

The Science Underground: Mycology as a Queer Discipline

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Abstract

This article explores the science of mycology through a queer theory framework with the intention of situating the state of the field in a historical and social context. With the understanding that everything is in community with fungi, we look to the biology and ecology of these organisms for transformative inspiration and a deep-time sense of belonging. Our scientific understanding of mushrooms and other fungi has been shaped and indeed impeded by *mycophobia*, a condition of fear and revulsion that we compare here to queerphobia. In this work, we argue that mycology relies upon queer methodologies for knowledge acquisition given both the nonbinary, cryptic, and subversive biological nature of fungi as well as a hegemonic, Western, cultural rendering of fungi as perverse and unworthy of formal investigation. We further argue that the queer methodologies of mycology that developed in response to these conditions have enhanced rather than hindered our knowledge of fungi. Because our ultimate quest as scientists is the pursuit of *truth*, as best as we can determine, we suggest that scientists would do well to meaningfully reconcile with the inescapable and oftentimes queer reality of bias and subjectivity.

We are human only in contact and conviviality with what is not human.

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—David Abrams, *Becoming Animal*

Introduction

Clustered in supergroup Opisthokonta, fungi, animals, and amoebae share a more recent common ancestor than with plants or bacteria. The vegetated environment that enabled the transition of animals to land and evolution of amphibians, reptiles, birds, then mammals, was bound to symbiotic fungi known as mycorrhizae. Over 90 percent of plants form these associations (Smith & Read, 2008), and myceliated landscapes sustain cascades of nested biological systems, from which every evolutionary layer of our human biology is indistinguishable, arising and persisting in conviviality with fungi or fungal-bound organisms. As terraforming bodies, fungal transindividualism is our collective ecological history. Fungi are engaged in continual processes of renewal, interfacing with death, creating life through decomposition, nutrient reallocation, and the spectrum of symbiosis. Fungi can remediate environments by digesting fossil fuels and converting them into fungal sugars. Fungi can accumulate heavy metals and radioactive materials, and a fungus has even been found to metabolize ionizing Cesium-137 in the reactors of Chernobyl. Both single cellular forms and filamentous, hyphal networks of fungi can be found in almost any conceivable niche: of, on, within, and for human and nonhuman bodies.

Despite this dynamic profile of fungi complex social histories have influenced outcomes and trajectories of mycology, rendering it a marginalized science. Kingdom Fungi has been persistently maligned, feared, and misunderstood, and these cultural forces have directly sabotaged scientific understanding of this group for hundreds of years. In Western Europe and in the United States particularly, children are typically raised to fear all mushrooms, which are unilaterally viewed as poisonous, diseased, and degenerate. Although science, in its ideal form, should be an equal-opportunity investigative methodological tool, we know that the history of modern science has been disproportionately written by white, often Christian, men from Western Europe, excluding other voices. Consequently, dominant cultural lenses—heteronormativity, racism, sexism, ableism, and binaries inherent to them—have influenced scientific understandings.

Tiokasin Ghosthorse, a member of the Cheyenne River Lakota Nation of South Dakota and scholar at Yale Divinity School and the Yale School of Forestry and Environmental Science, explores relational and egalitarian thinking processes familiar to the Lakota people, as compared to rational, hierarchical thinking processes within Western cultures. Ghosthorse says that, for Lakota people,

language is inherently relational and all things are bound together. Ghosthorse (2019) writes,

The rational mind is the human living within the hierarchy of a box that seeks to capture it through its own narcissistic addiction to the anthropocentrism of a society or a people who hold themselves up as somehow more grandiose than others in that box of conscience. It deadens the intuitive or non-dogmatic life. This is where the separation begins—with a concept and a word that doesn't exist within many intuitive languages, such as Lakota. That word is domination. (paras. 10–11)

By invoking rationality over intuition to defend a viewpoint, a person makes the assertion that the intuitive—often feminized—lens is neither legitimate nor legible, with no footing in any discursive cultural space. Often with derision, it is written out of the conversation. Such disregard for intuition is part of the pathway toward domination that Ghosthorse describes. Dualistic thinking about life and non-life, male and female, and other categories Ghosthorse alludes to, permeate mycophobic discourse.

Western scientific thinking seeks security through objective assessment, but objectivity is meaningless when it comes to gender and queerness because attempts to determine the bounds of queerness are already exercises of power. Donna Haraway (1988) discusses the falsity of objectivity in her essay on situated knowledges, which describes the partial perspective any one person is able to have depending on sociopolitical factors influencing their gaze; these partial perspectives form a patchwork of messy, layered knowledge that inches toward some measure of shifting objectivity. This encourages rethinking scientific endeavors not as observations of subjects, but as interactions with them. Similarly, fungi defy objectivity and standardization. Specifically, sporadic, ephemeral, and unpredictable appearances of fruiting bodies complicates mycologists' ability to obtain thorough population data. The complex biotic and abiotic forces that lead to a species producing a fruiting body remain unknown in many cases. While some fungi, like some species of morels, can be reliably found in the same place on more or less the same calendar day every year, other species, such as members of genus *Ionomidotus*, may be seen once in a given location and then never again. But is its mycelium still present in that spot? We often do not know. If so, does that count as being present? Then there is the issue of quantification of an individual. If you find a scattered grouping of mushrooms growing around a tree, are they one genetic individual? If so, do you quantify them as one mushroom? Or do you count the number of mushrooms, reporting them as individuals? There is not a clear and universally applied answer to these

questions. This lack of conformity to quantifiable boxes has put many fungi at a greater risk of extinction. Their biological realities are not given necessary accommodations in our current conservation assessment framework, whose attempts to standardize data diminish many essential properties of fungi. Interrogating our dualistic, mycophobic view of fungi—and our often pathologizing attempts to understand them—can help make Science more accountable.

Mycology is a science that, by its very nature, challenges paradigms and deconstructs norms. Mycology disrupts our mostly binary conception of plants versus animals, two-sex mating systems, and discrete organismal structure, calling upon non-normative, multimodal methodologies for knowledge acquisition. Mycelium is the web-like network of fungal cells that extends apically through substrate, performing sex, seeking nutrients, building multispecies and multikingdom symbioses. This essay seeks to remediate our relationship with fungi and all organisms—thereby queerness—by collapsing and myceliating the emotional space between human and nonhuman. In order to do this, we explore dogma of institutional (capital S) Science, as well as the biology, history, and methodologies of mycology through a queer theory framework, as seen by a queer mycologist and a feminist educator.

