physicist Evelyn Fox Keller, along with mathematician Lee Segel, looked to the slime mold as a demonstrable example of spontaneously emergent, self-organizing principles. Their preliminary research, though, was largely abandoned by the scientific brotherhood in favor of the so-called "pacemaker hypothesis," which suggested that a centralized authority, composed of special pacemaker or "founder cells," ordered other cells to aggregate. Despite the complete lack of evidence for the existence of such cells, the pacemaker hypothesis was upheld as conventional scientific knowledge throughout the sixties and seventies. In 1983, though, Keller definitively overturned this hypothesis with the help of developments in mathematical biology, including the study of nonlinear reaction-diffusion equations, which provided a means of understanding the interaction between the production and diffusion of acrasin and cellular chemotaxis. Chemotaxis, Keller revealed, *not* special founder cells, directs slime mold aggregation and movement. In her article, Keller exposes the extent to which scientists had imposed hierarchical and ultimately patriarchal structures of thinking onto cellular slime mold. To "posit a single central governor," she writes, was to subject scientific inquiry to a "zealous desire for familiar models of explanation, . . . imposing on nature the very stories we like to hear" (1983, 521).

Though many scientists sheepishly admit enjoying science fiction, many often disavow any significant influence cultural texts might have on

the work they do in the laboratory, despite the common emphases on speculation and experimentation shared by scientists and science fiction writers alike (Haraway 1991; Milburn 2010; Shaviro 2016; Bahng 2017). Feminist science studies scholar Banu Subramaniam has called for "more engaging plots and stories that are located in the interdisciplinary fissures of the sciences and the humanities" (2014, 72).

At the conjuncture of science and fiction, Octavia Butler's speculative fabulation instantiates just such an assemblage of transdisciplinary knowledge making. Reading Butler's speculative fiction alongside scientific research on slime molds, one can begin to trace the entangled fictional and nonfictional stories of how human and nonhuman species organize themselves. One can begin to track the narrativization of human exceptionalism in the conventional story of life itself. And because slime molds lead us away from systems of hierarchical ordering, the story of how humans have tried to shoehorn slime into a more familiar form reveals how storytellers of science become susceptible to their own frameworks. In other words, while there may very well be a slime mold ontology beyond human understanding, one ethical way to reach across to that speculative reality might be to *wonder with* it, rather than *marvel at* it from a distance. In this way, considering Butler's work moves the new materialist conversation from trans-species allyship to multispecies solidarity, and in so doing, advances a feminist queer materialism as threaded through cross-ethnic antiracist work. Such consideration puts Butler's fabulations and Evelyn Fox Keller's research on slime mold aggregation in a more capacious feminist genealogy of nonhierarchical organizing that might include, for example, Jasbir Puar's theorization of political assemblage (2007), or Occupy, or #BlackLivesMatter theories of decentralized and nonhierarchical organizing.

Butler's study of the slime mold's transversal movement across and through single- and multicellular identities challenges notions of propriety, the proper, and the proper noun: She crafts the particularly queer pronoun "itselves" to describe slime mold differential collectivity. Slime molds organize themselves somewhat spontaneously and collectively. As Steven Shaviro describes it, the slime mold is "a *collective* without individuals, without any specialized parts, and without any sort of articulated (or hierarchical) structure" (2016, 195). Also called "social amoebae," slime molds, with their distributed modes of organization, constitute a radical

departure from hierarchical organizational systems and also confound notions of privatization. Butler spent most of her time in public spaces—in public libraries and on public transportation. Indeed, her dyslexia made her nervous about driving, so the bus became a way for her to navigate the LA sprawl while also affording her the time-space in which to imagine the world in ways that transected the rather segregated neighborhoods and logics of privatization rapidly engulfing much of the Southland into racial and class enclaves.[3] Most of Butler's scientific research and thinking happened during her hours commuting on the bus to her various factory and temp jobs, or during her frequent trips to the Central Library. Even in 1988, at the accelerated turn of science into private funding, Butler was taking science back to public spaces.

