



Shimmering Presences

Frog, Toad, and Toxic Interdependencies

Attending to the present moment implies, necessarily, understanding that the present we move through—a perpetually shifting bubble-node that we cannot fully grasp but that simultaneously is the only thing we can experience—is a reliquary of the past, holding traces of everything that has happened and everything that has been erased. The present is also necessarily a continually receding seed for the future. Whatever happens *now* shapes the conditions for what can happen in any given *then*. This quality of the current moment is beautifully if terrifyingly manifest when we think about toxins, pollutants, and, as I explore in chapter 4, nuclear by-products with half-lives that stretch beyond our capacity to understand their scope. The things we experience now as toxic dangers are often the remnants of past innovation—the DDT that cleared mosquitoes later producing cancers and fragile eggshells, bedbug resurgence, and so on. We are now producing and consuming things that later will, if history is any guide, sicken and kill us and others. If we live that long.

In this chapter, I think of the present situation as *interdependent*, manifesting a kind of toxic connectedness. I forecast here a network of understandings of interdependence that I will unpack further in chapter 6, where I argue for disability interdependencies as a key for crafting different futures. There, I draw on certain Indigenous, Buddhist, and disability-theory conceptions of interdependence. For the purposes of this chapter, I am relying on a smaller-scale notion of interdependence. Here I understand this concept to mean that feature of our organic life such that we are physically constituted through the stuff of the world. We are coconstituted and in that sense interdependent, made up of the materials around us. Such literal interdependence is

perceptible in thinking about the ways that substances we call toxins cross barriers, shaping current bodies and predicting future embodiments when they affect reproductive possibilities. In this chapter, I take an approach to the toxic present grounded in conceptions of queer relationality. As Samuel Delany and José Esteban Muñoz have helped me understand, queer practices of relationality are also practices of temporality—being in the present with a relation to the past and future offset from the normalizing progression of both subject formation and the accumulation of capital as an always-increasing progress narrative. Mel Chen, another keystone for this chapter, frames queer and racial temporalities as “a kind of shimmering presence. They are less easily bound to capital or to any other regimented time; or perhaps we could say that the time of capital is also no longer in the form it might once have been” (Chen, 219). In this chapter, I work with the shimmering presence of the present with an eye toward the possibility of different futures—a notion I discuss more in Part III of this book. The title of this chapter also intends to invoke a culturally specific memory of the Frog and Toad children’s books—cross-species friends, probably queer, with very different characters, anthropomorphized through their suit-wearing, cookie-eating, kite-flying behavior. For me, reading Frog & Toad stories as a kid predicted my assumption that anurans—frogs and toads—are interesting and friendly.

Now an adult, I doubt that anurans are friendly (or unfriendly)—they aren’t, I think, registering on affective scales I can understand, though we can be in relation to one another, with attention. But the stories we tell about them continue to be interesting. I will attend both to the tropes of gender-bending or disabled amphibians and to their actual bodies and lives. I will argue for a queer disability attention to the toxic present as a kind of responsibility. Anurans have, over the last ten years, been frequently held up as warning signs for biological dangers inherent in many of our practices around food, climate, and mining. Industrial production, of corn or petroleum or most anything else, has significant effects on the world around it. As I’ll explore below, one of the main ways people argue that these effects are too harmful to justify current production practices evokes gender and disability danger; humans, the warning goes, will be born disabled, queer, or genderqueer if we continue using or producing certain substances. And the way we know this, the narrative continues, is that frogs and toads are being born with bodily anomalies including ambiguous genitalia, changed

voiceboxes, extra limbs, and more. My agenda here is not to argue that we should not be worried about toxins and their effects—worry and anticapitalist action are both, I believe, at least justified and perhaps necessary. Rather, I argue that we ought to cultivate practices of responsibility for the toxic present we are implicated in creating that do not rely on antidisability or trans-hating tropes and that simultaneously do not attend to anurans merely as indicator species. Further, practices of perceiving interdependence may nourish an ethical relation to complex ecologies in which we are implicated and through which we are formed.

The chapter begins with a description of the context in which I started thinking about anurans—a small mining city—as a way to ground my discussion of the more general issues involved in this area. After that, I give a reading of Mel Chen’s understanding of toxicity, attending to their account of the queer relationality we might find in toxic interdependence. I then examine two sites: first, a controversy around the herbicide Atrazine, exposed as a danger by biologist Tyrone Hayes, and second, practitioners of what Anna Tsing has called “arts of noticing on a damaged planet”—civilian/amateur naturalists who attend to their local environments and who model ways of being connected to anurans and our mutual ecologies. To conclude the chapter, my guide is poet and field naturalist Jim Maughn, an old friend who has taught me a lot about what it means to notice the world as a practice of responsibility.

Toxic Contexts

For five years, I lived in Sudbury, Ontario, Atikameksheng Anishnawbek land. Classified for purposes of auto- and industry-emissions standards and urban-rural hierarchies as “The North,” Sudbury is both far and not far away from big cities. A five-hour drive up a two-lane highway from Toronto, Sudbury feels further. You see the smokestack of the main mine’s smelter while you’re still miles away, driving into town. Sudbury is very close to all of us, though: home to the second-largest nickel-mining operation in the world, odds are that at least some of the metal in my computer, your phone or stainless-steel sink, the wiring in the walls, is Sudbury nickel alloy.

Smelting is toxic, any way you do it, and because Sudbury is among the longest-running mines in the world, the land, water, and air there bear the traces of more than a hundred years of industrial offcasts. This is true for any mining town, but it is more layered there simply because of time; most

mines tap out after thirty or forty years. In Sudbury, we tested the ground before planting anything in it that we might eat, before letting babies play in the dirt. The water in the lake in the middle of town, the primary sources of drinking water for the humans of Sudbury, takes in runoff from a parking lot on its edge made of slag fill—mining detritus gradually leaching copper, nickel, arsenic, lead, manganese, and other metals into the lake's ecosystem. People there generally avoid eating bottom feeders, as they bioaccumulate parts of the slag runoff. Acid rain, that relic of the 1980s, was “discovered” in Sudbury. Creeks, lakes, and watersheds bear the imprint of still-significant acidification, and acid-water environments alongside potentially toxic trace metals shape the situation for all the inhabitants of the area. Rocks that were pink and sandy-white before industrialization, shot through with quartz, now are charcoal-black, and animals and fish carry biologically (temporarily) secured deposits of various elements. Blueberries, which happen to like more acidic soil, grow in profusion in northern Ontario. Parts of the ground are crusted with a kind of black bubbling coat, and what vegetation grows in those parts is sparse, perhaps a response to the products of smelting carried in the air and water, perhaps a legacy of widespread clear-cutting during the period when the area was a major source of lumber. I lived in the part of town where everyone knew “the air was bad”—more often downwind from many of the mines, even with the “superstack” that diverts more of the by-products of smelting higher into the atmosphere than the old, shorter stack used to. I went running on trails through land owned by the mining company, passing through alternating patches of verdant life and gray ground in which little grew. My chemical reactions and nickel allergies amplified in that place—I was very sick often, kind of sick a lot, tired almost always. This is one way that interdependence manifests: the places and ways we live show up in our bodies as sickness and health.

