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Brave New Worms: Orienting (Non)Value in the Parasite Bioeconomy
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Abstract

Parasites have long been disdained as a drain to be eliminated and eradicated. Helminthic therapy - the use of parasites to treat autoimmune diseases - seeks to change this. Helminthic therapy transforms the parasite from bane to boon, from a pathogenic scourge to a valued resource to be bought, sold, and researched by a growing network of biohackers, health activists, and medical scientists. Yet, this is not a simple story of pure natures newly commodified. This novel bioeconomy is both contested and multiple, engaging with parasites not only as commodities but also as not-yet-but-soon-to-be-commodities, as useful but not formally valued, as inconsequential, or as dangerous to profit. Drawing on qualitative interviews and digital ethnography and grounded in relational feminist and queer approaches to political economy, this chapter traces the ways in which parasites are oriented in multiple ways, engendering myriad forms of capitalist value and non-value. This approach illustrates how resource geographies and the worlds they engender are always multiple and never inevitable. They are pregnant with myriad possibilities and potential futures.

Introduction

Parasites have long been disdained as a drain to be eliminated and eradicated. From the moment modern parasitology crystallized as a scientific field in the early 19th century, parasites have been seen as a blight on human life and capitalist productivity. The profession of parasitology was itself a colonial project aimed at maintaining a productive colonized labor force and protecting European profits (Foster, 1965). Within medical discourse, the number of parasitic worms (known as helminths) living inside a person is called a *worm burden*, highlighting the toll they take on their human hosts. By definition, the parasite benefits at the expense of its host. Now, a nascent but growing industry is questioning such commonsense and imagining alternative human-helminth relationships.

Helminthic therapy refers to the practice of ingesting parasitic worms into the human body to treat a range of autoimmune diseases and disorders like severe allergies or Crohn's disease. Helminthic therapy reframes the parasite and, importantly, the parasitic relationship between helminths and human as a valuable resource. In some circles, parasites have become a hot commodity, worthy of being bought, sold, grown, traded, and gifted. Indeed, a loose network of biohackers, patient advocates, and medical researchers has emerged around this practice and proto-industry. The visions and tactics deployed by each differs, however, when it comes to helminths, helminthic therapy, and the future of this newly-valued resource. As these contests unfold, shifting biosocial relations push and pull helminthic therapy in multiple, often contradictory directions. Regulate. Outlaw. Share freely. Test. Synthesize. Provision as a public good. Enshrine as a human right. Eradicate. Conserve. Patent. Commodify. What is to be the future of helminthic therapy, the people who seek it out, the worms on which it depends, or the burgeoning bioeconomy it has created?

Value and its Others

Biocapitalism refers to the accumulation of capital through the commodification and sale of what Donna Haraway calls "lively capital" (2008): vital materials like blood plasma, lively critters like exotic pets, or ecosystem functions like CO₂ sequestration (Collard, 2014; Collard and Dempsey, 2013; Cooper, 2008; Rajan, 2006). Surveying the late-twentieth century rise of the biotechnology industry and genomic science, it would seem as though biocapitalism has only accelerated. New breeds of cattle. New strains of corn. New means of organ transplantation.

Indeed, helminthic therapy seems to tell a similar tale – a strange and sensational story wherein capital commodifies another untapped nature, a natural resource newly minted.

Yet, this narrative proves insufficient in both analytical and practical political terms. It carves life into a binary: valued commodities and everything else. If we focus only on commodification we risk painting capitalism as discrete and totalizing, as though all life were either inside or outside its walls (Gibson-Graham, 1996). The battles over helminthic therapy, however, are more than a two-sided struggle over whether *to commodify or not to commodify*. They unfold through a complex web in which relations of capitalist value are both made possible and exceeded by relations of capitalist *non-value*. Non-value refers not to value's mirror opposite but to its diverse alternatives, its queer relatives.