History of “Queer”

Historically, “queer” was used pejoratively to describe non-heteronormative behaviors. People now self-identify as queer, to describe their existence outside heteronormativity. In the United States, “queer” was reclaimed and gained popular usage during AIDS political activism of the 1980s and 1990s. “We’re Here! We’re Queer! Get Used to It!” was the rallying cry of Queer Nation and ACT UP, which sought to unify subgroups not quite captured by the terms “gay” and “lesbian.” The word “nation” suggested a coalition of queer people, bound together in their non-heteronormativity, redefining what it meant and what it looked like to have a sense of belonging rooted in shared identity and struggle (Chen, 2012, pp. 61–63). Whether people identify as queer to describe their homosexuality, gender nonconformity, or transgender identity, “queer” is fluid, invoking a spirit of community and a history of defiance (Butler, 1990; Sedgwick, 1990/2008; Clare; 2015).

Queer theory explores the constructed dichotomy of “normative” and “deviant” sexuality and systems and frameworks that interact with sexuality, including race, nationality, dis/ability. This field grew from feminist and gay and lesbian studies, which focus on challenging “essential” qualities of women and femininity, as well

as the normativity of heterosexuality, which becomes posited as the unspoken, unnamed standard and expectation for romantic and sexual relationships. While this essay interrogates the relationship between mycology and queerness by defining “queer” as non-heteronormative identities and expressions, there is value in thinking more broadly of “queer” as referring to identities, bodies, and behaviors pushed to the margins of Western, hegemonic, heteronormative life.

Queer theory has drawn from a number of philosophers and theorists, including poststructuralists and postmodernists such as Jacques Derrida. One of Derrida's contributions to semiotics is the concept of “deconstruction,” which seeks to “deconstruct” logocentrism, the idea that there are inherent, stable truths, calling attention to the importance of language in the formation of our framework of truths. Derrida (1981) writes,

by means of this double play, marked in certain decisive places by an erasure which allows what it obliterates to be read, violently inscribing within the text that which attempted to govern it from without, I try to respect as rigorously as possible the internal, regulated play of philosophemes or epistimemes by making them slide—without mistreating them—to the point of their nonpertinence, their exhaustion, their closure. (p. 6)

Probing the limits of socially ingrained concepts is an exercise of deconstruction and reshapes systems of power. A project of queer theory is deconstruction of heteronormative concepts, such as a family as a procreative unit, which exposes contingencies, obsolescence, and fallacies in these norms, reinforcing the viability of alternative structures and spaces. By challenging protected social groups and their associated dogmas, queer theory seeks to make plastic seemingly stable notions of fact, knowledge, knowledge acquisition, and Science, whose otherwise reified, institutionalized standing maintains commonly held assumptions. Queer ecology is an intervention specifically targeted against institutionalization of heteronormative modes of scientific thought, unraveling abounding queerness.

History of Science

People all over the world have systematically documented their surroundings and interactions with nonhuman organisms, abiotic factors, and ecologies for millennia. By way of reproducible knowledge acquisition, mass observational patterns and longitudinal documentation, many systems of knowing have long existed. Despite this, some forms of knowing and conceptions of *truth* have been given priority over others. In Western Europe, women had historically been keepers of ecological knowledge, but their voices were excluded from formal

participation in Science, their knowledge often dismissed as “folk tales,” “witchcraft,” or “old wives’ tales,” meant to indicate that their knowledge was irrational—sometimes, unnatural, evil, otherworldly—with no basis in reality, because women’s knowledge was fundamentally threatening to hegemonic institutions of knowledge-creation (Barstow, 1994). Val Plumwood (1993) writes, “Feminine ‘closeness to nature’ has hardly been a compliment” (p. 19), and instead an assertion that women did not possess rational, intellectual, and positively human capacities of liberal, modern, Western men, who channeled “untamed” nature into reputable, reified Scientific Knowledge. The culture of institutional Science has been disproportionately shaped by a small subset of people, and the consequences can be limiting to research and dangerous for posterity.

With the spread of institutional Science, Christianity continued to spread, in part through colonialism. It is well known and documented that Christianity strongly influenced scientists. Scientists, such as Descartes, Euler, and Newton, often were loyal to the Church in their supposedly objective pursuits of knowledge. Large-scale agriculture also interacted with Science and Christianity, with scientific discoveries enabling new manipulations of land and crops, and with Christian domestic and marital structure organized in connection with agriculture in what can be termed *agro-heterosexuality*. Rachel Stein (2010) states,

Christian thinkers compared human sexual actions to planting a field and only those activities that corresponded to “seeding,” or procreation, were accepted as natural; other activities impeding or ignoring reproduction, whether performed with members of the same or opposite sex were forbidden as against nature (Bullough & Bullough, 1977, p. 28). (p. 286)

Bodies that perform forbidden actions become forbidden themselves, marked as unnatural, offensive, defiant. This is also where queer sexuality meets queer ecology, including the effect of fungi on agriculture and agricultural metaphors.

Anna Tsing (2012) explores the relationship between emergence of intensive agriculture as the standard of modernity and progress, and solidification of fungi as the enemy of those ideas of modernity and progress. The relationship is tinged with irony: when agriculture disrupts and strips bare natural ecologies, the resulting monocultures are increasingly vulnerable to pests and pathogens, some of which are fungal. Tsing (2012) writes, “The emergence of vast fields of grain offered fungal plant parasites a field day—and a reputation as the enemy of civilisation and, later, progress” (p. 147). This notion of “progress” implies forward

movement, productivity, growth, and improvement, concepts which queerphobic discourse suggests become hindered through a lack of heterosexual procreation. Science is not inherently a capitalistic endeavor, but discourse of progress can strap capitalistic notions of productivity to scientific spaces and pursuits. Tsing (2015) explores this idea with the word “scalability”: the capitalistic drive of perpetually scaling up, making research questions apply to greater and greater scales without changing the research question, which is apparent with industrial agriculture. Tsing (2015) even refers to mushroom forests, sites of boundless “indeterminate encounters” with no prescribed measures of productivity or success, as “anti-plantations” (p. 51). It is through interplay of these factors—dominant heteronormative structure and capitalist drive—that disdain for fungi crystalized within Western Europe, and later within postcolonial US.