Sudbury also bears the marks of struggle, and one of the wonderful things about living there was the experience of seeing how people who care about the world they're in can shape it against the imperatives of capitalist depredation. A periodic queer women's party was called “Super Stacked,” the flyers modeling a hot, curvy woman alongside the phallic main smelting stack, its plume of smoke—which in real life is visible at a great distance from town—drifting off. Workers' struggles, smuggling air-testing kits into the mines in their lunchboxes and taking action based on the data they gathered, provided key footholds in early workplace safety legislation (Steedman, Suschnigg, and

Buse 1995). Thirty years ago, the landscape in Sudbury was denuded; vegetation hardly grew, a response to what one report calls a “multiple stressor” environment. An often-told story says that the people preparing for the first Moon landing walked first in Sudbury, to get a visceral experience of what walking in a place without living things felt like. Now there are trees and bushes, and when you go out walking you can see the effects of years of people scattering alkalizing lime powder with their hands. The lakes aren’t dead anymore; the air is breathable though sometimes sulphurous. These changes are traces of activism and sometimes of social movements—those miners carrying air-quality-assessment test kits secretly underground, working-class people who wanted to be able to hang laundry outside without it getting coated with black sticky something, other, often immigrant, ordinary people taking political action about lakes that had lost all their fish, liberal environmentalists with good intentions, scientists in the very early days of understanding the effects of industrial off-products, and others. People are justified in lifting up and honoring the work that every clear-ish stream and every green tree manifests. Another way of understanding interdependence.

Perhaps especially since leaving I have begun to think through some of my experiences of being constituted in and with the material situation of Sudbury as a kind of interdependence. Five years living there shaped my consciousness, perhaps permanently, of being a product of what Anna Tsing calls “contaminated diversity” (Tsing 2015, 33). As she argues, “Everyone carries a history of contamination; purity is not an option” (27). I follow Tsing in understanding contaminated diversity to require us to attend to stories that are not easy tools for knowing the world. As a relational condition, contaminated diversity might unsettle us; Tsing argues that it is “complicated, often ugly, and humbling.” She continues:

Contaminated diversity implicates survivors in histories of greed, violence, and environmental destruction. The tangled landscapes grown up from corporate logging reminds us of the irreplaceable graceful giants that came before. The survivors of war remind us of the bodies they climbed over—or shot—to get to us. We don’t know whether to love or hate these survivors. Simple moral judgments don’t come to hand. (ibid.)

We all participate in situations and worlds unavailable for simple moral judgment; attending to stories about the effects of substances, lively though

inert substances, that change bodies and ecosystems but are useful or needed, opens one way to form more adequate ethical judgments.

The multiple lively substances that shape the conditions for existence in Sudbury are, in aggregate, almost certainly more harmful than not. There are, people told me, cancers that show up in the lab and in Sudbury—I carry the effects of those years in my body, maybe to come to fruition later. Such effects matter, and having better ways to think of that mattering is important. Now that I live in a very “clean” city, I think such thinking is perhaps especially important for those of us who can live further away from the depredations of capitalist production, those of us who might imagine that there is a raw substance existing before or beneath its incorporation into systems of exchange. Once living in a place where the effects of mining and clear-cutting are present and obviously involved in people’s lives has shifted my experience of *not* directly experiencing the production of products I still buy and use. Being against purity, as I think about the effects of mining and clear-cutting in Sudbury, involves recognizing that even if we live in a city where the air does not make us sick, we are still implicated in the air, land, and water of contaminated places.

As I discussed in chapter 1, colonialism is centrally a practice of dispossession and displacement—land is expropriated and pollution is distributed. “Clean” cities achieve their status in large part through downloading the effluents and excreta they require into other places and other bodies. This is global: Sudbury, for example, “cleaned up” its air through building the main stack higher alongside adding more “scrubbers” to filter the smoke produced in smelting. Pushing the stack higher sent the off-gasses further into the atmosphere, leaving the area near the stack (the city itself) cleaner at the cost of sending the unwanted substances on to other places. And scrubbers that capture some of those substances on their way out of the stack also must go someplace—the substances exist, whether they’re in a part of the atmosphere higher up than we breathe or captured in a filter, and so it’s just a question of *where* they exist. Purity in this context is a fiction, and one tracking a decision about how to store and host pollution, and who will bear the effects of that decision. Coconstitution poses a perpetual problem, a struggle: if we want things made, in this example, out of metal, how will we determine the distribution of harm involved in its production? In an impure world, interdependence will always mark a site for struggle.

Toxic Presents

Let me turn to frogs and toads as a node for unpacking the idea of interdependence as a site of struggle, starting again with Sudbury. There is a long and fairly big creek there: Junction Creek. Appropriately though unimaginatively named, Junction Creek connects many smaller towns that were forcibly amalgamated during state austerity measures in the 1990s that aimed to reduce government spending and that now make up the city. There is a small civilian activism committee that has taken stewardship of the creek, with activities including creek cleanups, fish releases, and lobbying for watershed-related policy changes at city council. They are not a particularly radical group, nor queer, and they don't have a sharp analysis of interlocking oppressions. They have a project called "FrogFind," which, as they say, "encourages local Citizens to take an interest in the amphibian life present throughout Greater Sudbury." Their aim is to protect "frogs and toads" (anurans), but interestingly—in a way that may seem at first pass very simple—the activity we could take up if we lived there and took an interest would be learning the calls of frogs and toads, and reporting their prevalence based on these calls. I will return to this kind of project in the section below on naturalism.

On one hand, the FrogFind project simply (and obviously) uses frogs and toads as indicator species. They are understood as beings immersed in water, therefore in chemical soups, membranous, obviously (and, the implication is, more than we are) experiencing what Nancy Tuana calls "viscous porosity" (Tuana 2008). Amphibians are framed explicitly as useful for telling us something about situations we cannot see or understand, if we can access that telling through a dispersed network of dog walkers, smokers out for a quick one, and joggers willing to pause and take off their headphones who later input data into an online survey. Amphibians' function here as an indicator species is not only human-centric (and putting them in an instrumental relation); it to a certain extent ignores that they are their own beings with their own worlds, differentially taking in the toxic load we create and distribute. And yet because of the differential distribution of chemical harm, surely also we who cause that harm ought to track it. Further, the people who take up this work take it up as a noninstrumental kind of joyful attention to the world they are in—a mode of attention that manifests also when people are not formally involved in FrogFind, but just spending time near water—fishing, walking, sitting on the deck. This is an extremely specific

and local example, and honestly in the context of how deeply messed up the land and water of Sudbury are, it feels very minor. But read in a bigger context, the situation in Sudbury and the attempt to access and understand it through amphibians and their voices is part of an interesting shift in understanding our connection with the impure, toxic world.

As Mel Chen has compellingly argued, toxicity offers a usable case study of a mode of being in which it is not possible to stably distinguish between the experiencing subject and some imagined ontologically separate “other” that affects the subject. As Chen points out, “There seems to be a basic semantic schema for toxicity: in this schema, two bodies are proximate; the first body, living or abstract, is under threat by the second; the second has the effect of poisoning, and altering, the first, causing a degree of damage, disability, or even death” (Chen 2012, 191). This is intuitively compelling as a schema, constellating as it does a conception of bounded individuality requiring defense from outside pollutants and purification of the toxins already taken on. The model of separable bodies—one affected, one affecting—is insufficient for understanding the kinds of coconstitution Chen has in mind. Instead, we might engage “toxicity as a *condition*, one that is too complex to imagine as a property of one or another individual or group or something that could itself be so easily bounded. . . . How can we think more broadly about synthesis and symbiosis, including toxic vapors, interspersals, intrinsic mixings, and alterations, favoring inter-absorption over corporeal exceptionalism?” (197). Animacy theory, as Chen unfurls it, allows repeated iterations of this move from delimited-though-affecting-and-affected bodies to an understanding of multiple, mutually shaping complex conditions. Both the material and social ontologies we engage are marked by constitutive interpenetration.