As J.K. Gibson-Graham (1996) argue, capitalism has historically been conceived in cisheterosexual terms. Champions and detractors alike talk about capitalism as 'penetrating' new markets or 'capturing' non-market life; as though capitalism were itself a sovereign, masculine body. Yet, if capitalism *were* a body, then capitalism, like all bodies, would be both penetrating and penetrated. To think queerly about capitalism means understanding this relationality, mutual vulnerability, porosity, and, most importantly for our purposes, multiplicity. Some lifeforms are valued as a resource. Some resources are commodified. Yet, life also takes other forms under capitalism. Rather than being commodities, some lifeforms may be seen as not-yet-but-soon-to-be-commodities, as useful but not formally valued, as inconsequential, or as dangerous. These relations constitute non-value under capitalism. They are what Collard and Dempsey call "value's necessary others" (2017: 78).

Rosemary-Claire Collard and Jessica Dempsey (2017) craft a non-binary relational framework for conceptualizing life under capitalism. They outline five *orientations* that humans and nonhumans can take in relation to capitalist value. Borrowing from Sara Ahmed, they define an *orientation* as the way in which one thing is "positioned in relation to something else" (Collard & Dempsey, 2017: 81). Orientations are performative, depending on "the repetition of norms and conventions, of routes and paths taken" (Ahmed, 2006: 16). Nothing just *is* a resource. No resource just *is* a commodity (Smith, 2010; Bakker & Bridge, 2006; Richardson & Weszkalnys, 2014). Commodity-ness is a consolidated effect. Thus, for something to be *oriented as a commodity* it must be *repeatedly related to as a commodity*. Bought and sold. Day after day. As Collard and Dempsey outline, however, *commodity*, or what they term *officially valued*, is

just one of five possible orientations humans and nonhumans can take in relation to capital accumulation¹. These include:

1. *Officially valued*: lives, labors, and bodies directly valued as inputs for capital accumulation; e.g., wage laborers, slaves, commodified animals, titled land;
2. *Reserve army*: not yet directly valued but promising future exchange value and profit; e.g., temporarily unemployed laborers, seeds for planting, ‘biodiversity’ and gene banks;
3. *Underground*: useful to, but officially unvalued by, capitalism – commonly referred to as social (or biosocial) reproduction; e.g., unpaid domestic labor, ecosystem functions;
4. *Outcast surplus*: inconsequential to capitalist accumulation; e.g., paupers, feral dogs;
5. *Threat*: hindering or endangering capital accumulation, or perceived to be; e.g., union organizers, mad cow disease.

Importantly, Collard and Dempsey include seemingly inanimate entities such as land within their framework, thereby suggesting their refusal of the life/not life binary so characteristic of settler colonial US society and other post-Enlightenment contexts (Tallbear, 2017). Indeed, whether it be made of flesh or stone, under the logic of capital “there is not one way that nature is appropriated or exploited or dominated to produce capitalist value” (Collard & Dempsey, 2017: 94).

This approach, we argue, offers several important tools and insights for doing critical resource geographies. First, by turning our attention to the broader field of biosocial relations that extend beyond capitalist value and beyond the resource-as-commodity, we are able also to expand our analytical frame beyond capitalism’s most obvious and violent sites of transformation. We are able to excavate the “hidden abodes” (Fraser, 2014) of capitalism to see how processes of capital accumulation have world-making effects both within and beyond spaces of formal value. If we focus only on the forest felled, hewn, bought, and sold, then we miss the pine beetle, the soil, the undergrowth laid waste, and the ties binding commodified lumber to each.

Second, centering the multiple orientations of (non)value illustrates the constitutive relation between resource-making and world-making. Commodification, for example, always

¹ Collard and Dempsey (2017) clarify that their typology is not meant to draw a simple analogy or moral equivalency between human and nonhuman exploitation, appropriation, or domination. Rather, each orientation highlights the similarities in how human and nonhuman lives become *structurally* valued or devalued. We echo this caution.

also involves making and remaking whole ways of living, which are themselves entangled within, but irreducible to, capitalism. The relational framework of (non)value thus makes visible the *multiple* power-laden worlds in which humans and helminths dwell together. Big Pharma. Self-help. Gut communes. Worm banks. Parasite conservation. Black markets. Rather than just inaugurating and commodifying a novel resource, helminthic therapy creates, however tentative or liminal, new forms of socio-environmental organization, new ways of getting on together, new ways of (de)valuing one another. This approach thus makes clear how the creation and commodification of novel resources always requires the making, unmaking, and remaking of whole worlds.

