

# ***Proposing an ethics for interdependencies and sensing ...***

Braidotti, Rosi. *"Conclusion: On Posthuman Ethics"*. The Posthuman. Polity press, 2013

Gabrys, Jennifer. *"The problem of milieus" and "Animals as sensors: badgers, elephant seals, and white storks"*. Program earth: Environmental Sensing Technology and the Making of a Computational Planet. University of Minnesota Press, 2016

Forlano, Laura. *"Data Rituals in Intimate Infrastructures: Crip Time and the Disabled Cyborg Body as an Epistemic Site of Feminist Science"*. Catalyst: Feminism, Theory, Technoscience 3(2), 2017

Haraway, Donna J. *"Crittercam" and "Able bodies and companion species"*. When Species Meet, University of Minnesota Press, 2008

McKittrick, Katherine. *"Mathematics black life"*. The Black Scholar 44, no. 2 (2014): 16–28

Serres, Michel. *"Information and Thinking"*, Philosophy After Nature. Rowman & Littlefield International, 2018.

Grosz, Elizabeth. *"Ruyer and embryogenesis of the world"*. Incorporeal: Ontology, Ethics, and the Limits of Materialism. Columbia University Press, 2017.

Shotwell, Alexis. *"Shimmering Presences: Frog, Toad, and Toxic Interdependencies"*. *Against purity: Living ethically in compromised times*. University of Minnesota Press, 2016.

## **Ageing Companions / Geprogrammeerde veroudering / Les cyborgs vieillissants**

Helen Pritchard, June 2018

multiplicity of empirical acts: there is nothing to say, but everything to do. Life, simply by being life, expresses itself by actualizing flows of energies, through codes of vital information across complex somatic, cultural and technologically networked systems. This is why I defend the idea of *amor fati* as a way of accepting vital processes and the expressive intensity of a Life we share with multiple others, here and now.

## Posthuman Ethics

We are becoming posthuman ethical subjects in our multiple capacities for relations of all sorts and modes of communication by codes that transcend the linguistic sign by exceeding it in many directions. At this particular point in our collective history, we simply do not know what our enfleshed selves, minds and bodies as one, can actually do. We need to find out by embracing an ethics of experiment with intensities. The ethical imagination is alive and well in posthuman subjects, in the form of ontological relationality. A sustainable ethics for non-unitary subjects rests on an enlarged sense of inter-connection between self and others, including the non-human or 'earth' others, by removing the obstacle of self-centred individualism on the one hand and the barriers of negativity on the other.

In other words, to be posthuman does not mean to be indifferent to the humans, or to be de-humanized. On the contrary, it rather implies a new way of combining ethical values with the well-being of an enlarged sense of community, which includes one's territorial or environmental inter-connections. This is an ethical bond of an altogether different sort from the self-interests of an individual subject, as defined along the canonical lines of classical humanism, or from the moral universalism of the Kantians and their reliance on extending human rights to all species, virtual entities and cellular compositions (Nussbaum, 2006). Posthuman theory also bases the ethical relation on positive grounds of joint projects and activities, not on the negative or reactive grounds of shared vulnerability.

This process-oriented vision of the subject is capable of a universalistic reach, though it rejects moral and cognitive

universalism. It expresses a grounded, partial form of accountability, based on a strong sense of collectivity and relationality, which results in a renewed claim to community and belonging by singular subjects. Lloyd refers to these locally situated micro-universalist claims as 'a collaborative morality' (Lloyd, 1996: 74). The stated criteria for this new ethics include: non-profit; emphasis on the collective; acceptance of relationality and of viral contaminations; concerted efforts at experimenting with and actualizing potential or virtual options; and a new link between theory and practice, including a central role for creativity. They are not moral injunctions, but dynamic frames for an ongoing experiment with intensities. They need to be enacted collectively, so as to produce effective cartographies of how much bodies can take, which is why I also call them 'thresholds of sustainability' (Braidotti, 2006). They aim to create collective bonds, a new affective community or polity.

The key notion in posthuman nomadic ethics is the transcendence of negativity. What this means concretely is that the conditions for renewed political and ethical agency cannot be drawn from the immediate context or the current state of the terrain. They have to be generated affirmatively and creatively by efforts geared to creating possible futures, by mobilizing resources and visions that have been left untapped and by actualizing them in daily practices of interconnection with others. This project requires more visionary power or prophetic energy, qualities which are neither especially in fashion in academic circles, nor highly valued scientifically in these times of coercive pursuit of globalized 'excellence'. Yet, the call for more vision is emerging from many quarters in critical theory. Feminists have a long and rich genealogy in terms of pleading for increased visionary insight. From the very early days, Joan Kelly (1979) typified feminist theory as a double-edged vision, with a strong critical and an equally strong creative function. That creative dimension has been central ever since (Haraway, 1997, 2003; Rich, 2001) and it constitutes the affirmative and innovative core of the radical epistemologies of feminism, gender, race and post-colonial studies. Faith in the creative powers of the imagination is an integral part of feminists' appraisal of lived embodied experience and the bodily roots of subjectivity, which would express the

complex singularities that feminist embodied females have become. Conceptual creativity is simply unimaginable without some visionary fuel.

Prophetic or visionary minds are thinkers of the future. The future as an active object of desire propels us forth and motivates us to be active in the here and now of a continuous present that calls for both resistance and the counter-actualization of alternatives. The yearning for sustainable futures can construct a liveable present. This is not a leap of faith, but an active transposition, a transformation at the in-depth level (Braidotti, 2006). A prophetic or visionary dimension is necessary in order to secure an affirmative hold over the present, as the launching pad for sustainable becoming or qualitative transformations of the negativity and the injustices of the present. The future is the virtual unfolding of the affirmative aspect of the present, which honours our obligations to the generations to come.

## Affirmative Politics

The pursuit of collective projects aimed at the affirmation of hope, rooted in the ordinary micro-practices of everyday life, is a strategy to set up, sustain and map out sustainable transformations. The motivation for the social construction of hope is grounded in a sense of responsibility and inter-generational accountability. A fundamental gratuitousness and a sense of hope is part of it. Hope is a way of dreaming up possible futures: an anticipatory virtue that permeates our lives and activates them. It is a powerful motivating force grounded not only in projects that aim at reconstructing the social imaginary, but also in the political economy of desires, affects and creativity that underscore it.

Contemporary practices of posthuman subjectivity work towards a more affirmative approach to critical theory. Beyond unitary visions of the self and teleological renditions of the processes of subject formation, posthuman thought can sustain the contemporary subjects in the efforts to synchronize themselves with the changing world in which they try to make a positive difference. For instance, against the established tradition of methodological nationalism, a different

image of thought can be activated that rejects Euro-universalism and trusts instead in the powers of planetary diversity. We also need to enlist affectivity, memory and the imagination to the crucial task of inventing new figurations and new ways of representing the complex subjects we have become. Science itself is socially inscribed and ecologically integrated not along the nationalistic axis but in a nomadic web of posthuman earth-wide connections.

Becoming-posthuman consequently is a process of redefining one's sense of attachment and connection to a shared world, a territorial space: urban, social, psychic, ecological, planetary as it may be. It expresses multiple ecologies of belonging, while it enacts the transformation of one's sensorial and perceptual co-ordinates, in order to acknowledge the collective nature and outward-bound direction of what we still call the self. This is in fact a moveable assemblage within a common life-space that the subject never masters nor possesses but merely inhabits, crosses, always in a community, a pack, a group or a cluster. For posthuman theory, the subject is a transversal entity, fully immersed in and immanent to a network of non-human (animal, vegetable, viral) relations. The *zoe*-centred embodied subject is shot through with relational linkages of the contaminating/viral kind which inter-connect it to a variety of others, starting from the environmental or eco-others and include the technological apparatus.

This non-essentialist brand of vitalism reduces the hubris of rational consciousness, which far from being an act of vertical transcendence is rather re-cast and pushed downwards in a grounding exercise of radical immanence. It is an act of unfolding the self onto the world, while enfolding the world within. What if consciousness were, in fact, just another cognitive mode of relating to one's own environment and to others? What if, by comparison with the immanent know-how of animals, conscious self-representation were blighted by narcissistic delusions of transcendence and consequently blinded by its own aspirations to self-transparency? What if consciousness were ultimately incapable of finding a remedy to its obscure disease, this life, this *zoe*, an impersonal force that moves us without asking for our permission to do so? *Zoe* is an inhuman force that stretches beyond life, to new,

vitalist ways of approaching death as an impersonal event. The process ontology centred on life leads the posthuman subject to confront this position lucidly, without making concessions to either moral panic or melancholia. It asserts a secular ethical drive to enter into modes of relation that enhance and sustain one's ability to renew and expand the boundaries of what transversal and non-unitary subjects can become. The ethical ideal is to actualize the cognitive, affective and sensorial means to cultivate higher degrees of empowerment and affirmation of one's interconnections to others in their multiplicity. The selection of the affective forces that propel the process of becoming posthuman is regulated by an ethics of joy and affirmation that functions through the transformation of negative into positive passions.