Eula Biss connects the wish to dissociate ourselves from that which we call toxic to an earlier attention to regimes of defense against filth. She writes:

Where the word *filth* once suggested, with its moralist air, the evils of the flesh, the word *toxic* now condemns the chemical evils of our industrial world. This is not to say that concerns over environmental pollution are not justified—like filth theory, toxicity theory is anchored in legitimate dangers—but that the way we think about toxicity bears some resemblance to the way we once thought about filth. Both theories allow their subscribers to maintain a sense of control over their own health by pursuing personal purity. For the filth theorist, this

meant a retreat into the home, where heavy curtains and shutters might seal out the smell of the poor and their problems. Our version of this shuttering now is achieved through the purchase of purified water, air purifiers, and food produced with the promise of purity. (Biss 2014, 75–76)

I agree with Biss and Chen that the discourse of toxicity attempts to secure a rhetorical space for individual purity that would allow us to imagine that we can succeed in not being altered and shaped by the world. The practices that come out of this—in the overdeveloped world including all the filtration money can buy—replicate the redistribution of externalities away from some bodies and toward others. Rich people have an easier time enacting the kind of redistribution or avoidance of poison in their bodies than poor people. But, as Chen and Biss help us understand, these practices are temporary and illusory; we cannot in the end be separate from the world that constitutes us. Corporeal exceptionalism cannot be sustained because inter-absorption is the way things actually are.

Where do we find normative guidance for orienting ourselves toward meeting the future organisms we are becoming in coconstitution with complex ecological situations that range from pH-altering elements in the rain to the slag heaps of nickel mines to endocrine-disrupting compounds in our waterways?¹ What approaches might we take that do not revert to anti-disability or human-centric political orientations? Whatever answer we give, it cannot rest with some wholesale approval of pollution, contamination, or toxicity. Whatever answer we give, it has to reckon with the differential distribution of harm. Whatever answer we give, it should not treat frogs and toads as mere indicators, or as mattering only because of human concerns. Chen's conception of toxicity helps me think about this problem. I agree that we can

in a sense, claim toxicity as already “here,” already a truth of nearly every body, and also as a biopolitically interested distribution (the deferral of toxic work to deprivileged or already “toxic subjects”). Such a distribution, in its failure to effectively segregate, leaks outside of its bounds to “return,” and it might allow a queer theoretical move that readily embraces, rather than refuses in advance, heretofore unknown reflexes of raciality, gender, sexuality, (dis)ability. In assuming both individual and collective vulnerability, it suggests an ulterior ethical stance. (Chen, 218)

The *ulterior* here signals forms of knowing and being not articulate but often obvious; weighty and dense node points that shape and inform the space around them. Understanding vulnerability as not something we must (or can) defend against, but instead as a constitutive fact of our lives, a world-shaping mattering, offers us something. Chen argues that “thinking and feeling with toxicity invites us to revise, once again, the sociality that queer theory has in many ways made possible. As a relational notion, toxicity speaks productively to queer-utopian imagining and helps us revisit the question of how and where subject-object dispositions should be attributed to the relational queer figure” (207). Central to formulating an ulterior ethical stance, a subject-object variable orientation, we might adopt queer practices of relationality. Such practices turn aside from narratives organized around an expected line of descent, denaturalizing “fitness” and modeling something more interesting about what it might be to survive and thrive in disrupted landscapes. As I’ll articulate below, such practices might learn much from forms of loving attention to our proximal ecosystems and coinhabitants.

Atrazine, Hayes, and the Gender and Sexuality of Toxic Effects

Eva Hayward’s work informs how I think about one particular use that frogs have come to be put to in expressing one kind of response to complex and toxic coconstitution. Such responses are perceptible, for example, in media representations of biologist Tyrone Hayes’s work on the sex, reproductive, and voice-box changes in frogs exposed to the herbicide atrazine, which I discuss in this section. The fear evoked in these articles is primarily directed toward frogs as a different kind of indicator—a cohabitant of toxic worlds who might show us what sex and gender dangers we’re courting through our chemical habits. In a short editorial about sex-changing frogs and fish, Hayward writes: “Is there a way to re-evaluate ecological resilience—such as the sex-changing response—and meet the future organisms that we are becoming? . . . We are all in chimeric borderlands where new forms of life are emerging” (Hayward 2014). With Malin Ah-King, Hayward has articulated an approach to “toxic sex,” understanding “sex as an ongoing process influenced by endocrine disruptive chemicals, describing our shared vulnerability to one another; our bodies are open to the planet.” This dynamic and emergent conception of sex conceives of bodily response and “ecological resilience that reframes the toxicity without reasserting a politics of purity” (Ah-King and Hayward 2014, 2). Ah-King and Hayward compellingly argue

that we ought to understand “endocrine disruption as an unavoidable co-presence in the liveliness of organisms. . . . Neither utopic nor dystopic, toxic sex opens the realization that bodies are lively and rejoinders to environments and changing ecosystems, even when those same engines of changes provide exposure to carcinogens, neurotoxins, asthmagens and mutagens” (8–9). In this section, I connect this kind of approach to thinking about endocrine-disruptive compounds (EDCs) to the story I’ve been telling above, about Sudbury and its frogs.

A central claim in assessing the effects of toxins focuses on the harms of environmental racism, of the disproportionate distribution of pollution and carcinogens in racialized communities, is that their kids are born with disabilities and that adults are made disabled. This worry resonates with and is frequently supplanted with a complex queer-phobic worry that EDCs, especially herbicides, are making us, or imagined future children, queer or trans, or, depending on the document, influencing sex development so that there is a disproportionate number of females (of whatever species) born. A surprisingly hard-hitting investigative article into industrial pollutants and their effects appeared in the magazine *Men’s Health*. The article’s lead offers a warning: “On an Indian reserve in Canada, girls rule the day-care centers, the playgrounds, the sports teams. The reason: For the past 15 years, fewer and fewer boys are being born. It may be the leading edge of a chemically induced crisis that could make men an endangered species” (Peterson 2009). Low male birth rates, in this article and in others, are the flashpoint and a key indicator of danger—but also mentioned are “deformed rabbits and weasels scuttling through their woods” and air that the article’s writer can hardly breathe as she enters Aamjiwnaang. There are many reasons to write an investigative article about industrial pollution in this area, also called Sarnia—it is commonly identified as a “cancer valley,” for the carcinogens that leave the array of plants in the area. It is a case study for environmental racism, and for the specific genocide by industrial fiat that distributes poison in the water and foodways of Indigenous peoples on Turtle Island (Murphy 2013). And so it is notable that the hook for this piece, what the writer returns to over and over again, is not death, or pain, but rather a maldistribution of sex selection proportional to the norm.