Third, the concept of orientation decenters anthropocentric notions of agency, highlighting how nonhumans play a vital role in (re)orienting life and (non)value, co-shaping with other actors and forces their existence as resource, waste, underground, or otherwise. Worms are not a passive resource, used and molded by human whim (cf. Bakker & Bridge, 2006). As we will demonstrate below, worms actively shape those paths taken and not taken within helminthic therapy.

Finally, by tracing the way, as Ahmed argues, orientations direct us toward “some ways of living over others” (2006: 44), this approach lays bare the contingency and thus instability and mutability of resource creation and capitalist enclosure. As Gibson-Graham argue, capitalist relations are partial, mutually vulnerable, and interpenetrated with non-capitalist relations (1996). Thus, while we offer no programmatic prescription for altering life’s orientations under capitalism, we illustrate how even the most commodified relations can contain the germs of their own undoing.

In the rest of this chapter, we ask *what worlds are being oriented by humans and helminths?* As answer, we present a case study of helminthic therapy,² applying the relational framework developed above. We present multiple practices of helminthic therapy currently taking root and explore their shifting relations of (non)value, as well as their implications for human and more-than-human ways of life. In our conclusion, we discuss what insights critical resource geographers might take from this study for the study of world-making.

² The data that underlies this chapter consists of interviews with people in the helminthic therapy community and a digital ethnography of the online spaces in which helminthic therapy is discussed and practiced. This data was collected by Skye Naslund between 2016 and 2018.

The Many Pasts, Presents, and Futures of Helminthic Therapy

Helminths, at various points in time and in different geographic and social contexts, have taken on all five of the orientations presented by Collard and Dempsey (2017). Starting as a threat to be eliminated by eradication programs, they have since been oriented as outcast surplus (irrelevant to capital accumulation) by public health authorities in the US, as underground (necessary, but not formally valued) by those growing their own helminths, as officially valued by helminth vendors, and as reserve army (having some future value) by biomedical/pharmaceutical researchers studying them.

Indoor plumbing, socialized waste management, refrigeration, antimicrobial products, and personal hygiene, all projects of 19th and 20th century state-sponsored public health, radically altered relations between humans and a host of microbes, especially in wealthy countries of the Global North. Helminths, like bacteria and other ‘germs,’ were seen as threats to modernity, to the centralized state, to the social order, and to capitalist progress and thus humans endeavored to sanitize them from the ecology. The American hookworm - *Necator Americanus* - was first identified and described in 1902 (Rockefeller Foundation, 1922). At the turn of the 20th century, in the southern United States where both the climate and social practices supported hookworm life, as much as 40% of people suffered from hookworm infection. Infections were concentrated among the poor, the working class, and children (Elman et al., 2014; Rockefeller Foundation, 1922; Ettlting, 1981). By the 1920s, however, after a massive campaign to build latrines, educate school children on the importance of wearing shoes, and treat affected populations, hookworm infection became largely nonexistent. The eradication campaigns of the 1910s and 20s explicitly targeted hookworm infection as a scourge on worker productivity and the cause of perceived economic and cultural backwardness in the South. These campaigns, however, focused specifically on recapacitating the White working class, while overtly deprioritizing Black communities (Wray, 2006). Hookworm infection was termed “lazy cracker disease” and was blamed for the stereotypes associated with poor rural Whites (Ettlting, 1981; Wray, 2006). This population, and thus the hookworms infecting them, was seen as an internal threat to the White race and the cultural logics of White supremacy (Wray, 2006). Hookworm eradication, like other public health campaigns of the time period, was thus aimed at mass social change while maintaining the dominant racial order.