Very much a philosophy of the outside, of open spaces and embodied enactments, nomadic posthuman thought yearns for a qualitative leap out of the familiar, trusting the untapped possibilities opened by our historical location in the technologically mediated world of today. It is a way of being worthy of our times, to increase our freedom and understanding of the complexities we inhabit in a world that is neither anthropocentric nor anthropomorphic, but rather geo-political, ecological and proudly *zoe*-centred.

## Posthuman, all too Human

I stated in the introduction that how one feels about the posthuman depends to a great extent on how one relates to the human in the first place. I have honestly stated my anti-humanist propensities throughout this book; my interest in the posthuman is directly proportional to the sense of frustration I feel about the human, all too human, resources and limitations that frame our collective and personal intensity. There is anticipation as well as impatience in what I have been trying to write about in this book. Undeniably, the vitalist egalitarianism of *zoe* is likely to attract those who have become disenchanted with and disengaged from the anthropocentrism that is built into humanistic thought, even in what is left of the political Left, of feminism and post-colonial theory. I live at the tail end of bio-power, that is to say amidst the relentless necro-political consumption of all that lives. I am committed

a software program that is able to execute the steps necessary to analyze data and trigger an alert.<sup>72</sup> Wikelski sees this alert system as “really useable” as a “technical device,” and is seeking investment in order to create “a global animal observation system” especially useful for “areas where people don’t have much money.”<sup>73</sup>

From sentinel white storks to citizen-sensing apps to global animal observation systems, animals are increasingly made into sensor nodes and networks that would inform us about critical environmental conditions and their responses. Yet what are the implications of these burgeoning animal-sensor networks? And what sorts of animal-human-milieu interactions might unfold through the more pervasive project of tagging numerous organisms? I take up these questions for the remainder of this chapter, specifically attending to the traversals made across organisms, sensing, data, and milieus.

### THE PROBLEM OF MILIEUS

The ways in which animals are becoming both sensor nodes and parts of extended sensor networks raise questions about how these tagged and tracked individuals traverse and inhabit milieus. In this discussion of milieus, both technical and living, I am drawing on the work of Simondon and Canguilhem, who in varying but shared ways were interested to account for the ways in which individuals (per Simondon) and organisms (per Canguilhem) are formed and in-formed by encountering “problems” in their milieus. As Canguilhem has suggested in his analysis of milieus, how organisms encounter the problem of their milieu is how they become. Yet these problems are different for different organisms.<sup>74</sup> As Simondon similarly articulates, the problem of the milieu is a condition for inventive responses, which is also a condition for individuation.<sup>75</sup> As milieus are sites of inventive encounters and responses to problems, moreover, it is not possible to limit the relations and capabilities that individuals might draw on and express in addressing the problems of their milieus.<sup>76</sup>

This approach to organisms/individuals and milieus has several points of resonance for thinking about the implications of tracking animals and using their movement patterns as extended sensor networks. Humans in the form of scientists and citizen scientists have largely formed the problem of milieus as one of gathering more data in order to address environmental change. In this sense, understanding how to respond to the problem of our shifting milieus has become a project of ensuring there are no “blank spots” on our maps of environmental change. This problem-logic is influenced by the notion that when data sets are the most complete we will assumedly have the most advanced ability to manage environments. In turn, the problem of our milieus has also become one of monitoring all manner of environmental phenomena, including tracking organisms for the clues they provide about the worlds that they inhabit and how their worlds may be changing.

There are a curious series of translations that take place across animal-sensed milieus, tagged organisms, and generated data, since we could ask whether organisms are having to inhabit our encounters with our problem-milieus by living with tags and tracking devices, potentially for their entire lifetimes. Yet how do these intersections of encounters with milieus transform animals as they encounter their milieus and the problems of their milieus: Does the situation of wearing tags and tracking devices change the ways in which organisms encounter their milieus, while also in-forming their problems? It has been recognized in scientific literature on movement ecology that tagging can and does change the activities of organisms.<sup>77</sup> Questions have also arisen as to whether it is always instructive to tag organisms that are under threat, as the process of capturing, tagging, releasing, and monitoring may contribute to the stress of animals.<sup>78</sup>

But tagging and tracking are not just issues of intervention in order to gain a more accurate picture of organismal activity. There are also points of consideration about how monitoring devices and practices in-form the milieus and perceptive exchanges of organisms with those milieus, since this is also the very thing that would be mobilized, whether for conservation and policy or for disaster networks. Canguilhem has critically noted that a danger with some forms of science, such as physics, is that they can be based upon a universal milieu that speaks neither to the perceptive experiences of organisms nor humans. If science is in the world, however, as Canguilhem suggests, it must admit to a diversity of milieus.

Perception is the way in which organisms go about encountering and fashioning their milieus. Sensing is then a key practice for working through problems of milieus.<sup>79</sup> As Canguilhem writes, “In fact, as a proper milieu for comportment and life, the milieu of man’s sensory and technical values does not in itself have more reality than the milieus proper to the woodlouse or the gray mouse.”<sup>80</sup> No milieu or experience of a milieu is more real than any other, unless we adhere to the universal milieu of science, which establishes a version of the real that disqualifies all others.<sup>81</sup> Following Whitehead, to account for the experience of the woodlouse and the scientist, we would have to make room for the “pluralistic realism” of environments and inhabitations.<sup>82</sup> Yet this is not a description of an absolute relativism, but rather of accounting for the a/effects that different inhabitations within distinct milieus express.

Indeed, proposals to use animals as sensor networks on one level seems to take on the approach of diversifying the sensing-milieu exchanges that occur across individuals. The encounters of organisms with their milieus provide another empirical basis for understanding environments and make room for the experiences of other organisms. And yet, in attending to the diversity of exchanges within milieus, a consistent if universal mode of capture is employed in the form of sensing and tagging devices. Here, one might ask whether it is perception (rather



than a milieu) that has been transformed into a universal reality, whereby sensing devices, the variables they would measure, and the unfolding of sensing processes are made generalizable across organisms as an exchange of information. These generalized modes of information-based perception, furthermore, might be described as distinctly cybernetic operations, where sensing of milieus produces information that is the basis for actuating and producing further effects in milieus. Rather than the physics of a universal milieu, sensors might have given us the cybernetics of generalizable perception and experience.

Working across Canguilhem and Simondon, one could then ask: How do milieus and perception shift, both for organisms and devices, when sensing is primarily undertaken and filtered through tracking and tagging technologies? Working laterally with Simondon's discussion of the associated milieu, we could say that technical objects concretize technical milieus in a way that could be compared to Canguilhem's articulation of how organisms at once encounter and concretize their milieus. The difference, following Simondon, between technical and living milieus would be the way in which living milieus can be self-reproducing, whereas technical milieus are self-reproducing only in distinct circumstances where they operate as natural objects, and even then they imply the contribution and intermediation of the living entities that made them—in other words, humans.

In traversing these different milieus, we could say that it is the living milieus of tracked organisms that begin to resemble the operations of the technical milieus of technical objects, since animal sensing becomes equated with computational sensors. By virtue of being equipped with sensors, animals' perceptive encounters with their milieus are transformed into informational exchanges through computational sensor networks. A response to an environmental event is a sensor-actuator exchange of information. An adaptation to an environmental event is a calculative decision, arrived at through an analysis of energy expenditure and environmental cues. Organisms' perceptual engagements with their milieus become informational not simply in the way in which they are in-formed but also as digital operations generative of computational data. Such an approach in part fits with the more recent notion that all of "nature" is composed of information and so is inherently computable.<sup>83</sup> But it also coincides with the longer histories of cybernetics where informational exchanges have been put to work to explain everything from ecosystems to population collapse.