Tsing (2012) writes, “Biological and social diversity huddle defensively in neglected margins...Most everywhere, a negative correlation exists between diversity and intensity of capital investment and state control!” (p. 151). As cereal farming under capitalism intensified throughout Eurasia, families were expected to give a portion of their yields to elites. Mushrooms grew wild on untended margins of these farms, and were incorporated into people’s diets “under the table,” providing a form of nourishment beyond the reach of the state. Under large-scale agriculture, crops are organized through “capitalist logics of commodification,” within which “things are torn from their lifeworlds to become objects of exchange” (Tsing, 2012, p. 158). These wild-growing mushrooms demonstrate non-extractive, non-capitalist entanglements with surrounding ecosystem lifeworlds. One type of *truth* is that humans are different from fungi due to our evolutionary history and genetics. Another type of *truth* is that we are similar because we both respond to the intensity of capital investment and state control in a similar way. We die.

In science, a tool can look tantalizingly like a *truth*, until the tool is deconstructed into its foundational elements. As scientists, we use tools and methods to access knowledge, and we standardize our work to create a common language. This is of tremendous power and value, as it allows for a language for globalized participation in knowledge formation. With all potential knowledge being infinite, science is collective incrementalism, each finding leading to infinity minus one. Replication and standardization are hallmarks of science for good reason. The difference between “pseudoscience” and alternative ways of knowing should be clarified: purporting to be science and failing to abide by the scientific method is fundamentally different from openly and explicitly operating outside the confines of the scientific method, and it is essential that they be regarded differently.

“Pseudoscience” can be destructive and dishonest, and is rightfully criticized. Trouble arises, however, when replication and standardization are conflated with knowledge itself. Some will argue knowledge cannot exist absent these structures, and while science requires these structures, it is critical to emphasize the difference between tools and *truth*. The strength of science can also be its weakness: linear, logical atomization of information excavates clean and standardized data, but in our infinitely complicated universe, such expectations for cleanliness seem improbable; to choose, at times, messiness is to see more fully.

Taxonomy, the naming, describing, and classifying of organisms, is a vital and often undervalued tool for communication in organismal science. Taxonomy is often undervalued because it is considered simple, observational, basic research.” Within our system of categorization, species concepts for fungi can be ambiguous, shifting depending on the objective of the investigator. While a phylogenetic or biological species concept might be true in the context of phylogenetics and evolution, the ability to strictly define a species is not a requisite for accessing the *truth* of all organismal relationships. For example, a yeast (a single-celled fungus) could hardly be more morphologically and genetically distinct from a human body, and yet, there is a suite of yeasts found within human bodies (the mycobiome) upon which we depend for basic bodily functions (Seed, 2015). These species are critically interdependent but this understanding cannot be derived from species concepts. Scientists have found that common morphologies are not always an indicator of relatedness; that populations within a species are sometimes on the verge of speciation; that data organization by way of DNA is data organization for the sake of data continuity. Things are fluid, scientific inquiry happens in a snapshot of deep-time, and this is also a *truth*.

The construction and imposition of units in taxonomy and biological surveys mimics individualized concepts of self, specifically the reified notion of self coveted historically through Western standards of white, masculine, self-sufficient personhood. Discrete units of self diminish the relational and interdependent nature of humanity and deny the labor of *others* in accounting of one’s success and viability. Declaring units of fungi feels forced and coercive because their fluid, indeterminant biology clashes radically with such abrupt and linear constructions. Clean taxonomic and population units deny the messiness of fungal biology—almost always embedded, connected, and dynamic—forcing scientists to question our own objectives in this pursuit. Failure to reassess objectives in science can leave one clinging to tools at the expense of better

answers.

From some perspectives, science during the Age of Enlightenment stressed difference over similarity. Carl Linnaeus's work on taxonomy specifically was organized around the pursuit of an inherent quality that differentiated, rather than bound, organisms into their own discrete taxonomic units (Wilchins, 2004). But queer differences in fungi went misread by Linnaeus, and many mycologists agree that Linnaeus's treatment of fungi did more of a disservice to the group than good. Linnaeus called lichens "*rustici pauperrimi*" or "poorest peasants" of vegetation (Plitt, 1919). Fungi were given the mycophobic title of "lower plants," which directly references perception of fungi as inferior and, hinting at teleological notions held at that time, less evolved. Based largely on nutritional modes, with fungi being heterotrophic and plants autotrophic, fungi were properly established as their own kingdom within the five-kingdom system proposed by Robert Whittaker in 1969. Even after this, however, mycology was placed under the purview of plant and/or forest pathology. Currently, if an institution has a mycology dedicated lab at all, and few do, it will most likely be placed in a department or sub-department titled plant or forest pathology. Scientific understanding of fungi has therefore been constrained by confirmation bias and social forces; fungi are approached through a pathologizing framework as something to be fought, controlled, and eliminated. No one should doubt the importance of these perspectives—after all, many fungi are pathogens, parasites, and disease agents of agriculturally and economically important crops—but the vast majority of fungi are not limited to those roles, if they fill them at all.

Mycophobia

Fungi are not plants, nor are they animals, and this binary conception is how many people today are inclined to interface with the natural world. Fungi are seen as poisonous, agents of disease, degenerate, deadly, freaky, gross, and weird—language historically leveled against both queer and disabled people—and as having no positive interrelationships with their environment(s). Mycology is rarely taught to undergraduate students, never mind sufficiently addressed in primary and secondary schools. Examples of dramatic and disdainful characterizations of mushrooms are abundant in many facets of Western European culture. In *Magical Mushrooms, Mischievous Molds*, George Hudler (1998, p. 73) explores socially important fungi throughout history and presents examples of these characterizations, such as the following poem by Emily Dickinson (1896):

Had nature any outcast face
Could she a son condemn

Had nature an Iscariot
That mushroom – it is him.
—Emily Dickinson, “The Mushroom”

Dickinson compares mushrooms in her poem to Judas Iscariot, the disciple who betrayed Jesus Christ to the chief priests, leading to his crucifixion. She suggests there is a sanctity to nature that is defiled and betrayed by mushrooms, as if they were not only an aberration of nature, but also an active, malicious threat to a holy place. A later section of the poem refers to mushrooms as the “Elf of Plants,” echoing the Linnaean title of “lower plants.”