Given the largely successful eradication campaigns leveraged against hookworms and other parasitic infections in the United States and other Global North countries, helminths were insignificant to the workings of capital in that part of the world throughout much of the 20th century. Until 1989, that is. In that year, British epidemiologist David Strachan first proposed what became known as the “hygiene hypothesis.” The hypothesis links this history of environmental over-sanitation to the rise in autoimmune and allergic disorders in the Global North. Without the microbes and parasites that populated humans for millennia and with whom humans have co-evolved, our immune systems no longer develop properly. According to the hygiene hypothesis, this dispossession of parasites explains the precipitous rise in autoimmune disorders among Global North populations in the later half of the 20th century. While scientific debate about the hygiene hypothesis and its practical implications continues, some researchers have proposed deliberately reintroducing parasites as one potential remedy to historical over-sanitation (Velasquez-Manoff, 2012). This intentional reintroduction of helminths is called helminthic therapy. Research on helminthic therapy continues to develop and multiply and the practice of helminthic therapy itself is highly variegated and contested. The deliberate reintroduction of parasites to the human body has taken many different forms, each with its own orientation of (non)value.

First tested in humans in the early 2000s, early clinical trials showed tremendous promise for helminthic therapy. Jasper Lawrence, an Anglo-British man living in California, suffered from severe asthma but had failed to find relief through conventional medicine. Lawrence read about the nascent helminthic therapy research and wanted in. No clinical trials were accepting patients, so Lawrence decided to conduct his own informal experiment. Lawrence traveled to Belize, where he walked barefoot around open latrines hoping to contract the same hookworms that had been eradicated from the US a century earlier. As Lawrence tramped through the feces-contaminated soil, dozens of hookworm larvae sensed the mammalian warmth of human skin. The larvae burrowed through the soles of Lawrence’s feet and into his bloodstream. From there, they migrated to his lungs and, after irritating his lungs enough to be coughed up and swallowed, they reached Lawrence’s small intestine, where they attached themselves to his intestinal lining, bloodletting their sustenance. Once attached, hookworms can survive two to five years, continuously excreting eggs that then pass into the stool of their hosts and back into the soil where they hatch and seek out new hosts. After considerable trial and error, Lawrence found

himself asthma-free. He was hooked. Lawrence began his own business *Autoimmune Therapies* selling hookworms, and later whipworms, to fellow allergy, asthma, and autoimmune disease sufferers. Using his own body to gestate worm larvae, Lawrence extracts eggs from his feces, processing, packaging, and selling them online.

Today, clinical trials are still underway, showing mixed results. While these trials have established the safety of helminthic therapy, its efficacy remains inconclusive (Summers et al., 2003; Feary et al., 2009; Fleming et al., 2017). Given the long timelines for biomedical research and government approval, not to mention the desperation of those individuals suffering from Crohn's disease or multiple sclerosis whom conventional biomedicine has failed, others are following in Lawrence's footsteps. A community of patients and biohackers is experimenting with helminthic therapy. Helminthic therapy users can cultivate worms themselves from their own or donated feces or they can purchase worms from one of several online vendors. This burgeoning bioeconomy is largely illicit, however. Most users live in the United States, but in 2009 the US Food and Drug Administration banned the commercial sale of parasitic worms. Online retailers like Lawrence have either moved their operations to countries where their business remains unregulated (e.g., Mexico) or gone underground to undisclosed locations.

Four species of helminths are currently used in helminthic therapy. Two are human parasites; the helminths complete their lifecycle by colonizing human hosts and viable eggs are excreted in human feces (hookworm and whipworm). The other two are non-human parasites--one's lifecycle passes through pig hosts (pig whipworm) and the other through a combination of rats and grain beetles (rat tapeworm). While still illegal to sell in the United States, the non-human parasites have been legally regulated in the Thailand and the UK respectively where vendors of those helminths are located. No country has yet explicitly regulated human helminths and thus the helminths used by many helminthic therapy users in the US are unregulated by any governmental organization.