Sensing of environments is then generally understood with tagging and tracking studies to fit within an informational logic of sensing stimuli, transferring signals, and actuating responses. Yet in what ways might this informational approach to perception preconstitute the possible modalities and relations of individuals as they interact with their worlds? A flight path chosen becomes a matter of a response to wind direction and speed and an organism's internal calculation about

energy to be expended to reach a particular destination. Rather than this being a question of what is captured and what is not—a usual way of attempting to make room for all that is in “excess” of scientific endeavor—one might suggest this is a way of making particular worlds and milieus in which the problems of organisms are articulated and acted upon. Environments and environmental change become informational problems. These are the informational-environmental-organismal processes, in other words, whereby we are working through the problem of our milieus, which are increasingly sites of environmental concern, as well as presupposing the perceptual-milieus of other organisms. We might then ask how such an approach to working out the problems of our milieus might also inform our possible becoming in relation to how to “protect” organisms and their milieus. The becoming environmental of computation and the becoming computational of environments are processes that concretize these extended political and ecological effects.

#### *Machine and Organism*

While we could discuss the animal-sensor networks that come together in movement ecology as hybridities or infoldings of sense, as discussed in chapter 2 (and throughout this study), I am interested to maintain a focus on the *environmental* operations of perception (rather than attend to different conjugations of subjects and objects, nature and culture). At the same time, it is useful here to turn to a particular discussion that Canguilhem raised in relation to machines and organisms that provides insights into the ways in which perceptive capacities may be understood, potentially through machinic, and later cybernetic, forces.

Organisms have circulated through computational and cybernetic imaginaries for some time now, from dolphins studied for sonar sensing and later taken up as a topic of interest by Gregory Bateson, to Nicholas Negroponte’s gerbil-based interests as displayed in the “Software” exhibition, and many more besides.<sup>84</sup> Automata studies have looped, continuously it seems, across organismal and technological modalities of sensing: linking, comparing, and fusing these to arrive at a more perfect union.

In his chapter “Machine and Organism,” Canguilhem works through “the mechanical theory of the organism” to consider how philosophers and scientists alike often “have taken the machine to be a given,” not only as though it is the concretization of scientific theory but also as though it provides an originary template for explaining the functions of organisms. But he sets out to demonstrate how “biological organization” is anterior to machines, so that life cannot simply be described through reference or analogy to machines. Across Descartes to Taylor there unfolds a certain mechanistic analysis of organisms that accounts for some outputs and not others. From Canguilhem’s perspective, there is a need to “inscribe the mechanical within the organic.”<sup>85</sup> He writes:

A common thread across these scientific and creative-practice projects is that communicative exchange unfolds not through speech, but rather through perceptive engagements built up through environmental inhabitations. The prevailing sense with tracking projects seems to be that this is a mode of communication that may be readily accessible to us, where by observing organisms it may be possible to deduce their environmental requirements. Watching, spotting, and reporting journeys; tagging and contributing to scientific monitoring; and amassing collections of migratory data—within and through the interstices of movement ecology projects—multiple projects are contributing to building up more detailed accounts of animals' movement and migration.<sup>46</sup> And in this watching and encountering of organisms, humans, more-than-humans, and organisms are moving through intersecting milieus, forming new nexuses of sense.

#### ANIMALS AS SENSORS: BADGERS, ELEPHANT SEALS, AND WHITE STORKS

Data sets that are more complete and comprehensive are meant to fill in the blank spaces on our maps of animal movement so that we might “build a global picture of the creatures with which we share this world.”<sup>47</sup> With animals serving as sensors and sensor networks, sensor data is meant to function not only as descriptive data but also as material that allows us to infer events from what animals might be sensing and responding to in environments. Animals-as-sensors become subject-superjects in a particular way within tracking projects, where their journeys are meant to communicate the experiences of their environmental encounters. The becoming environmental of computation here occurs through the journeys and tracking that unfold as sensors travel with organisms, as well as through the ways in which *organisms become computational* both as carriers of sensors and through the ways in which their sensory ecologies are meant to provide data and information on environmental conditions. Organisms are thus made to be computational twice over, as they sense and are sensed. I now turn to consider three specific journeys or movements of animals that attend to the ways in which animals-as-sensors concreate as indicators of specific engagements with milieus.

##### *Badgers Socializing in Wytham Woods*

WildSensing, an interdisciplinary collaboration between computer scientists and ecologists based at the University of Cambridge and Oxford University that took place between 2007 and 2010, involved a study of badger activity in Wytham Woods near Oxford—a highly instrumented test site known for its ongoing ecological experiments from at least the days of Charles Elton, an ecologist well known for his studies of population ecology and animal invasions in the early to mid-twentieth century.<sup>48</sup> Wytham Woods is a 390-hectare landscape that is “one of the most researched areas of woodland in the world,” with numerous monitoring projects underway at any given time.<sup>49</sup> But many of these projects are often set up



Figure 3.3. "Animal Messaging Service." Example of routes for sending messages via tagged animals as they undertake their migrations. Extreme Green Guerillas, illustration courtesy of Michiko Nitta.

in relation to distinct research questions and concerns and do not join up data sets collected from the site. At the same time, because ecological study and experimentation have taken place over several decades at Wytham Woods, there are extensive data sets and histories of animal observation. With badgers, for instance, data collection extends over the past twenty years, although it may have a larger granularity due to manual observation methods; and badgers have been trapped and released in Wytham Woods for the past thirty years (which has been the usual way of studying animal movement).

The WildSensing project was initiated to establish whether to and to what extent badgers transmitted tuberculosis, for instance, to livestock. Data from these observations were meant to aid in policy and management of badgers at agricultural edges.<sup>50</sup> To undertake this research, the project focused on the social networks of badgers, since as it turns out they have distinct modes of interaction and cooperation. In total, eighty badgers were tagged and caught once every six months over the duration of the project. Animals were tagged with RFID radio collars, which would be released when badgers were thinning. As a result of using RFID for detection, badgers could be sensed underground as well as above ground, but only within the sensor area and not across the entire forest.<sup>51</sup>

In the first iteration of the WildSensing project, badgers were tagged with RFID radio collars that communicated with fixed sensor detection and storage nodes located within a zone of the forest. From these points, field researchers could conduct mobile data collection (which could, theoretically, also be carried out by mobile robots). Within one year, the project collected over twenty-five million records, and so the gathering and transmission of data presented issues for how to structure these networks.<sup>52</sup> Due to the quantities of data collected and transmitted, much of the project focused on ways of duty-cycling data more efficiently in order to save power, which is an ongoing issue within sensor networks.

In the second iteration of the project, an increasing emphasis was placed on working with off-the-shelf sensor equipment. Rather than having fixed sensor nodes in the network, the project instead used the badgers as the mobile sensor network across which data circulated to fixed collection nodes triggered by presence detectors with a fifty-meter radius. The data from these nodes were then either stored on SD cards or transmitted via 3G mobile phone networks several times per day to servers. On the one hand, this approach focused on how sensors learn and adapt to animal behavior. Working with RFID sensors and machine learning in the form of an adaptive algorithm, this approach focused on having sensors operate in response to and at key moments of animal activity. On the other hand, as sensors and animals were paired in this form of environmental monitoring, sending new software over wireless networks to the animal collars also became a way to reprogram sensors without having to catch the animals or

adjust the sensor hardware or infrastructure so that the network could be adapted to animal activities.<sup>53</sup>

Emerging within this approach is the use of sensors not just to describe and capture environmental events but also to develop a dynamic evolution of sensors in response to animal behavior such that computation and the distribution of sensation are ontogenetic. While critiques of early tracking devices suggested that they were “‘mere descriptions of movement and activity,’”<sup>54</sup> and hence at times considered to be relatively static renderings of environmental processes, increasingly sensor systems are regarded as generating more integrated, adaptive, and actuated approaches to environmental monitoring.

As the WildSensing mobile network developed, it became a system for relating information from animal to animal via radio collars and then on to collection nodes. Animals became sensors and operators in the network, at once collecting data about their activities and location, while also becoming part of the extended computational infrastructure. The network patterns were ad hoc, based on the badger activity, and were not entirely preestablished configurations. The social behavior of the badgers, as well as the microclimate and other environmental conditions at Wytham Woods, contributed to the intersections of technical and living milieus. The sensors and computational network necessary to capture phenomena had to emerge along with ecological events and animal activity, where, for instance, practices of relaying data across organisms and storing sensor data in nodes, then capturing the data through mobile collection, developed as a more effective configuration for sensing the badger activity.