The following is an excerpt from Sir Arthur Conan Doyle’s *Sir Nigel* (1906):

A sickly autumn shone upon the land. Wet and rotten leaves reeked and festered under a foul haze. The fields were spotted with monstrous fungi of a size and colour never matched before—scarlet and mauve and liver and black—it was as though the sick earth had burst into foul pustules. Mildew and lichen mottled the walls and with that filthy crop, death sprang also from watersoaked earth.

Doyle intentionally uses language grounded in ableist and queerphobic sentiment to create a picture in which, instead of being integral to forest health, mushrooms are seen as dirty, foreign, and frightening markers of death. For instance, his ignorance—and resulting insecurity and hostility—about the critical ability of fungi to decompose organic matter and help maintain the nutrient cycle necessary for life leads him to depict fungi as “foul pustules,” suggesting illness and a visceral sense of *wrong*.

Mycophobia and Queerphobia

Mycology is queer at the organismal level. Fungi are nonbinary: they are neither plants nor animals, but possess a mixture of qualities common to both groups, upending the prevailing binary concept of nature. It is rare for a fungus to have only two biological sexes, and some fungi, such as *Schizophyllum commune*, have as many as 23,000 mating types. When two compatible fungi meet, their mycelia will fuse into one body, sexually recombine, then remain somatically as one as “they” continue to live, grow, and explore in their environment. Members of phylum Glomeromycota are only known to be asexual. Fungi in order Laboulbeniales sometimes have distinct bodies for male and female reproductive structures (dioecious), or both may be found in the same body (monoecious), and sometimes monoecious and dioecious bodies co-occur. *Mycology has queer investigators.* Of respondents to the Mycological Society of America 2018 survey,

12 percent of mycologists identified as LGBTQ, which is three to four times the national reported average (Haelewaters, personal communication, 2019). One will quickly notice that mycological spaces have dispensed with certain expectations of formality, and even academic mycological conferences have a comforting, casual air of an odd family reunion. *Mycology is queer methodologically.* Mycologists use sensing, intuition, experience, and storytelling, with experts operating outside of institutional affiliation more often than with other organismal fields. For many mycologists, our relationships with fungi stir powerful emotions tied deeply to our core. We sometimes cry or burst into song when we find these special and beautiful beings.

Organisms, bodies, and behaviors that are difficult to neatly categorize stir insecurity and a lack of control within the viewer, who responds with fear, revulsion, and hatred. What becomes difficult to discern or dominate through heteropatriarchal systems of oppression and dogmatic scientific understandings becomes a threat to institutions that codify bodies of knowledge. Queer bodies are seen as less “fit” and “functional,” which calls on ableist language in similar ways as mycophobic language does. This includes the relegation of mycology to subfields of “pathology” within ecosystem sciences, coloring institutionalized understanding of the many lives of fungi.

Whatever poisonous and destructive qualities exist among a small subset of fungi have become mapped onto the character of fungi as a whole. This is indicative of the devaluation of fungi, as the same could not be said of kingdom Plantae, even though there exist subsets of poisonous and destructive plants. Plants and other organisms classified as belonging to “higher” kingdoms are recognized as possessing a greater degree of social capital (Bourdieu, 1986)—for example, they are more likely seen as helpful, valuable, and capable of performing some service—that allows them to encompass an abundance of attributes in people’s imaginations. In contrast, fungi and other “lower” kingdoms, such as Archaea and bacteria, do not occupy this elevated space in people’s imaginations. In general, people who belong to marginalized groups experience a flattening of their person into a static state that suggests behaviors by individual members of a group can be generalized onto the supposedly singularly definable quality of the group as a whole; this is one of the ways mycophobia and queerphobia operate using similar logics. It is worthwhile to wrestle with the apparent tensions when marginalization is referred to as “dehumanization,” because while language that compares humans to nonhuman animals and other life forms is meant to strip those humans of empathizable qualities, leaving them vulnerable to “justifiable” violence and harm, it is crucial to resist human/nonhuman binaries and hierarchies

that are part and parcel of violent, oppressive systems. Plumwood (1993) writes about this tension: "Thus, for example, behind the view that there is something insulting or degrading about linking women and nature stands an unstated set of assumptions about the inferior status of the non-human world" (p. 26).

Well-intentioned scientists have utilized queerphobic rhetoric in depictions of environmental hazards. Whether or not this usage is unwitting, it stems from deep-seated, subconscious knowledge that sensationalizing and heteronormative language spurs public condemnation. Giovanna Di Chiro (2010) writes about the concept of "eco(hetero)normativity" in regards to ableist, queerphobic, and heterosexist language—such as "sexual abnormalities," including "male-to-female gender shifts and intersex conditions" among fish and other animals—environmentalists and popular media may use to rouse concern about environmental pollution and toxicity (pp. 201–202). Such language moves beyond the need to conduct science, inform readers, and demand a healthy environment—it sensationalizes depictions of queer and disabled bodies as tragic aberrations from a supposedly (hetero)normative order to life that must be upheld and protected. Analysis around the harmfulness of this language must be extended to discourse around fungi. Mycophobic language paints fungi almost as unnatural toxins themselves—a force whose specter of invasiveness is constructed through a similar mobilization of queer-fear. This depiction of fungi sustains legitimized and "respectable" bodies of scientific thought and methodologies of research.

Even when researchers are not actively queerphobic it is impossible to act fully outside hegemonic discursive norms. It is only once this tension is named and a person recognizes that their perceptions of reality are culturally mediated that they can perform methodologically thoughtful research. Articulating the way this cultural entrapment functions, Monique Wittig (1992) writes, "There is nothing abstract about the power that sciences and theories have to act materially and actually upon our bodies and our minds, even if the discourse that produces it is abstract. It is one of the forms of domination, its very expression, as Marx said. I would say, rather, one of its exercises" (pp. 53–54). In a general sense, people struggle to imagine the enormous breadth of fungal life because fungal bodies exist well outside gender binaries, heterosexuality, and other exercises of power that create, as Wittig says, "false absolute meaning[s]" of gender, sexuality, nature, and health.