As of 2015, it was estimated that approximately 7,000 people worldwide were using helminthic therapy (Cheng et al., 2015), though that number is quickly rising. The four species of helminth that are in use today have been carefully selected by researchers and users based on their lifecycles and interactions with the human body. These worms do not reproduce within the human body, they can be effectively cultivated, and, when used in relatively small numbers, they do not produce severe side effects or illness in their human hosts. The worms' biology and life

cycle pose little threat to humans. For some users, the worms have no apparent effect. For others, however, these worms are lifesaving, justifying a steep price. Helminthic therapy can run anywhere from \$30 to \$1000 depending on the species, the number of worms per dosage, the number of doses, and the degree of vendor support provided. “It was a lot of money to potentially throw away,” as one user put it, “but it was worth it for a decent chance of it helping, which it happens it has entirely been worth it” (personal interview, 2017). For such users, parasites can, with care-full human collaboration, become symbionts, both nourished and nourishing.

Within the helminthic therapy user community, however, debate rages over the ethics and economics of this growing industry. Some are happy to pay vendors for worms, assured by the security and accountability retailers claim to offer. Others insist that helminths should be free. Within this latter camp, some individuals self-cultivate their own worms, secreting, sterilizing, and ingesting their own larvae. Other users have developed small gifting economies, cultivating and donating worms peer-to-peer. As one such individual put it, “I give it away for free at no cost. I just give it to people” (personal interview, 2017). These networks are often small and proximate, usually only sharing worms amongst friends and family. Sharing via the Internet does occur, but it has proven limited. These so-called “gut communes” often develop their own standards for membership, requiring sharers to publish their means of self-cultivation and disclose their HIV status. (Vendors also commonly do both.) Some helminthic therapy users, however, worry about the safety of parasites cultivated within these collectives and oppose such sharing. The safety of helminthic therapy depends on dosage - the number of worms ingested. For this reason, some individuals refuse to obtain worms from anyone other than a well-established vendor. As the crowdsourced Helminthic Therapy Wiki warns, “there are risks attached to accepting larvae from a private grower” (2019). For vendors, proving that you can accurately count eggs under a microscope (and thus secure against the perceived and actual threat of overdose) has become essential to ensuring the value of your worm stock. Even self-cultivators will freeze excess eggs or fecal matter, to kill their larvae and ensure that worms thrown in the garbage can not spread in the wild.

Some scientific researchers, however, insist that unregulated do-it-yourself (DIY) helminthic therapy is inherently dangerous. Live worms, they claim, will never be safe. As one researcher explained, using live worms “is a bad idea for several reasons...[Parasites] are not

benign organisms. [Parasites] cause serious pathology and have to be monitored under very carefully regulated circumstances” (personal interview, 2018). In response, research is underway to remove the worm from helminthic therapy altogether. These researchers believe the future of autoimmune disease treatment lies with synthetically manufactured drugs that mimic the compounds worms secrete during infection (Helmsby, 2015). The eventual goal is to develop a pharmaceutical product or drug modeled on the *biological mechanisms* of helminthic therapy. Naslund’s interviews revealed that most DIY users, however, are skeptical of this research direction. The biomedical establishment failed them before, they feel. Now they worry Big Pharma will capture, enclose, and deprive them of helminthic therapy. Such a drug, they argue, would make something that is currently relatively cheap or free much more expensive. After all, pharmaceutical products, unlike worms, can be patented.

As researchers have worked to isolate the compounds responsible for calming host immune system attacks against parasites, they have encountered other potential avenues for capital accumulation. Research is currently underway to see whether hookworms might provide the base for a new class of antibiotics. Hookworms burrow into the intestines of their hosts for years, exposing abrasions to fecal matter and other microbes without ever producing infections. As one researcher explained the thinking, helminths “must be controlling the bacterial environment in their vicinity, because theoretically, you should be making the person more prone to bacterial infection, but it’s the opposite” (personal interview, 2018). While research remains preliminary, a recently published study identified an antibiotic compound in soil-dwelling nematode worms (Pantel et al., 2018), distant relatives of those worms used in helminthic therapy.