Machine learning here extended not just to parsing environmental data but also to learning animal behavior and reprogramming sensing and collection methods accordingly. In this sense, sensors became organismal *and* environmental. While this was not a completely open process, as sensors are configured to detect certain variables and not others, it was also not a process of complete automation, where sensors might be preprogrammed to detect phenomena according to fixed configurations. If we were to follow Simondon in this regard, how might this contingent approach to sensing shift both technical object and technical milieu in relation to the individuations that occur through encounters with living entities? Rather than approach sensors as “prosthetic” devices, moreover, might we find it more accurate to consider the ways in which these sensor technologies reorganize, in-form, and transform along with the organisms they would track?

#### *Elephant Seals Diving in the Southern Ocean*

If the badgers of Wytham Woods presented a quite local and land-based sensor study, then the elephant seals of the Southern Ocean offer up a much different milieu in the form of underwater spaces, relatively obstreperous temperaments

being experienced, researchers have developed a rich language around thick data (Wang, 2013), the qualified self (Humphreys, forthcoming) and, lived data (Kaziunas, Lindtner, Ackerman, & Lee, 2017).

Here, Carey's ritual view of communication is valuable for understanding differences between the lived experiences around data (rather than merely the transmission of data). He writes:

A ritual view of communication is directed not toward the extension of messages in space but the maintenance of society in time (even if some find this maintenance characterized by domination and therefore illegitimate); not the act of imparting information or influence but the creation, representation, and celebration of shared even if illusory beliefs. If a transmission view of communication centers on the extension of messages across geography for purposes of control, a ritual view centers on the sacred ceremony that draws persons together in fellowship and commonality. (Carey, 1988)

Building on this definition, I argue that *data rituals* allow for the creation of human and nonhuman fellowship as a feminist data practice in line with related modes of engagement such as feminist data visualization (D'Ignazio & Klein, 2016) and feminist human-computer interaction (Bardzell, 2010).

### Clock Time and Crip Time

In fall 2013, I opened a flat, white, rectangular box with a minimalist design, the kind that usually contains an Apple device. The experience screams: "Designed by Apple in California. Assembled in China." It's the embodiment of high-tech, Silicon Valley culture. Inside was not a new iPhone or a red iPod, but an upgrade for a medical device: the MiniMed 530G, an insulin pump produced by the medical technology company Medtronic. While these technologies differ from those commonly invoked in Silicon Valley rhetoric and innovation discourses, they are deliberately marketed, packaged, and branded in order to fit in with other high-tech

products. As a researcher of emerging technologies, I am interested in the ways in which technological language, meanings, and metaphors—such as a particular white box and its telltale sans serif font—are translated and replicated throughout seemingly disparate realms of society.

Shortly after receiving the box, I received an email from Medtronic's head of customer experience:

Earlier today, my team received positive comments on the packaging for our new MiniMed 530G with Enlite from a customer on Twitter, *"Nice set with the packaging of the new pumps @MDTDiabetes! It reminded me of opening a new Apple device."*

This compliment came after we worked to put ourselves in the shoes of our customers and understand the overwhelming experience they had opening their first shipment from us. (J. Anglin, personal communication, Nov. 7, 2013).

The MiniMed 530G—approved by the Food and Drug Administration (FDA) on September 26, 2013—is a system of technologies that includes the pump, a CGM, a glucose meter, test strips, and software. The CGM is comprised of a sensor, a transmitter, and a receiver. The glucose meter communicates wirelessly with the pump and the transmitter communicates wirelessly with the receiver. While Medtronic markets its own proprietary system that includes a CGM, I use a monitor that is produced by another company, Dexcom. The two proprietary systems do not interoperate, except through third-party applications that allow the uploading of data from both devices.

While insulin pumps have been used to manage Type 1 diabetes since the early 1980s, they often go unnoticed in everyday life; today's models are relatively small and resemble other mobile technologies—many people do not want to call attention to their medical conditions.

According to the American Diabetes Association, an insulin pump is:

an insulin-delivering device about the size of a deck of cards that can be worn on a belt or kept in a pocket. An insulin pump connects to narrow, flexible plastic tubing that ends with a needle



inserted just under the skin. Users set the pump to give a steady trickle or basal amount of insulin continuously throughout the day. Pumps release bolus doses of insulin (several units at a time) at meals and at times when blood glucose is too high, based on programming done by the user. (American Diabetes Association, 2015)

The first wearable insulin pumps—invented in 1976 by Dean Kamen—were very large and impractical (DEKA Research, 2017).

The MiniMed insulin pump is produced by Medtronic, a company that was founded as a medical equipment repair shop in 1949 and soon after created the first wearable, battery-operated pacemaker. In 1979 the company began to develop plans for an insulin pump when it was learned that heart problems are linked to diabetes; in 1983, it created the first MiniMed pump. In the past thirty years, Medtronic has made many incremental improvements to both the software and physical design of the pump. These upgrades include the ability to detach the pump from the body temporarily without having to completely change the infusion set (the tubes that connect the pump to the body). In 1999 the FDA approved the first physician-use glucose monitoring system, which relies on inserting a sensor into the body (Medtronic, 2015).

The MiniMed 530G is the first insulin pump in the United States that can be called an “automatic pancreas” (also known as an “artificial pancreas” or “smart pump”). Its defining feature is that it can automatically shut itself off when one of its monitored biometrics drops below a set threshold: for example, in the middle of the night. The menus—bold black lettering on a glowing green background, navigated by buttons marked with up and down arrows—seem archaic when compared to today’s interactive touch screens and voice-controlled artificial intelligence. They are reminiscent of a 1980s Casio calculator watch. But the pump itself is actually a sophisticated computer that can wirelessly receive information about blood glucose from a special meter and calculate the proper amount of insulin to administer. In order to “deliver” insulin, it turns a small screw inside the device, which pushes

the insulin through a long tube that has been inserted into the body. With only five buttons, it is simple enough for a diabetic of any age to use.

My insulin pump is on clock time. It leaks insulin into my body at set times and in set amounts: 12 AM, 3 AM, 6 AM, 4:30 PM. When I eat, another set of times, conversions, and amounts. When I make adjustments, another set. According to these settings, the insulin remains active in my body for precisely four hours. Here are two examples of how the clock time of devices interrupts lived experience.

*On March 16 at 7:49 PM, my pump displayed a “Low Reservoir” alert. At 11 PM, when I returned home from dinner at an Italian restaurant with a new writing group, I checked to find that only 2.9 units of insulin remained, which would last just over five hours, according to the pump’s settings. I decided to refill and reset the pump before I went to sleep rather than getting up in the middle of the night or very, very early.*

*My glucose monitor, on the other hand, announces with a high-pitched alert that it will need to be reset in two hours. Never mind that I am teaching on Wednesdays and am in the middle of a lecture in my Designing Futures class. I dismiss it but again, about ten minutes later, a shrill beeping sound and no way to silence it. It seems to sound louder and louder every time, unaware of its surroundings.*

In contrast to clock time or lived experience, according to Kafer, there are several reasons for developing the notion of crip time. For example, the medical field frequently describes disability in relation to time as well as duration of symptoms. Yet there are also other, more generative reasons to explore crip time in order to understand different experiences of time. This might mean expecting things to take more time due to slower physical mobility, or requiring more time on a test. Kafer (2013) argues that crip time is in fact “a reorientation to time” characterized by the need for flexibility, since the speed of everyday life is determined by normative

bodies. “Rather than bend disabled bodies and minds to meet the clock, crip time bends the clock to meet disabled bodies and minds” (p. 45).

### Data Rituals and “Fitting in with the Flow of Things”

Like crip time’s proverbial bending of the clock, data rituals envision the ways in which both medical devices and the broader society might more deliberately accommodate disabled bodies and related socio-cultural contexts. In this section, I will describe the social practices and my own lived experiences around tracking, measurement, and calculation over the past five years. During this time, I learned to manage a complex mesh of calculations, routines, and relationships that make life possible—and sometimes quite impossible. These narratives represent different phases and contexts with distinct features that configure unique temporal relations between people, technologies, and spaces. Briefly, these can be characterized as: pre-insulin-pump (spring 2012 to summer 2013), pump and CGM device (fall 2013 to spring 2016) and pump and CGM iPhone application (summer 2016 to present). In the pre-pump phase, it was necessary to use both a glucose meter to check my blood glucose (BG) and an insulin pen in order to administer the correct dosage at mealtime. In the pump and CGM device phase, I could check the monitor and administer the insulin via the pump. Finally, in the current phase with the pump and CGM iPhone application, my husband can also access the data from the CGM in real time.