In her writings on feminism, Sara Ahmed (2017) discusses the idea that being a lesbian/queer means inhabiting a body that feels constantly questioned. Ahmed (2017) states, "Sometimes, whether or not you are asked a question, you feel

questionable...You feel like a question mark; you feel marked by questions" (pp. 120–121). Mycology is marked by questions by those on the outside: *Why would you possibly study those things? Will you get sick or poisoned? What kind of job can you get with that degree?* This further evokes parallels to "coming out." Queer people are often met with confusion, fear, and even disgust and abuse if they reveal their orientation or identity. Even in more mycophillic countries where foraging for mushrooms is more likely a shared cultural pastime, scientific passion and research focused on this kingdom of life is often seen as whimsical, confusing, or even disturbing.

A slippery space often exists between revulsion and commodification. Simon Estok (2009) introduces the term "queer ecocriticism" on the pretext that "the commodification of nature and sexual minorities are similar, each depending on a large consumer base that seeks a vicarious experience, rather than the thing itself" (pp. 213–216). People may desire a superficial, extractive experience while maintaining distance from the queer subject. Within mycology, there are examples of how people engage with fungi opportunistically, but fail to regard them as the essential, deeply ecological beings they are. Many people have had their lives saved by penicillin, without realizing that the medicine is derived from a fungus, *Penicillium*. Only a small handful of mushrooms that can be cultivated for culinary purposes, such as the portobello (*Agaricus bisporus*), have made their way into the realm of acceptability. They are accepted for two reasons: (1) They can be controlled and they exhibit predictable behaviors that can fall neatly under the domination of a cultivator; and (2) they serve a direct purpose to humans, in this case as a food source. Fungi that fit into only one of those categories, such as wild "choice" edible mushrooms, are sometimes deemed acceptable. There is an increasing popularity in dining on wild mushrooms, but in the US, these gourmet mushrooms are often sold at a high price, tying them to wealthy and often white clientele, who are often gatekeepers of acceptability within dominant culture.

The consumer of expensive "wild" mushrooms may feel adventurous, daring, knowledgeable, and perhaps even superior to those who cannot afford those mushrooms. The excitement felt from exclusive access to a queer(ed) *other* is a hallmark of commodity culture. bell hooks (1992) writes about commodification and objectification of Black bodies through an analysis of white (often male) fascination with and desire for sexual contact with dark Others—"the consumption of the dark Other," as hooks puts it (p. 30). hooks explains that this fetishization of the body of the Other helps white people to feel like transgressive and bold Subjects, while Black people remain in the position of "primitive" Objects. While hooks's argument is about white cultural imperialism and not

queerness, her argument about the thrill white people feel when they come into close contact—a type of consumption—with an “unknowable” Other can be extended to queerness as well. Consumers of expensive “wild” and “rare” mushrooms also assert their power over mushrooms, queer symbols and representations of death, and the seemingly mysterious origins they sprang from. Among people who forage for mushrooms they will later sell, however, exist more complicated social, cultural, and economic relationships with mushrooms. Tsing (2015) describes these as “pericapitalist” spaces, or sites of “salvage accumulation,” in that they “take advantage of value produced without capitalist control” and both are, and are not, capitalist interactions with mushrooms (in Tsing’s research, specifically matsutake, a highly coveted and costly mushroom) (p. 83). Pericapitalist spaces allow enactment of people’s own sense of freedom, often tied up in their cultural legacies, that connect them with mushrooms. Even when mushrooms are not so costly as to fall along these economic pathways, they are still sites of social convergence, bringing together academic and nonacademic scientists and an assortment of people who feel their freedom is theirs to reclaim. Mushrooms offer witness to human vulnerability.

Stacy Alaimo (2008) identifies nature as a critical ideological junction in feminist thought: “the contradictory, ubiquitous, and historically varied meanings of ‘nature’ have made it a crucial site for various feminist social struggles, including feminist anarchism, socialism, birth control, racial equality, and lesbianism” (p. 229). Alaimo asserts that, although the wedge driven between nature and body is understandable as a reaction to the intentionally demeaning historical association of women and nature, this “flight from nature” is “one of the most unfortunate legacies of poststructuralist and postmodern feminism” (2008, p. 229). Calling for inhabitation of “trans-corporeality,” Alaimo seeks to reestablish a feminist intimacy between bodies and nature by emphasizing material engagements of space and time. In this trans-corporeal, space-time partnership of beings, human and nonhuman bodies exert their own intermingled agency and life-making power, leading Alaimo to ask, “How is it possible to understand agency without a subject, actions without actors? How can we rethink matter as activity rather than passive substance?” (2008, p. 245). These questions strike at the heart of feminist efforts to de-naturalize the pervasive grip of dualistic thinking. Fungi, with their ability to decompose and transform matter across space-time, enabling reconstitution of bodies into new materialities, are crucial agents of non-capitalist, anti-dualistic interchange.

Plumwood (1993) writes that mutually reinforcing dualisms, such as culture vs. nature; male vs. female; reason vs. emotion (nature); subject vs. object; and self

vs. other, result from a certain kind of denied dependency on a subordinated other" (p. 41). Plumwood goes on to argue that "virtually the whole set of dualisms can be mobilised for this purpose of inferiorising the sphere of nature and those human-beings who may be counted as part of nature" (1993, p. 47). Human experience of the world becomes categorized, understood, and curtailed by the alienation and domination these dualisms naturalize and sustain. Queer people are simultaneously compared to animals, but also characterized as unnatural, which itself utilizes the false divide between nature and culture. Similarly, fungi are regarded as wild and unruly elements of nature with no connection to humans, and simultaneously unevolved or somehow representatives of another, more evil realm.

Haraway (2007) offers an intervention into binaristic discourse that alienates humans from the natural world; we assert that such discourse also ensnares our fungal kin. Haraway communicates the inextricable dynamicism and co-constitutive relationship between nature and culture through her term "naturecultures," which says that any invocation of nature has a cultural context, and similarly, cultures do not exist apart from nature (2007, p. 25). Haraway argues that companion species—organisms whose communal and corporeal existence and identity demand interdependence—arise from naturecultures. She writes, "I am not a posthumanist; I am who I become with companion species, who and which make a mess out of categories in the making of kin and kind. Queer messmates in mortal play, indeed" (2007, p. 19). Messmates occupy space together; they witness one another's intimate moments, and their day-to-day lives depend on synchronous interplay with one another. This includes humans and the fungi we coexist with on a daily basis, from yeast cells mingling in our guts and nutrifying our foods, to symbiotic fungi whose role in forests sustains our global environment.