Worlds in the Making

Each of these world-making projects responds to the world diagnosed by David Strachan and his acolytes. The hygiene hypothesis flips previous thinking on its head, reconstructing the *lack* of parasites as a threat to capitalist ways of life. It reconceptualizes parasites (and, more specifically, a moderate number of particular species of worms living inside each human) as an ecological underground – not explicitly valued or commodified but a condition of possibility for a range of sources of capital accumulation. In so doing, it argues for a world in which parasites are not removed from the body, but rather re-introduced to it. Individuals suffering from severe

allergies and autoimmune disorders do not make healthy humans or productive workers. The problem of life and (non)value under capitalism must be solved anew.

Though born from the same hygiene hypothesis, each of these potential world-making projects adopts a different orientation between worms, humans, and (non)value. Online retailers and DIY helminthic users officially value helminths as commodities to be bought and sold. The worms present a steep price to many, but the use value they present in terms of (self-reported) health merits the high cost. Though the grey market of worm commerce presents the most public and likely largest segment of the helminthic therapy bioeconomy, worms are oriented in many ways beyond commodity. Self-cultivators and gift economies both aim to decommodify worms, gifting and sharing them at no cost beyond the social price of knowledge and intimacy (e.g., HIV status disclosure). Within these DIY spaces, we can understand parasites from both capitalist and non-capitalist vantages. On the one hand, gift economies orient worms as a capitalist underground. Parasites become a biological commons that individuals or communities share. Parasites, and the immune system modulation they prompt, recapacitate people who had previously been unable to work. People once unable to get out of bed can now commodify their labor. Health is wealth. Like bee pollination and industrial agriculture, parasites provide an ecosystem service and thereby make capitalist life possible. On the other hand, as with all social reproduction under capitalism, commoning sustains not just capitalist relations but all human life. In this way, helminthic therapy both supports *and* exceeds capitalist relations. Helminthic therapy users do more than sell their rehabilitated labor power. While helminthic therapy as a practice and industry remains relatively small in size, parallel tensions exist between capitalist orientations (e.g., worker productivity and profit) and non-capitalist orientations (e.g., health, wellbeing, a good life) in, for instance, the Paleo diet and other Silicon Valley-inspired biohacking (Leiper, 2017), Wal-Mart employee “self-improvement” campaigns (Tveten, 2017), and socialized medicine (Fine, 2018).

Medical researchers conducting clinical trials also officially value parasites. They purchase living worms to use as experimental inputs. Officially valued, commodified, and traded, these worms become, for researchers, a clinical tool. Researchers write parasites into their budgets, buying them from vendors or cultivating them in the lab from donated feces.

Helminths in general, however, have become a reserve army of future exchange value and profit. Indeed, within the field of environmental conservation, a growing movement has

called for the conservation of parasites, jump-started by Donald Windsor's evocative call for "Equal Rights for Parasites" (1995). Within this discourse, parasites represent a wealth of understudied and untapped species biodiversity. Almost every plant and animal on earth has its own parasites. Little is known about what potential benefits parasites may have for their hosts, ecological neighbors, or biotech companies. This future wealth might come in the form of intact organisms, synthesized proteins, or antibiotics developed through biomimicry.

Researchers seeking a synthetic alternative, however, see parasitic worms as inherently pathogenic, as ontologically oriented to threaten human (capitalist) life. They aim to make a commodity devoid of its liveliness, a commodity less likely to reorient itself away from the circuit of patent, profit, and capital accumulation. As Goldstein and Johnson argue, biomimicry itself "produces 'nature' through the well-worn logics of resource enclosure and privatization" in its reorientation of "nature as intellectual property" (2015: 61). While self-cultivators also acknowledge the threat of live worms reintroduced into the wild, they reorient these worms from threats to waste by freezing and killing excess larvae before disposal. DIY users see researchers as too fixed on the construction of parasites as a threat. They see drug development not as some beneficent reorientation of the parasite away from threat but as an insidious effort to eliminate their commons in three steps: substitute the unruly non-commodifiable agency of worms with a controllable and scalable synthetic; enclose the parasite as intellectual property; and outlaw its unpatented, unregulated existence.