### Waiting, Interruptions, Delays, and Cold Pizza

*Once, when dining out with a group of (newish) European friends, I waited for the food to arrive, sized it up quickly so as not to attract attention, did some calculations in my head, and rushed off to the restroom. There I tested my blood sugar with the glucose monitor. I took a small test strip out of a plastic canister and inserted it into the monitor. Next, I pushed a small blue lancet into the lancing*

*how we must act as a consequence*, if we have learned to care about the well-being of the entangled animals and people in those ecologies.

Probably because I work and play with herding dogs in real life, the humpback whale collaboration is my favorite one to illustrate these points. Fifteen years of research about how humpbacks live and hunt in the waters off southwest Alaska preceded the arrival of the Crittercam.<sup>10</sup> The scientists knew each whale individually by his or her calls and tail-fluke markings. The biologists developed strong ideas about the whales' collaborative hunting after watching them collect giant mouthfuls of herring. But researchers could not prove that collaborative hunting was indeed what the whales were doing, with each whale taking its place in a choreographed division of labor, like that of pairs of expert border collies gathering the sheep on the Lancashire countryside. Whale scientists suspected that individually known humpbacks had been knowledgeably working together for decades to harvest their fishery, but the limits of humans diving with the giant cetaceans stopped them from obtaining crucial visual evidence. Being crushed is no way to secure good data. The Crittercam gave questing humans a way to accompany the whales as if the people were merely commensal sucker fishes along for the ride—and the photo op. In the idiom of Bruno Latour's science and technology studies, the scientists and the natural history entertainment jocks "delegated" parts of their work to the Crittercam multitasking package and to the animals who bore the devices into their worlds.<sup>11</sup>

We have already seen how hard it was to secure the cameras to the whale hides and then recover them afterward. The sixteen successfully deployed Crittercams from near the end of the season were precious. The scientists wanted to test their hypothesis that certain whales deliberately blew bubbles from below to surround and trap herring that had been herded into tight congregations by other whales, forming a kind of net around the prey. Then, in unison the whales surged upward with their mouths gaping to collect their teaming dinner. People could see the bubbles from the surface, but they could not see how or where or by whom they were produced. Humans could not really tell if the whales were dividing their labor and hunting socially.

Footage from the first fifteen Crittercams did not show what the biologists needed. Suspense on television mounted, and, I like to think,

suspense and worry were also rife in the non-TV labs, where people were trying to make sense of the often confusing, vertigo-inducing pictures the videocams brought back. Then, with the sixteenth videotape, shot by a Crittercam-bearing member of the pod, came a clear view, just a few seconds long, of a whale going below the gathered herring that were surrounded by other whales and blowing a bubble net. Callers, bubble blowers, and herders were all accounted for. Bits of footage put together from several cameras gave a reconstructed, visually supported narrative of the border collie-like whales gathering their fish-sheep, penning them flawlessly, and eating them enthusiastically. Good border collies don't do that part, but their cousins and ancestors, the socially hunting wolves, do.

A knowledge bonus also came from the Crittercam in the humpback whale social hunting story. Bits of whale skin adhered to the detached suction cups once the videocam packages were released, and so DNA analyses could be done of individually known (and named) whales who had taken attributable pictures of one another and their habitat. The result: the discovery that whales in the social hunting groups were not close kin. The close teamwork over years would have to be explained, ecologically and evolutionarily, in some other way. I know I should suppress my pleasure in this result, but I raise my California wine glass to the extrafamilial social worlds of working whale colleagues. My endorphins are at high tide.

### THIRD SIGHT

So, the compound eyes of the colonial organism called Crittercam are full of articulated lenses from many kinds of coordinated, agential zoons—that is, the machinic, human, and animal beings whose historically situated infoldings are the flesh of contemporary naturecultures. Fugal accompaniment is the theme, not humans abstemiously staying away to let the animals tell an unmediated truth by making pictures of themselves. That much seems clear. But something is missing from my story so far, something we need to be at home in the hermeneutic web that is Crittercam. The question I have been deferring is simple to ask and the devil to answer: What is the semiotic agency of the animals in the hermeneutic labor of Crittercam?

Are they just objects for the data-gathering subjects called people and (by delegation) machines, just “resistance” or “raw material” to the potency and action of intentional others? Well, it shouldn’t take recounting twenty-five years of feminist theory and science studies to determine the answer there: no. Okay, but are the animals then completely symmetrical actors whose agency and intentionality are just cosmetically morphed variants of the unmarked kind called human? The same twenty-five years of feminist theory and science studies shout the same reply: no.

It’s easy to pile on the negatives. In the Crittercam assemblage, the hermeneutic agency of the animals is not voluntary, not that of the first-person cameraman, not intentional, not like that of coworking or companion animals (my border collie analogy notwithstanding), not a weaker version of the always strong human hermeneutic game. It’s harder to specify the positive content of the animals’ hermeneutic labor in Crittercam’s particular naturalcultural encounter.

But it is not impossible to get started. First, there is no way even to think about the issue outside the relentlessly fleshly entanglements of this particular techno-organic world. There is no general answer to the question of animals’ agential engagement in meanings, any more than there is a general account of human meaning making. Don Ihde insisted that in the human–technology hermeneutic relation, the technology adapts to the humans and vice versa. Human bodies and technologies cohabit each other in relation to particular projects or lifeworlds. “In so far as I use a technology, I am also used by a technology.”<sup>12</sup>

Surely the same insight applies to the animal–human–technology hermeneutic relation. Hermeneutic potency is a relational matter; it’s not about who “has” hermeneutic agency, as if it were a nominal substance instead of a verbal infolding. Insofar as I (and my machines) use an animal, I am used by an animal (with its attached machine). I must adapt to the specific animals even as I work for years to learn to induce them to adapt to me and my artifacts in particular kinds of knowledge projects. Specific sorts of animals in specific ecologies and histories make me adapt to them even as their life doings become the meaning-making generator of my work. If those animals are wearing something of my making, our mutual but unidentical coadaptation will be different. The animals, humans, and machines are all enmeshed in hermeneutic labor

(and play) by the material–semiotic requirements of getting on together in specific lifeworlds. They touch; therefore they are. It’s about the action in contact zones.

That’s the kind of insight that makes us know that situated human beings have epistemological–ethical obligations to the animals. Specifically, we have to learn who they are in all their nonunitary otherness in order to have a conversation on the basis of carefully constructed, multisensory, compounded languages. The animals make demands on the humans and their technologies to precisely the same degree that the humans make demands on the animals. Otherwise, the cameras fall off and other bad things happen to waste everybody’s time and resources. That part is “symmetrical,” but the contents of the demands are not symmetrical at all. That asymmetry matters a great deal. Nothing is passive to the action of another, but all the infoldings can occur only in the fleshly detail of situated, material–semiotic beings. The privilege of people accompanying animals depends on getting these asymmetrical relationships right.<sup>13</sup> Compound eyes use different refractive indices, different materials, different fluids, to get something in focus. There is no better place to learn such things than in the immersive depths of the earth’s oceans.

of generational passage, no less corporeal and no less full of desire and lure, no less leery of the law, no less in the game, but in an economy that leads the daughter to remember in joy and grief. This kind of look has made my body what it is in life as a writer and as a woman playing a sport. I want to take us, take me, through part of this legacy.

Consider “regard” and “respect” a bit longer. I am drawn by the tones of this kind of active looking at/regard (both as verb, *respecere*, and as *respectus*) that I sought and experienced with and from my father.<sup>2</sup> The specific relationality in this kind of regard holds my attention: to have regard for, to see differently, to esteem, to look back, to hold in regard, to hold in seeing, to be touched by another’s regard, to heed, to take care of. This kind of regard aims to release and be released in oxymoronic, necessary, autonomy-in-relation. Autonomy as the fruit of and inside relation. Autonomy as trans-acting. Quite the opposite of the gaze/look usually studied in cultural theory! And certainly not the fruit of the gaze of incest.

In recent speaking and writing on companion species, I have tried to live inside the many tones of regard/respect/seeing each other/looking back at/meeting/optic–haptic encounter. Species and respect are in optic/haptic/affective/cognitive touch: they are at table together; they are mess-mates, companions, in company, *cum panis*. I also love the oxymoron inherent in “species”—always both logical type and relentlessly particular, always tied to *specere* and yearning/looking toward *respecere*. “Species” includes animal and human as categories, and much more besides; and we would be ill advised to assume which categories are in play and shaping one another in flesh and logic in constitutive encounterings.