When language is limited to a binary conception of gender, those who do not fit squarely in those constructs are often thought to not exist, and explicitly written out of existence through their exclusion. Fungi are often unnamed—only about 120,000 of an estimated 2.2 to 3.8 million fungi have been named and described (Hawksworth & Lücking, 2017). While the call to name all currently undescribed fungi will be a step in the right direction, and is in fact the pursuit of one of the authors of this paper, taxonomy alone cannot cure this problem, because it does not break from the need to delineate the bounds between fungi and humans which, to borrow from Derrida, is a hierarchical regime. Derrida (1981) argues,

To deconstruct the opposition, first of all, is to overturn the hierarchy at a given moment. To overlook this phase of overturning is to forget the conflictual and subordinating structure of opposition. Therefore

one might proceed too quickly to a neutralization that in practice would leave the previous field untouched, leaving one no hold on the previous opposition, thereby preventing any means of intervening in the field effectively...The necessity of this phase is structural; it is the necessity of an interminable analysis: the hierarchy of dual oppositions always reestablishes itself...That being said—and on the other hand—to remain in this phase is still to operate on the terrain of and from within the deconstructed system. By means of this double, and precisely stratified, dislodged and dislodging, writing, we must also mark the interval between inversion, which brings low what was high, and the irruptive emergence of a new "concept," a concept that can no longer be, and never could be, included in the previous regime. (p. 42)

Extending this linguistic idea to the material, fungal realm, we argue that naming all fungi would be an oppositional act, but such an engagement would leave us wrought in the same oppositional tension of our current framework. Rather, we must phase shift into a newly imagined, but simultaneously ancient, non-hierarchical space in which human–nonhuman (fungal) oppositions are deconstructed.

Robin Wall Kimmerer (2007) reflects on Western scientific discourse's need to mark the bounds of existing knowledge. She explains that the term *Puhpowee* in Potawatomi means the force which causes mushrooms to push up from the earth overnight. A member of the Potawatomi Nation and an academically trained scientist, she writes,

As a biologist, I was stunned that such a word existed. In all its technical vocabulary, Western science has no such term, no words to hold this mystery. You'd think that biologists, of all people, would have words for life. But in scientific language our terminology is used to define the boundaries of our knowing. What lies beyond our grasp remains unnamed...The makers of this word understood a world of being, full of unseen energies that animate everything. (Kimmerer, 2007, p. 49)

This inability—or refusal—to engage with language that reveals the limitations of our perception curtails our engagement with fungal life (and as a parallel, with queerness). But as Kimmerer points out, this disconnect is inherent to the English language and its naturalized assumptions of animacy or lack thereof; Science then institutionalizes these assumptions. It is not impossible, however, for English-language speakers to recognize flaws and fissures in language, even if words to meaningfully bridge them do not exist.

Religious ideology and discourse influences understandings of animacy and relations between beings. Some biblical scholars believe that “dominion” was a mistranslation, and the original text used a word more closely synonymous with “stewardship.” It is through this translation that some Christians felt empowered to dominate and exploit Earth (Weldon, 2016). Riki Anne Wilchins (2004) writes about this drive for dominion: “We want to have, as the Bible says, *the Word made flesh*, something we can have dominion over” (p. 46). The remarkable ability of fungi to subvert human domination and defy expectations has bound fungi with other supernatural forces often feared by Christians, including witches, devils, and the demonically possessed. Whether the context has to do with religion or any other institution, culture and language cyclically reinforce discourse. Wilchins writes,

Discourse is a set of rules for producing knowledge that determines what kinds of intelligible statements can be circulated within a given economy of thought. For example, in the discourse on gender, you can only say meaningful things about two kinds of bodies that will make sense. References to third genders will always sound fanciful, nonsensical, or just ridiculous. Discourse is the “cookie cutter”...The social truths we have about gender have to do not with the body, but with the cutter. (2004, p. 73)

In this analogy, science and methodology are the cutter, and the dough is all that can be learned. The cutter is shaped to accommodate biological and methodological realities of non-fungal organisms. This cleaves off entire sections of what we can know about fungi so that they keep shape with other organisms. Biological discourse has limited our framework of possibility for fungal biology because this discourse was formed in the context of mycophobia. Mycology is on the margins, where biological discourse has been abruptly cut by the cookie cutter; on the boundaries of discourse that prioritizes and enforces normalcy of other organisms.

Psilocybin within psychedelic mushrooms was posited to have evolved to defend mushroom bodies against mycophagous insects (Reynolds et al., 2018). However, a subsequent study disputed this, finding evidence for a mutualistic role of psilocybin between insects and fungi (Awan et al., 2018). This same compound facilitates the birth of alternative epistemologies in human minds by connecting and energizing regions of the brain that have atrophied in our sterile, individualized, and isolated position atop the self-declared hierarchy of Western philosophy. Much like a mycorrhizal network, neurotransmitters flow like carbon,

nitrogen, and phosphorus, connecting and reconnecting regions of our brains, reminding us of our deep-time home, the sentience of Earth, and interlocking biotic systems of *We*. Psychedelic mushrooms take people to a vulnerable site of deconstruction, where what was once considered to have social or cultural significance suddenly feels obsolete and what was once seen as static and inert is suddenly pulsing and humming with animacy. It is not a coincidence that the relational discipline of ecology (from Greek *oikos* “house”) gained public traction in the 1970s, in concert with psychedelic, anti-war, civil rights, and environmental movements—a greater recognition of the interdependence of all beings was taking shape.

The experience of marginalization lends a critical vantage point and potential for subversive examination. Patricia Hill Collins (2000) discusses using “alternative epistemologies,” which are entirely new frameworks of thought, as fundamentally subversive challenges to dominant “knowledge claims” (pp. 253, 256).