Giovanna Di Chiro has compellingly argued that the focus of environmental activism against toxins recapitulates a limited conception of what will count as “normal.” She argues that

the dominant anti-toxics discourse deployed in mainstream environmentalism adopts the potent rhetoric that toxic chemical pollution is responsible for the undermining or perversion of the “natural”: natural biologies/ecologies, natural bodies, natural reproductive processes. This contemporary environmental anxiety appeals to cultural fears of exposure to chemical and endocrine-disrupting toxins as troubling and destabilizing the normal/natural gendered body of humans and other animal species, leading to what some have called the “chemical castration” or the “feminization of nature.” (Di Chiro 2010, 201)

Drawing on Eli Clare’s generative theorization of the interconnections among a class analysis, environmental activism, disability justice, and queer gender and sexual flourishing, Di Chiro notes that if you “scratch a liberal environmentalist and you might find polluted politics enforcing ‘eco(hetero)normativity’ lurking underneath; disability becomes an environmental problem and lgbtq people become disabled—the unintended consequences of a contaminated and impure environment, unjustly impaired by chemical trespass” (202). I agree with Di Chiro that the focus on supposedly inappropriate sex formation seriously occludes possibilities for appropriate response to environmental harms arising from the chemical context we inhabit. Like her, I turn to a consideration of a key chemical, and scientist, in this story.

Consider, then, the talk around atrazine. Atrazine is an herbicide, one of hundreds of kinds of chemicals currently in use in industrial food farming to tilt the scales toward the kinds of plants humans want to grow and eat and away from the plants classified as weeds or unusable. As Sandra Steingraber outlines in her account of the environmental conditions of cancers, atrazine (as a triazine herbicide) intervenes in a particular chain reaction of photosynthesis in non-grass-species plants. It is usable in industrial food production in part because species like corn, widely consumed by humans and the animals we feed to later eat, are less susceptible to its effects than other plants we call weeds. Atrazine, like other herbicides, is toxic because it is dispersed and taken up in water. Steingraber says,

Applied directly to the soil, atrazine is absorbed by the roots of plants and transported to the leaves. It poisons from within. Atrazine is thus water soluble. And because of its solubility, it tends to migrate to many other places. . . . Atrazine-sprayed fields are leaky fields. And atrazine’s capacity to inhibit photosynthesis does not stop once it leaves the farm. It has demonstrated a remarkable capacity

to poison plankton, algae, aquatic plants, and other chloroplast-bearing organisms that form the basis of the whole freshwater food chain. . . . Once it enters the water cycle, atrazine becomes a component of precipitation, so that raindrops themselves are now laced with a chemical that possesses the wily ability to blow up chloroplasts. (Steingraber, 157)

Much of this is true of other herbicides, and the fact of solubility and wide dispersion of chemicals is true also of many pesticides. For example, think of the widely used pesticide permethrin, which has been around since 1979 and is now infused in much sport and outdoor clothing as well as military uniforms. These clothes usually carry a warning label to not allow contact between the clothing article and any water systems because of the chemical's toxicity to marine invertebrates, bees, and amphibians (and, when wet, felines)—but they never explain how wearers of the clothing are supposed to launder it without sending permethrin out into the water system. Atrazine, however, has become a more well-known flashpoint than its siblings largely because of the efforts of scientist Tyrone Hayes.

Hayes is a biologist whose work focuses on how steroid hormones may effect the development of frogs and toads; he has become well known as a result of a more than fifteen-year-long dispute with the agricultural chemical firm Syngenta about the question of whether atrazine (one of its products) creates environmental conditions that affect frogs' reproductive capacities. Hayes argues that his research shows that atrazine affects the voice box of male frogs, leading them to have difficulty signaling their availability for mating, but more directly that atrazine affects their gonadal development. As Hayes writes on his website: "My laboratory showed that the herbicide atrazine (the number one selling product for Syngenta) is a potent endocrine disruptor that chemically castrates and feminizes exposed male amphibians at low ecologically relevant concentrations" (Hayes, n.d.). Syngenta argues that there is not sufficiently rigorous scientific evidence for these claims, and the company has spent years attempting to discredit Hayes's work (*Democracy Now!* 2014; Aviv 2014). There is a lot to say about the conflict between Syngenta and Hayes that I will not address here, including a complex story about the ways that racialization, science research culture, and graduate student funding structures have shaped the narrative. As a Black man at an elite but public university who speaks about the conditions in which primarily people of color are exposed to herbicides, Hayes is complexly positioned

in relation to these things. He has performed and emailed explicitly rap-influenced and confrontational communiqués to Syngenta employees that have been responded to in quite racist ways. Here, I focus on the substance and rhetoric of the claim that Hayes is making: that these chemicals cause feminization in frogs, and that they may have the same effects on humans.

Consider the language in an interview with the news program *Democracy Now!* Amy Goodman, the program's host, asks: "And, Professor Hayes, talk about exactly what you found. What were the abnormalities you found in frogs, the gender-bending nature of this drug atrazine?" Hayes answers:

Well, initially, we found that the larynx, or the voice box, in exposed males didn't grow properly. And this was an indication that the male hormone testosterone was not being produced at appropriate levels. And eventually we found that not only were these males demasculinized, or chemically castrated, but they also were starting to develop ovaries or starting to develop eggs. And eventually we discovered that these males didn't breed properly, that some of the males actually completely turned into females. So we had genetic males that were laying eggs and reproducing as females. And now we're starting to show that some of these males actually show, I guess what we'd call homosexual behavior. They actually prefer to mate with other males. (*Democracy Now!* 2014)

The set of assumptions at work here about what threat we face are not spelled out, but they come up over and over. They rest on the idea that there is an uncontaminated, pure, natural state that is being affected by artificial chemicals. On this account, we see the effects in the harms manifesting in frogs: first, feminization, and then, homosexual behavior. As one 2011 public radio program puts it in an introduction to the situation, "Scientists are continuing to sound the alarm about some common chemicals, including the herbicide atrazine, and link them to changes in reproductive health and development. Endocrine disrupting toxic chemicals have been found to feminize male frogs and cause homosexual behavior. Ashley Ahearn reports on how these substances may be affecting human development and behavior" (*Living on Earth* 2014). I am tempted to quote the entire transcript of these episodes of *Living on Earth* and *Democracy Now!* because they so richly illustrate a very troubling approach to depicting the relations among frogs and humans, gender and disability—but let me just pick out a few key points.

Consider Goodman's framing of atrazine as a "gender-bending" chemical. Now, Hayes's research is on frogs. Frogs may have social relations that we understand as gendered, but certainly those relations aren't the same as human gender enactment. As Bailey Kier notes (speaking of fish in the Potomac River): "'Transgender fish' are transgender only because we signify them as such culturally, and this signification disrupts clear distinctions and an imagined knowledge progression of the categories of sex, gender, and sexuality" (Kier 2010, 304). Sexuality, and homo sex, certainly has various things to do with gender (in humans)—but if the finding is that frogs are feminized, and "completely turned into females," it is not clear how or why we should understand the sex they're having with male frogs as homosexual. And while we may all, frogs and humans alike, experience these chemicals and respond to them in predictable ways, the meaning of that response may well be different depending on whether we exist in frogly or humanly ways.

The "Living on Earth" segment extends some of the worrying tendencies of the DN! dialogue with a discussion of not only the supposed gender and sexual effects of atrazine but also the threat of disability. The host again introduces this shift, beginning with a comment from Hayes:

HAYES: People go, well, it's frogs. I go, yeah but look, the estrogen that works in this frog is exactly, chemically exactly, the same as the estrogen that regulates female reproduction. Exactly the same testosterone that's in these frogs regulating their larynx or their voice box or their breeding glands or their sperm count is exactly the same hormone in rats and in us.