Written on New Year's Eve, Butler's slime mold note falls at the cusp of multiple transitions. For one, 1988 is when she was wrapping up the Xenogenesis series and moving her thinking toward the Parable series and what would become a religious fabulation called Earthseed. The plasmodial improprieties that slime molds enact through channels of connectivity might also remind readers of Butler's grappling with notions of private gated communities and alternative possibilities for communal living, as well as Lauren Olamina's hyperempathy syndrome, from the Parable series. The timing of Octavia Butler's research on slime molds also coincides with the pinnacle of Reagan- and Thatcher-era financialization, deregulation, and privatization. The late '80s is precisely the era in which we see the financialization of science in particular, when, as Melinda Cooper has demonstrated, venture capitalists started funding scientific research largely based on its promise of deliverable goods that could be sold to a consumer culture being trained toward constantly upgradeable selves (2011). This form of speculation produces probable states as calculable outcomes in investment contracts (futures, options, swaps) and choices for individual portfolios (Bahng 2017). Such packaging *forecloses* alternative possibilities in the interests of a precise rate of return. Butler's speculations are more creative (Bahng 2017). They learn to learn from other human and nonhuman actors. They don't abide the proprietary norms of intellectual production in the era of the corporate university. No silos. No atomization. Just concatenation.

In slime mold–Oankali-Earthseed aggregation, I contend, Butler begins to experiment with forms of communing perhaps most akin to

feminist Marxist formulations. Silvia Federici, for example, proposes a commons that exceeds human social sortings: "Indeed, if communing has any meaning, it must be the production of ourselves as a common subject [itselves]. This is how we must understand the slogan 'no commons without community.' But 'community' has to be intended not as a gated reality, a grouping of people joined by exclusive interests separating them from others, as with communities formed on the basis of religion or ethnicity, but rather as a quality of relations, a principle of cooperation and responsibility to each other and to the earth, the forests, the seas, the animals" (2012). But Federici's move away from communities of humans toward a set of relations among humans, animals, and the environment seems to propose a moving beyond "the subject" that fails to consider processes of subjection. In Butler's *Parable of the Sower* (1993), the gated community to which Federici gestures in this quotation clearly does have its limitations. In the near-future world in which Lauren Olamina founds Earthseed, the gated community is a failed remnant of private interests, but Earthseed, which replaces it, remains conflicted with very human forms of power. It is no utopia.

Decolonizing *Physarum polycephalum*

Slime molds have been made much of in recent popular science news headlines, as everyone from computer scientists to city planners began modeling the adaptive behavior of *Physarum polycephalum*—not a cellular but a plasmodial slime mold (aka myxomycete)—as part of a turn toward more complex, algorithmic methods for prediction and speculation. When presented with oat flakes arranged in the pattern of Japanese cities around Tokyo, *Physarum polycephalum* constructed networks of nutrient-channeling tubes that were strikingly similar to the layout of the Japanese rail system (Sanders 2010).[4] The telecom industry, which increasingly relies on so-called "emergent software" to plan how to lay down subterranean cable infrastructures most efficiently and with minimal disruption, has also turned to slime mold–based modeling, as the plasmodial organism lays down not only efficient pathways but also networks that stand the least chance of disruption should one strand be compromised or temporarily severed (Gorby 2009; Keim 2008). The plasmodial slime mold has become such a key modeling agent in commercial and scientific research

that it has been used to "grow a computer" and was part of an experiment to predict Mexican migration patterns across the US (Adamatzky and Martinez 2013). As of 2014, slime molds are even now being bred and raced for entertainment (Hotz 2014).