Conclusion

Helminthic therapy is a field still wildly at play, messy and undetermined, multiply and even contradictorily oriented. The long history of helminth eradication, the equally deep associations between helminths and harm, helminthic therapy's liminal legal status, the desperation as well as discord among autoimmune sufferers and worm users, and the vital agency of hookworms themselves all entangle to produce multiple orientations within this web of humans and helminths, life and (non)value. At times, these orientations co-exist. At others, they compete. We offer the framework of orienting as one approach to understand resource-making as world-making. As multiple actors (re)orient themselves to worms and (re)orient worms to value, they spin into being whole worlds, whole ways of organizing social and biological life. Sara Ahmed describes orientations as "paths well trodden" (2006: 16). In the case

of helminthic therapy, some paths are more trodden than others. Some paths carry the power of law or corporate might. Some paths resist. Other paths cut entirely new lines of flight. The future for worms and humans remains uncertain. By offering our multiple diagnosis of this messy present, however, we hope to grow our shared analytical capacity to read and hear and tell stories of resource-worlds not yet written.

This complex case, we argue, carries several key insights for critical resource geographers and allied scholars of capitalist nature. First, as Collard and Dempsey (2017) argue, orientations are dynamic. They can change slowly or precipitously. An entirely new orientation can take hold or, as we illustrate here, multiple, conflicting orientations may compete or coexist. When a resource is commodified, it is never simple. Logging might assign capitalist value to some trees, but such valuation does not preclude other relational orientations toward trees. Trees continue to be valued as habitat, as CO₂ sinks, or for their aesthetic beauty. By examining the birth of the helminthic therapy bioeconomy through the lens of multiple orientations, we can see the instability of resource creation and capitalist enclosure. Following Gibson-Graham (1996), capitalist relations are partial and mutually vulnerable, interpenetrated by non-capitalist relations. “[B]odies move or are moved through [orientations] and even the orientations themselves may change” (Collard and Dempsey, 2017: 94). Rather than seeing the world as divided between capitalism and everything else, this approach makes visible the multiple and dynamic worlds that are made possible through different orientations.

Second, we demonstrate how nonhumans play a vital role in (re)orienting life and (non)value, co-shaping with other actors and forces their existence as resource, waste, underground, or otherwise. Worms are not a passive resource, used and molded by human whim (Bakker & Bridge, 2006). Worms actively shape those paths taken and not taken within helminthic therapy. Worms’ liveliness frustrates the efforts of biomedical researchers while simultaneously offering important insights. Worms’ life cycles make peer-to-peer gifting risky. Worms commingle with human immune responses to produce benign or null effects, shifting both use value and exchange value. As lifeforms that can themselves move, infect, evolve, worms can be simultaneously cure and poison, valued and threat.

Finally, parasitic worms push us to extend Collard and Dempsey’s framework of orientation, life, and (non)value. We argue that, at least in the case of helminths, but likely in the case of other “companion species” that entangle human and non-human ways of life (Haraway,

2003), human and non-human orientations are relational and dialectically interdependent. Helminthic therapy is inherently relational. There is no parasite without a host. Value depends on non-value, not-yet-value, anti-value, and vice versa. Different worms become (non)valued because different humans become (non)valued, and vice versa. Early-twentieth century eradication campaigns in the US South oriented parasites as threats precisely because US racial capitalism demanded productive White workers. Present-day campaigns in the Global South adopt a parallel logic, enrolling eradication efforts within projects of economic development. Today, helminthic therapy promises to recapacitate the sick. By contrast, gifting economies (re)orient worms as a biological commons, emphasizing human life over labor. As one user professed, sharing worms is simply “completing your biome” (personal interview, 2017). Parasites are valued because of the value assigned to their hosts, which is in turn dependent on the lively workings of parasites themselves.

Helminthic therapy, in all its orientations, reminds us of the relational nature of life, as well as the far-reaching networks of valuation within which so many ways of life and lifeforms are tangled. Commodification extracts and abstracts resources from their broader context in order to assign them value. Yet, as we have shown, this is not the whole story. By considering (non)value itself as also relational, we argue that critical resource geographers can more consciously attend to the ways in which resource-making is always also a process of making and unmaking many worlds.

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