AHEARN: So, what about us? Could endocrine disruptors be having feminizing effects in humans? No one knows for sure, but some believe that rising rates of one birth defect could be an indicator. (*Living on Earth*)

The program goes on to interview a pediatric surgeon who performs surgeries on children diagnosed with hypospadias, in which the urethral opening on the penis emerges along the shaft of the penis as well as, and sometimes instead of, emerging at the tip. Hypospadias is one of the most frequently performed operations to change or—in most surgeons' terms—"correct" where the urethra emerges in any given penis. Intersex activists have identified hypospadias as one of a number of often-unnecessary surgeries performed on babies and children. For most people the condition is not harmful at all, carrying the "threat" simply of needing to sit down on a toilet rather

than standing to urinate, or needing to clean the penis along its shaft perhaps more carefully than in nonhypospadias bodies. This threat is, of course, a gender problem manifesting in the practices of bathrooms, where what it means to be a man can come down to standing at a urinal rather than sitting on a toilet. For most people, the physical condition of hypospadias is, then, not a threat at all; hypospadias is a threat only because of the social conditions that monitor and punish people's use of bathrooms. So it is notable that the radio program moves from framing the dangers of atrazine to frogs around sexual and sex dysfunction to hypostatizing, or rendering as the material and direct cause of, danger to proper penis formation. Here, again, note that the dangers held up, the reasons we are hailed to worry about atrazine, are that the supposedly deviant sexual formation and expression effects on frogs—sex switching or change to homosexual behavior in particular—might also affect humans.

Allow me to restate that Hayes—and indeed anyone who takes up his work on frogs and the effects of atrazine on their lives—is *not* a malicious person villainously deploying ableist, sexist, and queer-hating tropes to simultaneously drum up fear of trans people, disabled people, queers, and all the impurity we signal. Rather, there are two things that I believe structure this pattern in thinking about the harms of impurity: first, as I mentioned above, research funding structures have shifted, particularly in the United States, toward a particular metric of relevance that—unless research has military potential—to some extent relies on showing that the “ordinary public” cares about the issue the scientist examines. Since culture is so deeply imbued with oppression, and since people are remarkably prone to believing evidence that confirms their already-existing beliefs, it makes sense that research confirming views that are antitrans, ableist, homo-hating and so on would have popular uptake. At the same time, researchers of all sorts are able to direct their attention toward fundable areas, in a process that Jeff Schmidt identifies as cultivating “assignable curiosity” (Schmidt 2001). Schmidt compellingly examines the process through which professionalization shapes the lives and interests of people who go through graduate school and, perhaps especially in the case of research scientists, through postdoctoral programs. A piece of this, he argues, is the coproduction of “fundable” areas and scientists' interests. When companies or government agencies make their technical needs known, Schmidt finds that “scientists, through a process of self-adjustment, get interested in the appropriate topics” (57–58). This is not conspiracy theory,

but reflection on the implications of attaching research priorities to fundability. Also perhaps involved in this particular example is what Julie Guthman identifies as “problem closure,” or “coproduction”—a situation in which the investigation of a phenomenon uses tools or techniques that already presume much about the nature of the phenomenon, which then brings it into sharper existence” (Guthman 2011, 34).² As an endocrinologist and someone focusing on the hormone function in metamorphosis, Hayes was predisposed to notice hormonal shifts as they affect gonadal development in part through the directions of his curiosities and in part through the apparatus he has assembled through which to examine (and thus assemble) the world (Barad 2007). Consider the findings of scientist Rick Relyea, who has studied the effects of the herbicide Roundup on frogs. Relyea investigated the effects of Roundup on morphological shifts in tadpole developments in response to indicators that predators are present in their environment. Roundup (or perhaps the surfactant in it that breaches the cell wall of plants) seemed to cause tadpoles to develop larger tails, something they also do in the presence of dragonflies and newts (some of their predators) (Relyea 2012). Relyea and his team frame this in terms of “morphological changes” and “trait changes”—terms that could also be used, with different effects, to talk about the changes frogs and toads take up in response to atrazine. That is, a key difference between Relyea and Hayes, aside from the fact that Hayes has gotten much more airtime in popular and academic writing, is that Relyea’s research and findings focus on a different set of questions—morphology and function rather than hormone-intensive sex transformations—and thus his findings are structured by a less overdetermined set of political descriptors.

If we want to have more adequate understandings of the world, we need ways to talk about why atrazine and other chemicals used in industrial food production might be bad for us and the world that do not rely on the assumption that sexual bodily transformations, nonstraight sexuality, and disability are wrongs that must be avoided. The subtext of this discourse is that feminization or queerness are harms to be avoided and reasons to pursue noncontaminated waters and bodies. The logic here is that straight and non-disabled body formation—heterosexual practice and a hypostatized cis/gender-conforming body that lines up with current classifications of who is disabled—are the norm from which any form of difference deviates. If we want to pursue less-toxic interdependent worlds while simultaneously thinking that sex-changing bodies, queer behavior, and disability are great,

we need to have better ways to understand harm. Atrazine might still be very bad, a chemical in relation to which we want to avoid being coproduced. But the reasons for avoiding it or other body- and ecology-shaping chemicals cannot be read directly off of the fact of certain bodily transformations. Assessments that do the job better will rest on an embrace of the fact of interdependence rather than an attempt to avoid it. But within accounts based on an account of interdependence, we still need clear ways to understand and resist harm.

One way to think about harm is in terms of Ruth Wilson Gilmore's definition of racism as the differential distribution of group vulnerability to premature death (Gilmore, 28). This approach works well in thinking about who bears the effects of chemicals like atrazine and permethrin, as well as more conventional pollutants—the beings who absorb these things often being far away from those who make decisions to use them. In the groups made vulnerable to premature death, I would include the bees and the anurans along with the humans who are often migrant workers or communities of color downwind from industrial processing plants in the form of fields or factories. I follow Guthman in this, using her conceptualization of the body as a “spatial fix” of capitalism. Expanding on David Harvey's account of how capitalism addresses crises of overaccumulation through geographical expansion—moving the problems and externalities of production somewhere else—Guthman argues that in the current context, along with the soils, seas, and air, bodies (both human and animal) are absorbing much of capitalism's excess. . . . In effect, individual bodies are absorbing the so-called *externalities* of production processes, so that food companies most definitely do not have to pay the full cost of doing business. And then bodies became a site for commodifiable cures to the conditions and illnesses created through these foods and exposures.” She argues that “the body is wrapped up in the material processes of capitalism quite apart from the ‘decisions’ that human subjects make around production and reproduction. Rather, bodies as material entities are literally absorbing conditions and externalities of production and consumption” (Guthman, 182). Following Gilmore, we can understand that using the body as a spatial fix of capitalism unevenly distributes impurity, tending both practically and metaphorically to pollute supposedly already impure bodies. Racialized and Indigenous people bear the harms of being simultaneously a spatial fix for toxicity—living in polluted sites, breathing that air, drinking that water—and a metaphoric reservoir for pollutants.

Guthman's focus is on the problems with what I discussed in chapter 1 as "healthism"—the belief that individually we ought to manage our health to minimize or mitigate the effects of being immersed in the toxic soup that constitutes our everyday world. The idea that we can (or should) eat organic food, drink alkalizing water from personal water filters, or take up other practices meant to manage the effects of exposure to pesticides and herbicides is a version of an individualizing purity politics. Such an approach perpetuates the difficulty of perceiving how bodies are embedded in and fixed by the flows of capitalist production—in the cases I discuss in this chapter, the industrial production of food with all its side effects for anurans and for us. Healthism as a possible practice is heavily racialized; people who live at the site of multiple vectors of vulnerability have less possibility for individually managing their health to resist the structural context that produces premature group-differentiated death. We should, then, understand calls for personal responsibility for health as racist as well as classist, and deeply imbricated with the purity logics that delineate whiteness as a social location. Responses to the distribution of harm not based on healthism—particularly healthism in the form of naturalizing and transposing understandings of sex, sexuality, and disability in an attempt to mobilize action about herbicides and pesticides—may be more effective.