While slime molds may offer some alternative to ways of organizing, there is reason to pause the celebration of the liberatory potential of the social amoebae. Innovators and entrepreneurs have folded slime molds into the workforce as experimental bodies, picked up for their efficiency and utility, but not for their queerness. If we hear an echo of the Oankali collective in Butler's note on slime molds, we would do well to remember that the Oankali, though far advanced in communicating across species lines and pushing beyond human notions of individuality and collectivity, were not without their coercive aspects. As "gene traders," the Oankali roamed the universe as scientific prospectors, mining for genetically valuable material. One of them, Jdahya, explains: "We do what you would call genetic engineering. . . . We *must* do it. . . . It is part of our reproduction, but it's much more deliberate than what any mated pair of humans have managed so far. . . . We're not hierarchical, you see. We never were. But we are powerfully acquisitive. We acquire new life—seek it, investigate it, manipulate it, sort it, use it" (Butler [1987] 1997, 39). The Oankali may claim to be nonhierarchical, but they approach the universe through frameworks of usability. As gene traders, they inhabit a capitalist, colonialist mindset of mergers and acquisitions in which "the merge" never quite takes place across even footing.

Butler's nuanced depiction of the Oankali as nonhierarchical but powerfully acquisitive is indicative of how her interest in the slime mold differs from that of entrepreneurial technoscience. Slime mold modeling in the service of capitalist technological innovation emphasizes efficiency, and its promise as projected by popular science media marvels at the alien intelligence of such a "primitive" species. The novelty of the story lies in the surprise humans have at nonhuman intelligence and how that intelligence can be harnessed to serve human interests. Such a relation reproduces a colonialist version of trans-species exchange and sustains fascination as a means of reinforcing human supremacy in species hierarchy.

At a moment when state and corporate project managers are looking to slime molds for direction in constructing self-organizing and cost-efficient networks in the real world, what can we learn differently from these

problem-solving experimental subjects? Reading Butler's work through black, queer, decolonial studies provides a way to interrogate the processes of subjection into which slime molds have been called. There's a long history of scientific experimentation on people of color, and Butler's awareness of this racialized history leads her to a consideration of a trans-species set of solidarities. Lilith, the black protagonist of *Dawn*, understands this when she contemplates how the Oankali have subjected humans to a form of genetic experimentation:

> This was one more thing they had done to her body without her consent and supposedly for her own good. "We used to treat animals that way," she muttered bitterly. . . . "We did things to them—inoculations, surgery, isolation—all for their own good. We wanted them healthy and protected—sometimes so we could eat them later." (Butler [1987] 1997, 31)

Through Lilith's reflection on animal experimentation in the medical and meat industries, Butler asks us to consider what it means to rethink futurity from a multispecies undercommons. After all, Lilith likens Oankali gene trading not only to the meat industry but also to slave history: "Humans had done these things to captive breeders—all for a higher good, of course" (Butler [1987] 1997, 62). In slime mold, Butler may see a model for collective politics rather than merely problem-solving potentiality,[5] but she stops short of suggesting any sort of inherently liberatory ethos in collectivity. Though she takes interest in slime mold's plasmodial improprieties that confound hierarchical taxonomies, her characterization of the Oankali as "powerfully acquisitive" demonstrates the colonialist potentiality of collectivity, too. Perhaps Butler was also thinking of the 1958 film *The Blob*, which is to say communism,[6] though of course it's capitalism, too. We have witnessed how readily the World Bank has adapted the idea of the commons to suit global markets that actually serve private interests (Federici 2012).

In the Xenogenesis series, Butler's interest in the plasmodial improprieties of slime mold bump up against the matter of slavery—the rendering of human flesh as property. Reading Butler's *Dawn* as subaltern literature, Eva Cherniavsky invokes Hortense Spillers's theorization of the "theft of the body itself" to articulate the process by which "a body [is] rendered absolutely and impossibly improper insofar as it becomes

(another's) property" (Cherniavsky 1996, 107). Oankali reproductive practice thoroughly sees dialectical relations of master/slave, self/other, and alien/human to their enmeshed ends. The Oankali, Cherniavsky continues, "practice reproduction as a form of corporate/corporeal impropriety, in which they perpetuate 'their' identity and agency by displacing themselves across the historical and territorial limits of Oankali culture" (1996, 108). In conversations about human and nonhuman ontologies, about intra-action and sympoiesis, black studies and decolonial theory offer much-needed reminders of how the category of the human even comes to be.