Mycological history is replete with numerous alternative epistemologies, such as the concept of mutualism—a humbling concept often seen as an insult to the primacy of humans—which has historically gained and lost traction, mirroring trends in the zeitgeist. Original hypotheses on mutualisms of mycorrhizal networks put forward by A. B. Frank in the late nineteenth century were considered revolutionary when introduced and were therefore highly contested. Around the same time, the biology of lichens was being fiercely debated, with mycologists such as DeBary and Swchendener first probing into notions of symbiosis between fungi and algae (Plitt, 1919). A century and a half later, these ideas are only just becoming well-integrated into scientific literature and lexicon, and remain poorly understood and underrecognized outside of mycology (Trappe, 2005). Scientists are typically quite conservative when treating alternative epistemologies; there is extreme pressure to “just follow the data.” And yet, according to philosopher of science Thomas Kuhn (1970), this is what scientific revolution looks like: embracing what was marginal and elucidating new epistemologies.

Queer Pedagogy and Methodology

As Amy E. Winans (2006) states, queer pedagogy entails decentering dominant cultural assumptions, exploring facets of the geography of normalization, and interrogating the self and the implications of affiliation” (p. 6). In an attempt to challenge dominant logics and cultural assumptions, queer pedagogy asks, what has been normalized, why, and how can knowledge be produced differently by taking into account the function of power?

For most mycologists, mycological education was fostered outside the traditional classroom. There is often a reliance on individuals who were/are autodidactic, pursuing knowledge of this subject apart from dominant education systems. Many mycologists remember their first mycological experience very clearly; usually, it was by way of a charismatic teacher who brought to focus this queer world. Upon realizing that there was actually this other world, where the rules did not quite apply, many mycologists felt at once safe and awakened. Mycology speaks to the personal, sexual, and/or political lives of its often-marginalized investigators.

Mycological societies are also an example of alternative sites of knowledge. They de-center institutions as the sole source of knowledge, and challenge hierarchies through a structure that is member-supported, low-cost, and often provides free, public educational experiences. This type of structure is central to feminist methodology, which insists that learning and thinking are never confined to the classroom, and in fact are richer when experienced in community with others, out in the world. Anarchist organizers, designers, architects, and others look to nature, including fungi, for inspiration through a process called biomimicry, a term popularized by Janine Beynus's 1997 book *Biomimicry: Innovation Inspired by Nature*. Examples of this include an architecture group based in Brooklyn, NY called Terreform Open Network Ecology, which looks to nature to design sustainable architecture, and a group called Fungi for the People, which brings people together for educational workshops. Artists are even increasingly looking to fungi for inspiration. Whatever the group, those who learn and borrow from fungal biology are compelled by its dynamic, mutualistic, and transformative possibilities.

Despite this burgeoning, eclectic appreciation for fungi, funding is typically hard to come by for mycologists because the field is still largely in the phase of "basic research." In an academic environment mired in capitalistic notions of progress, application, patents, and "impact," funding basic research is difficult because it lacks a certain thrill. Curiosity for curiosity's sake is a hard sell to a person who compulsively asks the claustrophobic, capitalistic question, but what's the point? Mycological societies have flourished because they allow people to explore in peace, for the sake of exploration. The simple state of curiosity is the only requisite for joining such societies.

While many classical American naturalists such as Henry David Thoreau, Aldo Leopold, and Rachel Carson were not tuned into mycology, many of today's mycologists drew early inspiration from their patient, holistic, and arguably sacred

and dutiful art of observation. This art, this deep, daily, ritualistic communion with patterns, phenology, and nonhuman beings gives many of us a sense of purpose. Naturalism is beautiful because it is not inherently directed, there are no required hypotheses, practitioners need not have an academic affiliation. In fields such as mycology, as well as facets of organismal biology and ecology, lineages of classical naturalism have persisted, holding the practice of simple observation close to our hearts. These naturalists are the observers, the ones whose "indeterminate encounters," as Tsing (2015, p. 50) says, without a script or fixed set of goals, create mutually transformative relationships. By forging messy, shifting, anarchist human and nonhuman kinships, these encounters demonstrate the creative and productive energy possible outside capitalist bounds. Such non-extractive, transformative mingling of beings requires communication that listens, not demands, and research that seeks to observe and understand, not suture any sites of ambiguity.

In the age of climate change, it is becoming increasingly apparent that the tiny pin pricks of data recorded by observers have incrementally built enormous bodies of knowledge. Museums containing vast collections of organisms that most would call too insignificant to *know*, have been diligently preserved, catalogued, and curated by observers. We can use these treasure troves to understand how life once was, before such destruction, and to reimagine our future. The project now is to help break the obsession with progress by de-emphasizing scalability, challenging research frameworks, and supporting the world's observers. Science prioritizes quantitative data, but disciplines adjacent to or entirely outside of Science understand that qualitative data are also informative and sometimes carry greater explanatory power in certain contexts. Jack Halberstam (1998) posits that queer methodology is a multimodal "scavenger methodology," which points to a process of searching and excavating that does not come easily at first glance. Mycologists might prefer the term "forager methodology," as mycology is similarly built on a mix of quantitative and qualitative data that includes sensing, intuition, oral histories, and literally foraging. Stacey Waite (2015) encourages embracing messiness as necessary and fruitful.

[Waite] invites readers to think about and experience logics that contradict, tenses that shift, genres that mix, futures that are messier than what the present moment seems to allow...[and] asks scholars of composition and teachers of writing to become scavengers and to make seemingly disconnected worlds collide. (Waite, 2015, p. 52)

Mycological surveys are difficult to do with the quantified, restricted methods that botanists use. Mycologists use and publish methods such as "timed wander"

to survey a site (Victoroff, 2020). Extremely standardized transects and plot-based work of botany often feel unnecessarily limiting to mycologists, who are often guided to find fungi by a combination of intuition, sensing, and an intimate knowledge of the landscape and macro/micro habitats that foster mushroom growth.

Smell and taste are important methodological tools in identifying fungi; the communal, instinctual, cultural, and emotional reverberations of these senses potentiate more personal, nuanced research. People working in groups to identify fungi may often ask one another, "What does this smell (or taste) like to you?" and form inexact, but deeply provocative, systems of organization based on these senses. Even this invitation to smell carries a queer intimacy. The affective attachment mycologists have with fungi is apparent at mycological summits and conferences when someone asks, for example, what *Inocybe* smells like, and people respond with descriptors such as "spermatic" or "swimming pools!" There is indeed a queer and joyous sense of community when a group of people collectively comes up with a verbal smellscape of increasingly silly descriptions of ejaculate smell to describe a fungus. For those who have smelled *Inocybe*, the descriptions spark memories of those embodied and ephemeral moments, layered with dimensions of others' descriptions; for those who have not smelled *Inocybe*, listening to others share their impressions can sketch a full, patchwork, and memorable picture.