Sandra Steingraber's complex book, *Living Downstream*, which I discussed above, details a lot of what I am identifying as impurity, which is one way to think about coconstitution. Consider again Nancy Tuana's formulation of the production of "viscous porosity," a way of talking about what she calls *emergent interplay* (Tuana 2008, 189). Writing about what happened during and after Hurricane Katrina's effects on the Louisiana coastline and on New Orleans, Tuana examines the interaction between social relations, the levees, the sea, and more, on down to our cells. She frames the material interplay among these sites as a dance of interacting agency:

The dance of agency between human and nonhuman agents also happens at a more intimate level. The boundaries between our flesh and the flesh of the world we are of and in is porous. While that porosity is what allows us to flourish—as we breathe in the oxygen we need to survive and metabolize the nutrients out of which our flesh emerges—this porosity often does not discriminate against that which can kill us. We cannot survive without water and food, but their viscous porosity often binds itself to strange and toxic bedfellows. (198)

Tuana details the many ways we can perceive the toxic, polluted space that became particularly palpable in the friction of the storm—the superfund sites that may or may not have been breached, but also the long-lax regulations governing industrial pollution in what is known as Louisiana’s “cancer alley.”

Considering industrial offcasts (easily understood as pollutants) and substances like atrazine (a chemical framed as useful, harmless, and only in some contexts legible as harmful), we might find that they are more easily analytically than practically separable. As Tuana puts it, “There is a viscous porosity of flesh—my flesh and the flesh of the world. This porosity is a hinge through which we are of and in the world. I refer to it as viscous, for there are membranes that effect the interactions. These membranes of various types—skin and flesh, prejudgments and symbolic imaginaries, habits and embodiments” (199–200). Because of the ways materials in the world are taken into our body, the fact that there is always only a complex system that we name collectively “a human” becomes a little more obviously coconstituted.³

Unfortunately, this coconstitution becomes obvious because of effects that we don’t want—estrogen-responsive cancers, insulin resistance, and other effects. If we care about shifting some of those effects, *or* if we worry about framing nonstraight sex, gender, and sexuality as threats, we ought to attend more to harms that don’t happen to reinforce already entrenched social stigmas. Hayes’s work on hormone-intensive transformations, sex-selective response, and atrazine tells us a lot, perhaps much of it beyond the presentation of his work in the popular media. And Syngenta’s extraordinary efforts to discredit, defund, and defame Hayes could be a study in the forms of capitalist evil that distribute death to the many in the interests of profit for the very few. Even as I love the stand that Hayes has taken on atrazine, and stand with him against Syngenta, I would love more to see reasons for this stand that don’t recapitulate old narratives that, as Di Chiro frames it, “appeal to pre-existing cultural norms of gender balance, normal sexual reproduction, and the balance of nature. The deployment of the anti-normal or anti-natural in anti-toxic discourse is questionable political-ecological strategy and can work to reinforce the dominant social and economic order (the forces actually behind environmental destruction and toxic contamination of all our bodies and environments) by naturalizing the multiple injustices that shore it up” (Di Chiro 2010, 224). Next, I offer some paths toward more adequate responses to the human consequences of hormone-affecting additives through attending differently to nonhumans.

To the Frogs Themselves

In this chapter I have been raising concerns about the gender and sexuality tropes deployed to raise human alarm about the effects of products such as atrazine. Since scolding people for using oppressive examples rarely works to shift either examples or practices, I will focus on alternative approaches to the problem of toxicity in our shared ecologies. I argue that holding an ethical regard for anurans for themselves holds out promise for the rest of us. My touchstone here returns us to the Sudbury FrogFinder practice I discussed above: civilian naturalist practices of attention as a form of ethical response.

Jim Maughn took me on many walks and hikes when I lived in northern California, always showing me parts of the world around me that I was not capable of perceiving without his guidance. He is involved in one of the thousands of groups of people, more and less organized, on this continent who systematically observe their local ecosystems. Sometimes these groups are informal (hunters, farmers, gardeners); more often they are explicitly organized as civilian naturalists—observers of and carers for their proximal ecology. Jim is part of a formal project tracking the presence of designated endangered species in areas developers have applied to alter, work that involves counting members of those species. In order to count members of a species, you have to recognize them, and in order to recognize them Jim has developed a kind of attunement to the world that Tsing calls an *art of noticing* (Tsing 2015). I regard this kind of attunement as a rich resource for countering the dangers I have identified above: using frogs and toads as merely indicator species for potential human dangers and falling into harmful tropes around sexuality, sex, gender, and disability.

In a conversation with Jim, we talked about his love of amphibians, and how that love manifests in practices of noticing. He said:

I think that's kind of what all of my interest in learning things and learning the names of things and stuff like that is really, just about *seeing things differently* and they're somehow—learning what the Latin name for a particular thing is—sort of makes you see it differently. And, it, it stands out from the landscape in a particular way. I think because you start to notice the uniqueness of the creature, the uniqueness of the species . . . and so, the world comes into a sharper focus.

I read this kind of attention as a form of placing oneself in a community of other people who have cared enough to know about species and to recognize

individual members of species. Caring and noticing are also ways of placing oneself in community with the objects of care. Taking the time to get to know something about the frog, the bird, the flower is for Jim a matter of seeing the uniqueness of things, which allows perception of the thing as it is to emerge. Think here of the FrogFinder project, which is a method of training people to learn to be attentive to their environment in a way they weren't before—you go on the website and you listen to the calls, and then you can participate in the study. There are large networks of these kinds of naturalists, attending to everything from sea turtles to sea birds to amphibians, all shaping their arts of noticing and their self-formation in relation to the specific organisms and ecologies within which the cared-for species can be found.⁴

There is a possible narrative here in which practices of noticing and naming are simply parts of Man's God-given right to name the beasts of the field and the fowls of the air (Genesis 2:20), exercising dominion over the natural world—the ultimate in holding the rational, classifying, mode as mastery and use. Against this picture, I want us to understand this form of attunement, even as it uses practices of classification and naming—Latin names, common names—as a practice, perhaps paradoxically, of resisting human exceptionalism while at the same time thinking that humans have responsibilities. As Kier argues: “The point in interrogating these classificatory infrastructures, in order to de-centre the human, is not to put animals or other things on a pedestal or to include them, but to begin to map our interdependencies in larger systems of relational re/production. To simply include or valorize non-humans would deny the obligations humans bear as complexly thinking animals capable of solving some of the major social and ecological problems we've created” (Kier 2010, 306). What is it to care *humanly* without thinking that humans are the most important thing in the picture? If we want to do both, we need to have some way of caring about atrazine's effects on humans while also caring about its effects on frogs. So, to take an indicator species model is to care instrumentally—we think about the frogs because of what they might tell us about what could happen to humans. As Jane Bennett argues, “to acknowledge nonhuman materialities as participants in a political ecology is not to claim that everything is always a participant, or that all participants are alike. Persons, worms, leaves, bacteria, metals, and hurricanes have different types and degrees of power, just as different persons have different types and degrees of power, different worms have different types and degrees of power, and so on, depending on the time,

place, composition, and density of the formation” (Bennett 2010, 108). Naming and noticing might be a way to care humanly, but not instrumentally, to recognize and value the fact that the frogs and the toads and the lizards have their own life that we are just tuning into. This is why I’m interested in projects of ordinary people (which doesn’t mean that people can’t have training in ecology and still be ordinary people). They, we, you, are using ways of noticing and technologies of noticing, like naming, that don’t fundamentally have an allegiance to apparatuses of thinking shaped as a practice of dominion over the natural or social world.