With this essay I mean to interject Butler's thinking beyond the human into a recent flurry of critical interest in Sylvia Wynter's interventions into Enlightenment humanism (Hantel 2015; Jackson 2013; McKittrick 2014). The category of the human, according to Wynter, catalyzed its liberation as a rights-bearing subject on the backs of slaves and many others relegated to the nonhuman. At a moment when the slime mold presents itself as a new material to think with, Butler's archive offers up another way to think beyond the human without flattening that concept into a universal given.

Conclusion: The Alien within the Human

I met my first slime mold not too long ago when it was time to put some mulch down in the northern woodlands of Vermont. I recoiled from its gelatinous movements, creeped out by its "dog vomit" masquerade and alien presentation. It may have been of this earth but it felt as though I were encountering an extraterrestrial, and I needed to unlearn the visceral disgust that came with this interspecies contact. Several months later, I made my first trip to the Octavia Butler papers, where I came across the note that launched this essay. The surprise I felt upon encountering the slime mold in the yard and the slime mold in the archive was quite similar. I have always understood the practice of reading science fiction as an exercise in thinking beyond the self. As a woman of color brought up in fairly conventional reading environments (at least in the classroom), I was asked constantly to understand from perspectives that were alien to me though they were often assumed to be universal.

This case study of the slime mold begins to reroute "the primacy of matter" in feminist theory through decolonial thought and queer-of-color

critique (Coole and Frost 2010, 1).[7] If the turn to matter in philosophy asserts a realism beyond human ken, it engages a speculative realism that would have thinkers taking up slime mold as an object through which to imagine another ontology, beyond the human. Butler manages to do so without dissolving the human into the object—even as she wants to get to know it better. What she does is speculative fabulation, and I offer it up as a feminist queer science studies methodology.

Notes

1 I would like to thank the inspiring audience and participants at University of California San Diego's "Shaping Change: Remembering Octavia E. Butler" conference in June 2016.

2 At a moment when many in the humanities and social sciences are taking a turn to the nonhuman, I am not alone in looking to science fiction as a site of inquiry that has long been thinking beyond the human. Donna Haraway was the person who first articulated this connection in my own reading trajectory, but I also join Colin Milburn, Steven Shaviro, Rebekah Sheldon, McKenzie Wark, and several others in bringing together science fiction studies and conversations in the recent critical moves beyond the human.

3 Thanks to Sami Schalk, who brought this point to my attention during a June 4 Q&A session at the UCSD "Shaping Change" conference.

4 See also Tero et al. (2010), whose research on *Physarum polycephalum* led to the project featured in Sanders's *Wired* magazine article.

5 Indeed, the Oankali attribute the destruction of the human species to "two incompatible characteristics": Humans are intelligent, but we are also deeply hierarchical (Butler [1987] 1997, 37).

6 For a stunning account of the 1957 presidential prayer breakfast at which *The Blob* was conceived, see Jeff Sharlet's *The Family* (2008, 181).

7 Coole and Frost ask: "How could we ignore the power of matter and the ways it materializes in our ordinary experiences or fail to acknowledge the primacy of matter in our theories?"

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diversity. Scalability is not an ordinary feature of nature. Making projects scalable takes a lot of work. Yet we take scalability so much for granted that scholars often imagine that, without scalable research designs, we would be stuck in tiny microworlds, unable to scale up. To "scale up," indeed, is to rely on scalability—to change the scale without changing the framework of knowledge or action. There are alternatives for changing world history locally and for telling big stories alongside small ones, and "nonscalability theory" is an alternative for conceptualizing the world. But before considering these alternatives, let me return to that familiar domain for experience with scalability: digital technology.