In all those senses, I see the regard I am trying to think and feel as part of something not proper to either humanism or posthumanism. *Companion species*—coshapings all the way down, in all sorts of temporalities and corporealities—is my awkward term for a not-humanism in which species of all sorts are in question. For me, even when we speak only of people, the animal/human/living/nonliving category separations fray inside the kind of encountering worthy of regard. The ethical regard that I am trying to speak and write can be experienced across many sorts of species differences.<sup>3</sup> The lovely part is that we can know only by looking and by looking back. *Respecere*.



For the last few years, I have been writing under the sign of companion species, perhaps partly to tweak my colleagues' sense of proper species behavior. They have been remarkably patient; indeed, they understand that "companion species" does not mean smallish animals treated like indulged children-in-fur-coats (or in fins or feathers) in late imperial societies. Companion species is a permanently undecidable category, a category-in-question that insists on the relation as the smallest unit of being and of analysis. By species I mean, with thanks to Karen Barad's theory of agential realism and intra-action, a kind of intra-ontics/intra-antics that does not predetermine the status of the species as artifact, machine, landscape, organism, or human being.<sup>4</sup> Singular and plural, species resonate with the tones of logical types, of the relentlessly specific, of stamped coin, of the real presence in the Catholic Eucharist, of Darwinian kinds, of sf aliens, and of much else. Species, like the body, are internally oxymoronic, full of their own others, full of messmates, of companions.

Every species is a multispecies crowd. Human exceptionalism is what companion species cannot abide. In the face of companion species, human exceptionalism shows itself to be the specter that damns the body to illusion, to reproduction of the same, to incest, and so makes remembering impossible. Under the material-semiotic sign of companion species, I am interested in the ontics and antics of significant otherness, in the ongoing making of the partners through the making itself, in the making of bodied lives in the game. Partners do not preexist their relating; the partners are precisely what come out of the inter- and intra-relating of fleshly, significant, semiotic-material being. This is the ontological choreography that Charis Thompson writes about.<sup>5</sup> I'm telling a looping story of figuration, of ontics, of bodies in the making, of play in which all the messmates are not human.

Indeed, perhaps this is the daughter's knowledge, which is made possible by the kind of regard/respect her father gave—the knowledge that we have never been human and so are not caught in that cyclopean trap of mind and matter, action and passion, actor and instrument. Because we have never been the philosopher's human, we are bodies in braided, ontic, and antic relatings.

And so, we write the game story. In this account, the messmates with my father—the constitutive companion species knots that get my

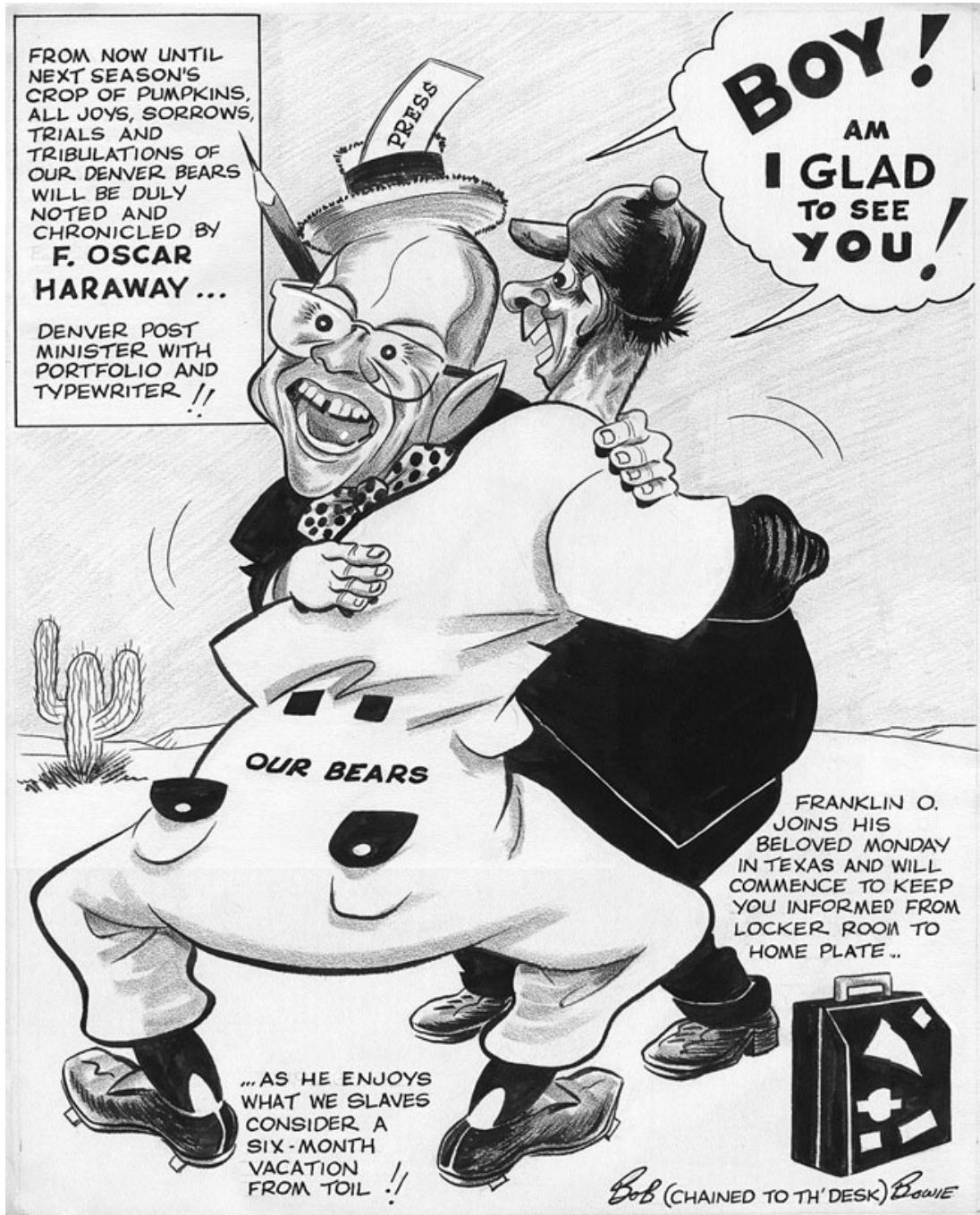
attention—are not myself or any other organism, but a pair of crutches and two wheelchairs. These were his partners in the game of living well.

When he was sixteen months old, my father fell and injured his hip. Tuberculosis set in. It subsided, only to return with a vengeance in 1921, when he slipped on an oiled floor. Tuberculosis lodged in the upper leg, knee, and hip bones, in a period when there was no treatment. We get this version of the history of the body from a tenth-grade school assignment, “The Autobiography of Frank Haraway,” which we found after Dad’s death in his orderly, but still packrat-inspired, files.<sup>6</sup> His own father had moved to Colorado Springs from Tennessee and Mississippi (the state line actually ran through the family house) in order to heal from pulmonary tuberculosis in a Rocky Mountain spa town that makes me recall *The Magic Mountain*. My father’s childhood tuberculosis meant that from an early age he could not move without excruciating pain. He spent the ages of eight to about eleven in bed in a full-length body cast from his chest to his knees, not able to attend school and so learning with a private tutor. Not expected to live, he nonetheless eventually healed. But, the hip joints were permanently calcified, and he was left rigid with no plane of motion, no ability to bend, from the hips. He could not separate his legs in any direction. (This fact made me curious in my adolescent years about how my parents pulled off feats of conception—ordinary epistemophilia, with a twist. There was more than a little joking in our house about these matters.)

My father’s father had money until a few years into the Depression. My grandfather was a sports promoter as well as the owner of Piggly Wiggly grocery stores in Colorado. A businessman and community figure, he brought sports figures to Denver such as Babe Ruth and Lou Gehrig, who came to Dad’s house and signed a baseball for him while he was still confined to bed. My grandfather and his industrialist colleagues founded the white men’s basketball leagues that preceded professional basketball as we now know it. The players for BF Goodrich, Akron Goodyear, Piggly Wiggly, and other midwestern and western industrial basketball teams were all white men destined to be middle-level managers. The bodily practices of racialization come in many forms, not least the braiding of family, sports, and business. My father was a sportswriter; that is part of how I am white; it is part of the game story. Race and money are part of how my father became a sportswriter.