Initiating newcomers into tasting mushrooms for experiential identification is a vulnerable and exciting moment. Some mushrooms, such as members of genus *Russula*, are difficult to identify to species level without incorporating taste because they are morphologically similar. However, some species are edible and taste mildly "mushroomy," and others will cause gastronomic distress, such as *Russula emetica* (from Greek *emetikos* meaning emetic or vomit-inducing), and will have a spicy or acrid taste. Few people know that all mushrooms are safe to touch (unlike plants) and fewer know and viscerally *believe* that all mushrooms are also safe to put in your mouth, so long as you spit them out! In our classrooms, we sometimes ask a brave volunteer to come forward and take a small nibble of two similar-looking *Russula* mushrooms and taste for difference. An intimate space is created as students gather around to witness their classmate's reaction as curious tastes roll over their tongue.

With some of these methodologies, there is risk of losing the ability to cleanly replicate, but the benefit is that there is a richer understanding of the lifeworlds of mycoflora in a given area. Forgoing straightforwardly replicable methodologies

opens a multitude of pathways, perspectives, and points of entry for mycologists who appreciate that notions of objectivity constrict ability to understand fungi. This creates friction with some of the foundational tenets of traditional Science, but mycology stretches and redefines the idea of replicability, because fungal growth does not lend itself to clean replicability. Mycological methodologies rely on a greater sense of intimacy between mycologists and both fungal organisms and the landscape, which speaks to Ahmed's (2017) reflections about intuition: "A gut has its own intelligence. A feminist gut might sense something is amiss" (p. 27). A mycologist's feminist gut demands that intuition, a feminized mode of knowing, be trusted. Fungi, in turn, demand the same of mycologists, and all those who seek to make kin with fungi. Maybe not coincidentally, human guts are home to an assemblage of microbes, fungi and bacteria, that communicate with and impact our brains.

Conservation

The hologenome concept asks, what is the relevance of an isolated human genome? Bodies are, in fact, communities, and there are more fungal and bacterial cells in the human body than there are human cells. As Haraway (2007) puts it, "To be one is always to *become with many*" (p. 4). *We become with*, because there is no *us* without *others*; even words such as "us" and "others" are misleading, as our bodies are mutually constitutive entanglements. Recently, scientific investigations have begun to attach quantitative data to interdependencies that have been recognized outside of Western culture for millennia. The notion that humans exist and function independent of other beings stems from a fear of our vulnerable dependencies and often indecipherable, queer entanglements, and that, as Myra Hird (2004) says, "the penultimate embodiment of queer may be bodies themselves" (p. 87). By embracing this queerness, we chip away at fallacious, capitalist myths of the neoliberal, individually agential Western subject.

Belief in human exceptionalism has devastating consequences for humans and all life. Impacts of mycophobia are immediately, materially apparent. According to *State of the World's Fungi*, only 56 species of fungi have been evaluated for placement on the International Union for Conservation of Nature Red List, with 43 species ending up listed (Ainsworth et al., 2018). Comparatively, 25,452 species of plants and 68,054 species of animals have been evaluated (Ainsworth et al., 2018). This list aims to be the world's most comprehensive inventory of species and their risks of extinction, and yet a kingdom with over one million species has only 43 species listed. This poor representation is not due to some miraculous ability of fungi to move unscathed through the Anthropocene and the world's sixth great

mass extinction event. Rather, it is because there is a failure to achieve quantification-based standards *proving* a species is endangered. This is largely because the ephemeral nature of many mushrooms and fungi makes their documentation patchy. The relative lack of mycologists compared to botanists and zoologists also means there is less data available to argue for protected status. This lack of protected status means there is less funding available for their protection, therefore fewer studies are conducted, and fewer mycologists are paid to do necessary work to generate more data. Holding fungi to biological determinations of more normative groups—say trees or birds—is to deny their basic biology, which puts them at risk for extinction. The solution is not to find out how to force fungi into the normative box. The capitalistic drum that beats towards extinction will not slow its tempo for the painstaking assessment of fungi, no matter how diligently mycologists work. The solution is to recognize that fungal data should not have to match that of trees or birds. Mycologists' experience, intuition, and sensing should be given priority in establishing whether or not a fungus is threatened or endangered. Conservationists should also be deferential to modes and practices of Traditional Ecological Knowledge, which has a rich history of profound, intimate knowledge of Earth. Radical circumstances such as mass extinctions demand radical solutions, and fungi demand to be seen in their messy totality. We must disentangle science from capitalism and Western hegemony. We must trust and support observers, turning to our deep-time microbial gut to draw strength in our advocacy for our interdependent communities. To deny the value of these systems of knowing is to shore up colonialist and queerphobic mindsets.

Conclusion

Mycology is queer insofar as it is marginal, subordinate, contested, ridiculed, but more critically, mycology is queer insofar as it is disruptive, collective, transformative, revolutionary. Fungi show us cooperative, alternative, promiscuous, entangled, interdependent, more-than-individuated, and more-than-human modes of living worth studying, imitating, learning from, and which queerness in humans has often shared. Just as fungi are capable of reclaiming land, bodies, and nutrients, so too can humans reclaim our relationship with fungi as siblings. Much like mycorrhizae, humans can forge mutually beneficial relationships with fungi. We can steward their land, and care for their bodies, much like how they have persistently continued to steward our land and care for our bodies. We can remediate poisoned relationships by challenging the paradigm in which they have been demonized and dispossessed, much like how they can remediate waters and lands poisoned by capitalist greed. Moreover, we can apply lessons learned from fungal biology to our human organization and forge stronger

networks of interdependence and mutual aid. Science can be and has been instrumental in challenging dangerous, exploitative notions of hierarchy, but it has also been employed at the service of those hierarchies. Through a thorough and honest recognition of the limits of human investigative reasoning and methods we can become better and more ethical scientists. Through challenging assertions of objectivity and purity, we push ourselves into the unknown, both with optimism and a critical outlook. It is past time that humans turn to the fungi to which we are bound, step into our mutual totality, and create space and futures for our wild ways of being.

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