The digital technologies of the last fifty years have shown us the pleasures of the pixelated zoom: we move from tiny details to wide views with a few clicks. On our computers, we enlarge text and the alphabet looks just the same. Our digital photographs lend themselves to looking for details or panning for overviews. On the website "Paris 26 Gigapixels," we see all of Paris, or one room inside a window.[2] This wizard-like skill is scalability. In digital files, scalability is the ability to move across scales without changing the shapes of images, which is made possible by the stability of the pixel, the picture element. The digital image is made bigger or smaller by resizing the pixels. Of course, pixels must therefore remain uniform, separate, and autonomous; they cannot bleed into each other or transform each other. Artists complain about pixelation, which fragments our vision of the world. Most of us do not care. But what made this technology so easy to imagine, I would argue, is the pixelated quality of the expansion-oriented world, which *is* something we ought to care about. To capture the vividness of the pixel, I will coin a parallel term. *Pixel* is an abbreviation of picture, "pix," and element, "el." Elements of the social landscape removed from formative social relations might be termed "nonsocial landscape elements" or, using the pixel formula, "nonso" plus "el" or *nonsoels*. How did we come to inhabit an expansionist world of nonsoels?

The term "scalability" had its original home not in technology but in business. Scalability in business is the ability of a firm to expand without changing the nature of what it does. "Economies of scale"—organizational practices that make goods cheaper because more are being produced—comprise one kind of business scalability. In contrast to digital technology, the point is not to zoom in; only expansion counts. Business scalability is about expansion for growth and profits: this was a tenet of twentieth-century progress. Under American hegemony, bigger was always better. Like business, development was supposed to scale up. The World Bank only funded village projects if they were already scalable; that is, if they could be spread to other villages without changing project elements. Indeed, the way you could tell if an institution was modern and developed, as opposed to backward, was if it was big. Bigness was progress.

Clifford Geertz went to study markets in Java at the height of this program, in the mid-twentieth century.[3] He was worried about what he saw: instead of scalable firms, Javanese traders based their businesses on *relationships* with buyers and other traders. Every time they expanded their networks, the business changed. Without scalable firms for expansion, Geertz argued, there could be no development. Javanese markets were hopelessly caught beyond the reach of progress. From our current perspective, Geertz's assessment tells us as much about the program of progress as it does about the Javanese.

3. Clifford Geertz, *Peddlers and Princes: Social Development and Economic Change in Two Indonesian Towns* (Chi-

Today, it is easy to look back with a critical eye on this twentieth-century program, because it has been challenged by changes in the global political economy. In the twenty-first century, the hegemony of economies of scale has crumbled before the advance of global supply chains in which economic activities are spread across many firms, in many places. Many powerful firms no longer strive just to be big; instead they use their "competencies" strategically. Competency here is one way of talking about privilege. Firms in powerful countries use their position to contract with firms in poor countries; and national elites, to contract with their countries' disadvantaged. Competency is also a way of talking about cultural mobilization. Firms at every level save costs by getting workers to do their jobs for cultural reasons, rather than for wage-and-benefit packets. The turn to cultural niche making in the global economy is surprising from the perspective of twentieth-century ideals of scalability, which depended on the regularization and discipline of labor to drive expansion. Today, inventory is scalable, but both labor and natural-resource management are in retreat from scalability. Meanwhile, supply chains require attention to relationships among firms, rather than just expanding inputs; there is something here reminiscent of the progress-resisting practices of the Javanese traders Geertz described. All these developments allow us to look back at twentieth-century projects of scalability with an awareness of their limitations and failings, including their aversion to diversity and its consequence—imprecision.[4]