My grandfather gave Dad a wheelchair as soon as he was able to get out of his bed and body cast, so he could go to the old Merchant's Park and watch the ballgames. But he was not just a spectator. From his wheelchair, in his typical semirecumbent seated posture dictated by his unaccommodating hips, Dad played baseball in the neighborhood. I have a picture of him and his younger brother, Jack, at about twelve and thirteen years old, both wearing characteristic pajama-mimic baseball pants, clutching bottles of Coke. Dad is in his wheelchair, flashing his trademark, gap-toothed smile, which showed up years later in the sports page cartoons drawn by Bob Bowie at the beginning of baseball spring training. Another photo shows my pimply-faced father swinging the bat with rather elegant athletic form. Dad was known in the neighborhood, I am told, as a good player, or at least a popular one. That wheelchair was in a companion-species relation to the boy; the whole body was organic flesh as well as wood and metal; the player was on wheels, grinning. Yet, perhaps not always grinning. At the end of a neighborhood game, so the family story goes, when their ancient baseball fell apart definitively and for the last time, the other kids persuaded Dad to bring out his Babe Ruth–Lou Gehrig autographed treasure. Sure, Dad thought, we only have one out to go. Dad watched the batter hit the ball past the fielder's outreached glove. The ball rolled down the urban gutter into the sewers, where it continues to fertilize narratives of loss and nostalgia—and narratives of the dramatic plays in a game.

When he graduated from Randall, the private high school he attended in his wheelchair, Dad got his crutches and galloped off to Denver University, where he became student sports editor of the *DU Clarion*. His track career at DU was cut short after an unauthorized race with a broken-legged football player, who was temporarily locomoting with crutches, a race that was set up by the other athletes on the track around the football field, starting gun and all. With his trusty cherrywood crutches under his armpits, swinging in long arcs, my father won the race handily, but his opponent fell and broke his other leg, prompting the coach to warn Dad off any further competitive exploits. These crutches belong corporeally in a life built out of relational, enabling objectifications, of coming into being through meldings with the physicality of the wheelchair, the bed, the cast, the crutches, all of which produced a vital, living, achieving sportswriter.



Bob Bowie's Denver *Post* cartoon of Frank Haraway arriving for Bears baseball spring training in the 1950s. From Haraway family archives.

historically present persistence of anti-black violence—we might not simply access black suffering and white supremacy but perhaps generate new ways of encountering the history of blackness.<sup>21</sup> As noted, access to new world blackness dwells on the archival display of the violated body, the corpse, the death sentences, the economic inventories of cargo, the whip as the tool that writes blackness into existence. How might we take this evidence and venture toward another mode of human being—so that when we encounter the lists, the ledgers, the commodities of slavery, we notice that our collective unbearable past, which is unrepresentable except for the archival mechanics that usher in blackness vis-à-vis violence, is about something else altogether.

There are strategies in place worth noting. Carrie Mae Weems rewrites “Scourged Back” to evidence the unutterable of contours of violence.<sup>22</sup> A different kind of strategic un-voicing of the unbearable can be found in *Incidents in the Life of a Slave Girl*—where a different unwritten narrative resides between the lines.<sup>23</sup> Aunt Hester’s scream, too, as it “open[ed] the way into the knowledge of slavery and the knowledge of freedom” for Frederick Douglass and post-slave populations.<sup>24</sup> Militant slaves, mass suicide, *At The Full and Change of Moon*.<sup>25</sup> The unraveled asterisk: Margaret Garner’s decision to kill her children so they would not have to endure the brutalities of slavery as recast in *Beloved* as a story of survival. The choke-cherry tree.<sup>26</sup> We can think of more. These strategies allow us to read the archives not as a measure of what happened, but as indicators of what else happened. Notably, the strategies above rest on encountering, think-

ing about and articulating black absented presences: the unspeakable, the unwritten, the unbearable and unutterable, the unseeable and the invisible, the uncountable and unindexed, outside the scourge, that which cannot be seen or heard or read but is always there. We are therefore also asked to imagine those lives that are so inconceivable, so unworthy of documentation, so radically outside our archives, that they are merely psychic impressions of life and livingness: lies and truths and new stories and familiar scars that, because they are unindexed, cannot provide us with the analytical tools to analytically take black life away.

In many ways, these kinds of strategies tell different stories that are tethered to the scourged back. In many ways, the racial economy of the archive begins a story that demands our betrayal of the archive itself. It gives us the scourged back as a commonly available image that is also an asterisk of history—the archive lies as it tells a truth. Which begs the question: What if we trust the lies—she says she was born free—and begin to count it all out differently? What if we harness ourselves to the brutalities of the violence that began all of this, while also honoring the impossibility of understanding exactly what the scars of history mean for post-slave diasporic peoples?

Punishment during slavery was, as Gordon’s back might reveal for some, intimately linked to counting; lashings are the soundtrack to slavery, four, ten, fifty, one hundred, two hundred.<sup>27</sup> Indeed, the black musical texts that reference this soundtrack and revisit the crack of the whip are numerous, although the work of The Wailers (“Slave Driver,” from *Catch a Fire*) and Nas

("Intro" to his album *It Was Written*) stand out for me. To be sure, the body, the lashings, the counting, culminates to affirm crass and familiar itemization, the corporeal consequences of rational reason: counting the cracks discloses measurable discipline. But again: What if we trust the lies—she says she was born free—and begin to count it all out differently? As we all know, numbers signify measurable items, but they also invite chaos. In her essay "Digital Epidermalization: Race, Identity and Biometrics," Simone Browne importantly asks: How do we understand the body when it is made into data? Analyzing the technologies of the border—fingerprints, passports, eye scans, facial recognition technology—Browne looks at the ways in which particular bodies are cast out of normalcy based on the "arithmetics of skin."<sup>28</sup> I borrow the arithmetics of skin from Browne because her work uncovers the ways in which contemporary surveillance practices are inflected with the relief of neutrality as they track biocentric human markers: race, gender, a two-sexed system. Put another way, the seeming neutrality of mathematics—the governmental trust in the technologies that calculate the textures of skin, eyes, hair—is trusted as innocuously objective, thus providing an alibi for racism. A glance above: one drop of blood/the accusation was/2.1 percent/genetic merit. As Browne's research shows, biometrics—the measurement of the living body—are, in fact, laden with digital epidermalization wherein the logic of whiteness is the measuring stick through which other racial technologies are understood. The white living body—spacing between the eyes, fingerprint ridges, hair, skin, thickness of the mouth—is the math-

ematical measuring stick through which all other bodies are calculated. Indeed, and looking the other way, Browne's research also importantly shows that contemporary surveillance practices can be linked to the tracking of escaped slaves—the black enslaved body, the black escaping body, was recorded and coded as biometrically knowable (or findable and searchable).<sup>29</sup> The future of the scourged back is revealed and Nas's album cover (figure 2) makes good sense. How then might we recast the arithmetics of skin, the truthful lies of the archive, and the making of black subjecthood that is always tethered to that status of nonperson? Or how do we, as Nourbese Philip asks, find freedom within these limitations?<sup>30</sup> Can we really count it out differently?

I hold close the technologies of slavery and the archives that produce the scourged back. I can't let go of the incomplete stories and brutal violence, in part, because letting go might involve not seeing how these violent acts are reproduced now. It might involve reading Nas's album cover through what Rinaldo Walcott calls "global niggerdom," thus underscoring that the making of racial subjectivities—all kinds of racially marked subjectivities that inhabit our white supremacist planetary slums—is a process that is tethered to a violent past and therefore demands a different future.<sup>31</sup> Indeed, I want to hold on to the numbers because "it's the evidence of what transpired" and "the bones actually ground you."<sup>32</sup> The numbers set the stage for our stories of survival—what is not there is *living*. The numbers, the arithmetics of the skin, the shadow of the whip, inspire our insurgency as they demonstrate the ways in which our present genre of the