In practice, I have observed that naturalists like Jim, even when they’re just going for a walk, go for walks that help them to see the world differently. And when I’ve been out walking with them, I have, in turn, a different walk. Jim’s capacities to attend to things sharpen and deepen and heighten my capacities to attend to things, on the level of actually being able to perceive previously imperceptible critters and flora. Sometimes these skills include walking in particular ways, knowing how to pick up a lizard to see the color of its belly, and more. I am identifying this as naturalism, which I think can be complementary and perhaps even necessary to the kind of biology Hayes and other laboratory scientists practice. This is not because I hate science, or think that it is cold, soulless, useless, or the usual other critiques. On the contrary: scientists and their work offer some of the most important sites for ethical attunement to the world. However, because of the ways funding structures, citation practices, and lab practices manifest now, it is not, I hope, rude to claim that practicing scientists might need help in critically examining the narratives that structure their exploration of the world and their exposition to nonscientists of why what they find matters. In a funding situation where scientists have to justify the importance of their work, it is no surprise that prurient or predictable narratives structure the presentation of their findings.

It is also no surprise that the narratives that seem to be available to show that a particular situation is worthy of attention fall in line with normalized forms of gender and sexuality. Jennifer Terry productively examines what she calls the “scientific fascination with queer animals,” arguing that we humans “look to the sexual behavior of animals to give meaning to human social relations, and by doing so, we engage in imaginative acts that frequently underscore culturally dominant ideas about gender and sexuality” (Terry 2000, 152). The stories we tell to make sense of the world shape what sense we make. As Donna Haraway has argued, in many ways, “*Both* the

scientist and the organism are actors in a story-telling practice” (Haraway 1989, 5). The stories scientist and nonscientist observers use to understand the world have an effect on what kind of work and noticing they do. As Martha McCaughey puts it, “Scientific storytelling is a consequential political practice” (McCaughey 1996, 263). Reflecting on heterosexist narratives about evolution, she continues: “Evolutionary theories, as scientific stories of the biological origin of species, harness an imaginary past and in so doing specify “natural” aspects of contemporary human sexuality—“perversions” of which can be theorized, condemned, or mocked by those who consider themselves properly and primarily heterosexual” (261). But since scientific stories are “inescapably value-laden, making values more invisible only enables irresponsible storytelling” (281). I am interested in what it means to take seriously the impossibility of telling value-neutral stories about the world, scientific stories or otherwise, holding in mind the ethical necessity for response that I believe attends human complicity in the damage done to the critters and biota with whom we share damaged ecosystems.

As Jake Metcalf argues, “Stories serve important epistemological and political functions by making the world intelligible. In order to adequately interrogate our ethical practices, we humans must interrogate our stories for which worlds they make possible” (Metcalf 2008, 100). Metcalf very usefully thinks through the stories about bears, considering especially what it means to hold an ethical relation with companion species that are neither innocent nor guilty, but that are enmeshed in human lives. Rather than attempting a return to a mythical past in which humans and bears did not coexist, Metcalf calls for an analysis that would “lead to a recognition of our obligation in the present for mutual flourishing, an obligation whose contours arise out of our entanglements, not despite them” (117). I find a model for such obligation in the caring practices of a kind of naturalism. Recognizing that this is a fraught term, I think of this as a naturalism without nature. This will need to be a naturalism based not on a separation and custodianship between humans and Nature, or the idea that the best form of care for the world is killing off the humans (an old Santa Cruz bumper sticker summed this up: “Save the planet! Kill yourself!”). It will need to be a form of practice arising from a thick conception of entanglement and coproduction, practiced as an obligation toward mutual flourishing.

We can draw on a naturalist’s attention to the world around us if we want to have access to narratives that do not replicate and reinforce the way suffering

is currently distributed in the world. The narrative we use to explain the world structures what we do in it. So we can ask, what happens if we use *this* narrative to make *these* changes in the world? If we say: atrazine is bad because gender and sex switching is bad, same-sex sex is bad, bodily changes we call disability are bad, and especially sex selection that results in fewer boy babies is bad, what happens? If the badness that we're pointing to happens to line up perfectly with the way *we tend to organize power in human life* already, then two things seem to be a problem. One is that this narrative reinforces the way we currently organize power in human life. The other is that if there aren't reasons to do things *for the love of the frogs*, we reinforce the ways humans organize power in the world altogether, which is currently ruining our shared world.

Consider the bullfrog, another example from Jim. Bullfrogs are not native to California, but they are everywhere. Jim noted:

Primarily, they are spreading because it's the frog that people tend to like to dissect in high school biology classes. And there's always people who feel bad about dissecting them, or they raise them from tadpoles and then rather than killing them they'll take them out to the local stream and let them go. Well, and the problem with that is that the bullfrog devours all the native frogs. It will just decimate the native frogs—the West Coast has lost almost all the native frogs, the populations are all either threatened or endangered, and one of the main reasons is bullfrog predation and also that the bullfrog passes along a fungal disease that the bullfrog is actually unaffected by but that can [harm other frogs].

This example of the bullfrog is helpful for thinking about how we might take responsibility for pushing a system out of livability without resorting to sexist, heterosexist, trans-hating, and ableist narratives. It is not that there is anything wrong with bullfrogs themselves—as Jim says:

Here's the thing: I like bullfrogs as much as I like California red-legged frogs. Bullfrogs are really neat. They're huge, and that's kind of neat, too. The problem is that there shouldn't be bullfrogs in California because the fact that we've released bullfrogs in California means that the ecology has changed in such a way that we are either going to be okay with the extinction of all the other frogs, or we're not.

Probably many people who release bullfrogs in California also would value the lives of California red-legged frogs, and might make different decisions about releasing them if they understood the effect they have. High school teachers might stop raising bullfrogs from tadpoles, using them in dissection, and so on. Again, thinking with Jim:

I can appreciate a bullfrog for what it is, but it's concerning to me that there are bullfrogs in the environment *here*, because although I don't think of the environment as a static thing, I do think that there is something tragic about the fact that we're losing these other frog species because people can't tell the difference between a bullfrog and a red-legged frog. They are distinct organisms.

Not having good understanding of what a bullfrog is and how it might effect the world means that people think they're being nice when they spare the bullfrog and release it. If the limit on our ability to perceive the world, or the scope of our narrative, is "frog"—rather than "bullfrog," "red-legged frog," or other more nuanced stories, we will fail to have the kind of attention that can even begin to take action adequate to the world we're in. Toxicity is not only about invisible chemicals that cause transformations in the breeding capacity of frogs—it is also about bullfrogs eating tree frogs, or transmitting fungal infections to them. How can we attend to those conditions for the living and dying of amphibious friends?