The problems of diversity, and of living together with others, require other modes of knowledge. Nonsoels are not enough, whether for knowledge about humans or other species. Consider the global political economy. It seems to me a striking fact that scholars and journalists have conducted many, many studies of the diverse niches that are drawn into global capitalism today. We know about rug-making children and indigenous suppliers of supermarkets and stinking computer graveyards. But most scholars of the global economy as a whole, whether qualitative or quantitative, Marxist or liberal, angry or self-satisfied, are still stuck on scalability assumptions and thus rarely make use of this wealth of ethnographic data. Its anecdotes are isolated, kept outside their big stories. These stories are continuations of twentieth-century scalability stories; the transformative diversity of economic niches is missing. We need nonscalability theory to tell a different story, a story alert to the awkward, fuzzy translations and disjunctures inherent in global supply chains. There are many scale-making projects here, and they do not nest neatly. Nonscalability theory shows us the architecture of nonnesting, which is key to the (re)making of cultural diversity, capitalist and otherwise.

The problem is equally severe in thinking about biological diversity. Classic twentieth-century population genetics blocked attention to diversity-making processes, because it was a science of expansion. By taking scalability for granted, it asked how populations expand. Expansion was possible because each organism was thought to be autonomous, a nonsoel. Collaboration was not necessary for survival. Diversity was the current scoreboard of varied but similarly autonomous strategies of conquest. To see the *making* of diversity, we need something different. In recent years, the spark has come from a new combination of evolutionary, ecological, and developmental biology, which has studied interactions across species in the generation of multispecies life.[5] For humans, this field shows how much we need the bacteria in our guts and in our skin to become who we are. Note how this knowledge changes the scale-making project. Our units are transformative relations, not self-contained nonsoels. The question of emergence takes precedence over expansion and is, thus, an application of nonscalability theory.

4. For additional discussion of supply-chain capitalism, see Anna Lowenhaupt Tsing, "Supply Chains and the Human Condition," *Rethinking Marxism* 21.2 (2009): 148–76.

Moten and Harney want to gesture to another place, a wild place that is not simply the left over space that limns real and regulated zones of polite society; rather, it is a wild place that continuously produces its own unregulated wildness. The zone we enter through Moten and Harney is ongoing and exists in the present and, as Harney puts it, "some kind of demand was already being enacted, fulfilled in the call itself." While describing the London Riots of 2011, Harney suggests that the riots and insurrections do not separate out "the request, the demand and the call" – rather, they enact the one in the other: "I think the call, in the way I would understand it, the call, as in the call and response, the response is already there before the call goes out. You're already in something." *You are already in it.* For Moten too, you are always already in the thing that you call for and that calls you. What's more, the call is always a call to dis-order and this disorder or wildness shows up in many places: in jazz, in improvisation, in noise. The disordered sounds that we refer to as cacophony will always be cast as "extra-musical," as Moten puts it, precisely because we hear something in them that reminds us that our desire for harmony is arbitrary and in another world, harmony would sound incomprehensible. Listening to cacophony and noise tells us that there is a wild beyond to the structures we inhabit and that inhabit us.

Jack Halberstam (2013) 'The wild beyond: with and for the undercommons' Intro to:
"The undercommons: fugitive planning & black study"
p. 7
Harney & Moten

This book does endorse biology. It vouches for the capacity of biological substance to forge complex alliances and diverse forms. It advocates for a biology that is nonconsilient. It disputes the grandiose notion (increasingly found in science-humanities scholarship) that biology can conclusively resolve questions of psyche or politics or sociality, and it rejects the creed that biological data bring interpretative methodologies to an end (see the conclusion). Instead it seeks out systems of biological overdetermination. In particular, this chapter examines how feminist theory got itself trapped in relation to biology. If, as I argue, there is no intrinsic orthodoxy to biological matter (if it can be as perverse and wayward as any social, textual, cultural, affective, economic, historical, or philosophical arrangement), why have we so readily joined with conventional biologism to think of biology as predetermined matter? What conceptual payoff (what secondary gain) have we received for this? And how easy will it be to do otherwise?

Elizabeth Wilson "Gut Feminism" (2015)

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