Consider another example of attention, which I encountered through Hugh Raffles's book *Insectopedia*.⁵ Cornelia Hesse-Honegger is an observer of the world, an artist who illustrates the damages experienced by insects who live near nuclear reactors. This is a different case than the kinds of toxicity narrated or experienced in exposure to herbicides and pesticides, but it tells us something about arts of noticing as a productive supplement and spur for scientific attention. Hesse-Honegger started her work as a scientific illustrator, a practitioner of a craft that some might have imagined would be replaced by photography. Scientific illustration is a form of nonphotographic realism, deriving its accuracy from the fact that it selectively renders aspects of the physical world, showing different parts of them to be salient depending on the theoretical question at issue. It is thus a form of epistemically interesting scientific practice, though often understood as not "Science" properly construed.

Raffles writes about Hesse-Honegger: “I don’t want to tell a hero story. But let me tell you what she did” (Raffles 2011, 27). In its simplest form, what she did was draw leaf bugs, also called true bugs, living near nuclear reactors. Her close attention to their morphologies showed the bodily difference manifesting in them. Believing that these bodily differences are a result of the bugs’ exposure to low-level radiation, Hesse-Honegger has been campaigning for scientific attention to what is happening in these places. Thinking more closely, or complexly, about what she did—the reason Raffles is tempted to tell a hero story—Hesse-Honegger initiated a very interesting and profound shift in understanding the effects of nuclear radiation. One piece of this is changing how we understand what’s at stake in living in disturbed landscapes, to echo Anna Tsing’s reflections on the landscape disturbance necessary for wild matsutake mushrooms to flourish (Tsing 2014). This shift starts with a mode of attention that displaces or defers habits of thinking. Raffles quotes Hesse-Honegger: “I realized that I had to free myself from all my prior assumptions and be completely open to what was in front of me, even at the risk of being considered mad” (Raffles 2011, 21). A key prior assumption concerns “dose dependency,” a commonplace way to measure harm.

Dose-dependency is a core premise in conventional conceptions of toxicity. As the saying goes, the dose makes the poison—a little of something can be harmless, easily processed by our bodies, or even medicinal. I believe that conceptions of dose-dependency serve as foundational assumptions in much of our thinking about toxicity—hinge propositions, on which whole arguments, practices, and ways of understanding the world turn. In practices around radiation, dose-dependency theory establishes a fixed threshold beyond which it is dangerous to accumulate radioactive exposure. These practices rely on measuring and tracking the effects of the atomic bombs exploded at Hiroshima and Nagasaki—high-level, short-term nuclear exposures. Taking this event as the benchmark/reference point traces a linear exposure curve. As Raffles says:

The resulting curve emphasizes the effects of exposure to artificial radioactivity at high values. Low-level radiation, such as that emitted over long time periods by normally operating nuclear power plants, appears relatively, if not entirely, insignificant, its effects falling within the range of the “natural” background radiation emitted from elements present in the earth’s crust. The assumption is that large doses produce large effects; small doses, small effects. (23)

But this assumption seems to be quite incorrect. Instead, it seems that cells respond to radiation differentially depending on their stage of quiescence, growth, or repair; if cells experience radiation in a period of replication, they will respond. Raffles takes an analogy from Hesse-Honegger: if bullets are fired, “it doesn’t matter how many are fired, whom they’re fired by, or even when and where they’re fired; you need only be hit by one at the wrong time and in the wrong place to suffer its effects” (25). If high-level, short-term radiation is like standing in a thick hail of bullets (some of which are bound to hit you), long-term, low-level radiation is like being shot at by perhaps more bullets—even though they are more widely distributed, if you’re in their way you’ll be hit.

So, effects from radioactive exposure are emergent, context-dependent, and not understandable using our most widespread, conceptual apparatus. This means that if we want to understand and act with more adequate resources, we need a different approach. Methodologically, I draw inspiration from Hesse-Honegger’s artistic practice: resolutely attending to the shapes of the bugs as they appear, refusing to paint what she (or we) might expect. Critics of the kinds of theories of the effects of low-level radiation have argued that a problem with the approaches taken so far is that it lacks scientific rigor. In particular, making claims about the effects of something on something else (say, the effects of low-level radiation on leaf bugs) usually requires a reference population that can be demonstrated to not be affected by the agent in question—a pure, unaltered baseline from which we can track difference (leaf bugs that experience no radiation would be a reference population). But if the work that Hesse-Honegger is doing is right, we must follow her in arguing that “there can be no reference habitat on a planet thoroughly polluted by fallout from aboveground testing and emissions from nuclear power plants” (35). Astrid Schrader has articulated the kind of attention following from the form of attention, which I have followed Tsing in thinking of as an “art of noticing on a damaged planet” as a practice of nonteleological care. Such care “articulates a relation to the other and a mode of attention” (Schrader n.d., 5). In a piece reflecting on teaching the Chernobyl entry in Raffles’s book, Schrader persuasively argues that Hesse-Honegger is able to perceive and think about a biological situation unthinkable by conventional scientists—she is able to “perceive the unexpected”—as “part of her technology of care, a particular mode of attention. In systematically complementing precision with randomness, Hesse-Honegger’s self-withdrawal is no longer

opposable to judgments about the exposure of deformities, but becomes its condition of possibility, such that the insect may contribute to its visible renderings” (26). But it is only an opening to a condition of possibility. The vital insight here is that merely noticing is not the same as acting on the basis of that observation.

I take great hope in reflecting on the people who are practicing arts of noticing in a damaged world, who manifest the kind of complex care and responsibility we need now. I believe they are legion, stretching from people living, fishing, and hunting in the far north who attend to how the biosphere is changing with global warming to the people who care for the frogs in Sudbury’s damaged landscapes to the civilian naturalists who attend to the sea turtles on the South Carolina coast. I echo Ah-King and Hayward’s articulation of their motivations for giving an account of sex as already shaped by toxicity:

It is not that we are promoting pollution, but rather, offering ways of coming to terms with the real conditions of everyday life. Rather than reinvesting in purity politics—the hope of some environmental movements—we wonder how resilience and healing can occur in the context of transnational capitalism and its monstrously under-regulated dumping and pumping of various by-products into air, water, and earth. As opposed to simply positioning oneself as an ideologue—the world is doomed unless we clean it all up—we offer a more pragmatic, if you will, and practical theorization for understanding the organisms we are becoming and the changing nature of the ecosystems to which we belong. (Ah-King and Hayward 2014, 6)

Consider, in closing, the etymology of the terms “pesticide” and “herbicide”—the suffix that marks these as deadly is from the Latin *cida*—slayer, killer, cutter. These substances cut, and at the same time they introduce something. Perhaps we can understand them to manifest an agential cut, in Karen Barad’s sense, that process through which an apparatus that materially reconfigures the world delineates what is acted upon and what acts—boundary making and breaking agents. In toxic mattering, the compounds that we use to disrupt photosynthesis in undesired plants then disrupt the formation of human bodies: they are classic boundary objects. As Barad frames them, “Apparatuses are specific material reconfigurings of the world that do not merely emerge in time but iteratively reconfigure spacetime-matter as part of the

ongoing dynamism of becoming” (Barad 2007, 142). Endocrine-disrupting compounds are apparatuses in this sense. In order to engage their effects without obscuring the decisions about what will count as a salient harm, worth attending to, we need to make different agential cuts that allow us to generate different narratives and different nodes of attention. Again: I highlight here the naturalist’s art of attention not because scientists don’t have rich and complex modes of attention. Rather, we might do better science—attend better—if we have better narratives, grounded in arts of noticing that open to and allow for noticing in contexts that are already disturbed, already impure.