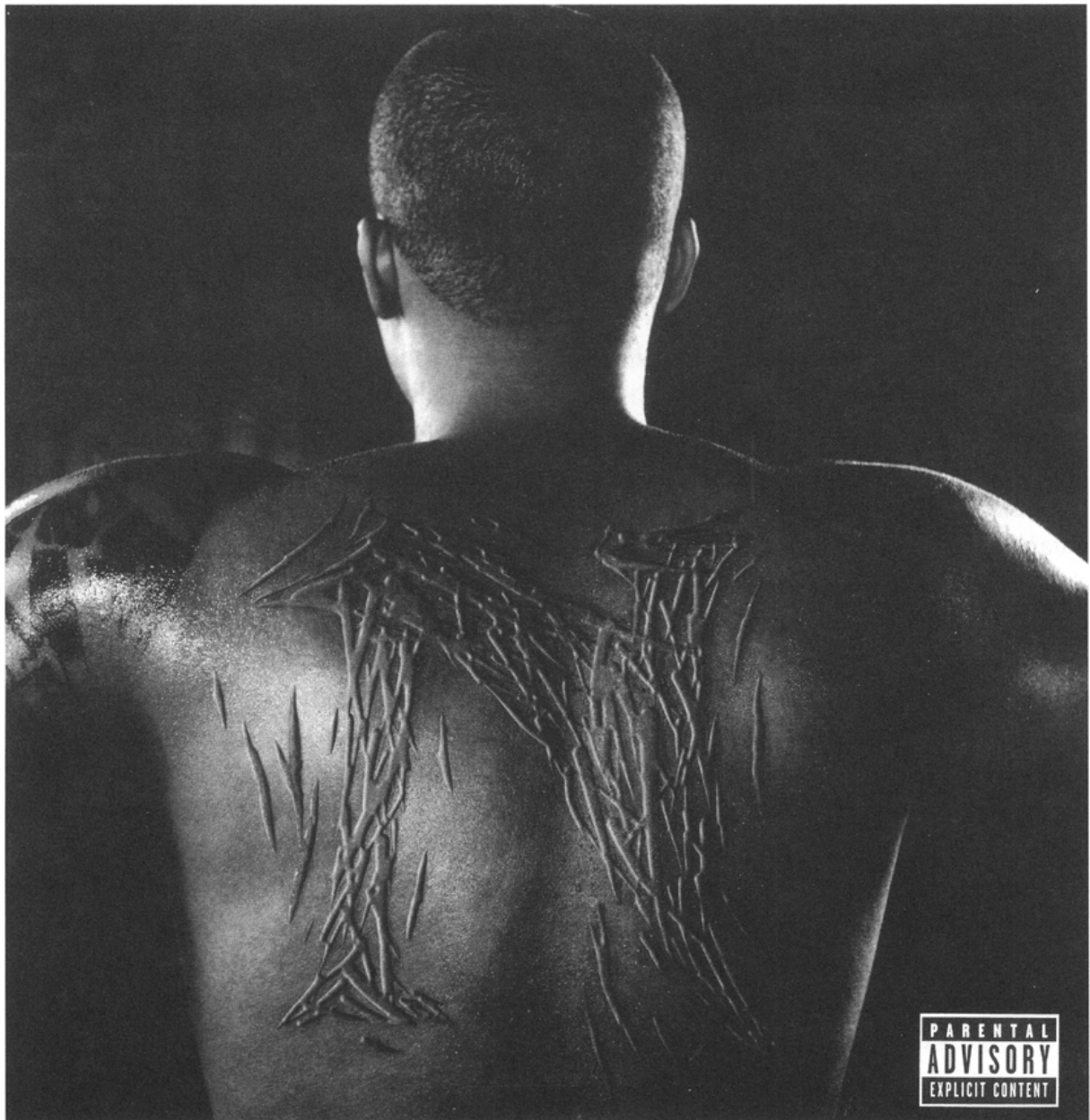


Figure 2: Nas, (Untitled) LP Artwork

human is flawed. Indeed, numbers, like the archives, are truthful lies that can push us toward demonic grounds, a place not where one must choose between white supremacy and oppression, but rather honors the ways in which blackness is archived as a violent beginning and, to be sure, does not consider

this beginning as inevitably tied to trajectory that leads to something rightful or natural or ethical. Put differently, we might emphasize how the demonic—in physics and mathematics—is a nondeterministic schema; it is a process that is hinged on uncertainty and nonlinearity because the organizing princi-



ple cannot foresee the future. This schema, this way of producing or desiring an unanticipated outcome, calls into question “the always non-arbitrary pre-prescribed” parameters of sequential and classificatory linearity.<sup>33</sup> This forecloses the descriptive analytics of violence. The methodological and intellectual work of black studies, I am suggesting, is embedded with this organizing principal precisely because the mathematics of blackness and white supremacy are seemingly knowable (because accountable and counted) and always laden with a chaotic uncertainty. This schema understands arithmetical-epidermal history as a violent unfinished with numeric bursts that uncover a logic that fosters the anti-colonial human being as praxis. This is the future that black studies, at its best, has given me. What is not there is living.

This forces us, in my view, to wrestle with our present anew, and think seriously about what Saidiya Hartman calls the “incomplete project of freedom” and imagine that Sylvia Wynter’s being human as praxis does not, in fact, embrace a bitter return to the scourged back, breathe a sigh of presently emancipated post-race relief, or find comfort in the dismal dance of authenticity—for all of these strategies refuse to take us anywhere new.<sup>34</sup> Instead, I trust that the unindexed lies of our world and the evidence of what transpired are not blueprints for emancipation, or maps to our future, but instead are indicators of the ways in which the brutalities of racial encounter demand a form of human being and being human that newly iterates blackness as uncomfortably enumerating the unanticipated contours of black life. She says she was born free.

## Acknowledgments

This piece is inspired by the writings of Saidiya Hartman. The comments and suggestions offered by Alexander Weheliye, Simone Browne, and the anonymous reviewers made this paper much stronger—thanks to all for taking time with this work. All shortcomings are mine.

## Endnotes

1. Hartman, “Venus in Two Acts,” p. 2.
2. These ship ledgers are from the *Book of Negroes* and can be found at [www.blackloyalist.com/canadiandigitalcollection/documents/official/book\\_of\\_negroes.htm](http://www.blackloyalist.com/canadiandigitalcollection/documents/official/book_of_negroes.htm). Accessed May 3, 2010. Emphasis added.
3. On black modernities, see Gilroy, *The Black Atlantic*, and Iton, *In Search of the Black Fantastic*. I borrow “meta-Darwin” from Sylvia Wynter. See also Wynter and McKittrick, “Unparalleled Catastrophe for Our Species?”
4. Cf. Mbembe, “Necropolitics.”
5. Fanon, *The Wretched of the Earth*, p. 103.
6. I discuss the dead-end analytics of racial violence at length in McKittrick, “On Plantations, Prisons, and a Black Sense of Place.” “Terrible utterances” is from Hartman, “Venus in Two Acts,” p. 3.
7. The “one drop” quotation is from the memoir of Essie Mae Washington-Williams, *Dear Senator: A Memoir by the Daughter of Strom Thurmond*, as quoted in Sharpe, *Monstrous Intimacies*, p. 193n26. The “familiar tone” quotation is from Browne, *The Condemnation of Little B*, p. 5. The quotations regarding Negro “crime” and “technicians” are taken from Moynihan, *The Negro Family*. The “Bell Curve” quotation is from Wynter, “Unsettling the Coloniality of Being/Power/Truth/Freedom,” p. 323. The quotations “just walking



## *Chapter Two*

# **Information and Thinking**

Michel Serres (translated by Joeri Visser)

Bacteria, fungus, whale, sequoia – we do not know any life of which we cannot say that it emits information, receives it, stores it and processes it.<sup>1</sup> Four universal rules, so incontrovertible that, by them, we are tempted to define life but we are unable to do so because of the following counterexamples. Crystal and, indeed, rock, sea, planet, star, galaxy – we know no inert thing of which we cannot say that it emits, receives, stores and processes information. Four universal rules, so uniform that we are tempted to define *anything* in the world by them but are unable to do so because of the following counterexamples. Individuals, but also families, farms, villages, cities and nations – we do not know any human, alone or in groups, of whom we cannot say that they emit, receive, store and process information.

### **FOUR UNIVERSAL RULES**

These four rules of information (defined, in turn, by its rarity) change the idea we have had of thinking and, likewise, the subject–object relationship. Because information circulates universally within and between the totality of all existing things, we really cannot say that we are as exceptional as we think we are. What is thinking, if not at least carrying out these four operations: receiving, emitting, storing and processing information like all existing things? There is no doubt that we do not really know that we think like the *world* because we have been separated from it – by a colossal temporal chasm<sup>2</sup> of millions or thousands of years. There is no doubt that we do not really know that we think like the *living* because we have been separated from them by a colossal temporal chasm of millions or thousands of years.

Better yet, if thinking means inventing, what is left to say? Emitting information that becomes increasingly rare, increasingly controlled during the emission, increasingly independent from the reception, storage and process, increasingly removed from its balance. So dive into bifurcations, branches, yes, real inventions that emerge in the ‘grand narrative’<sup>3</sup> of the Universe or the Evolution of life.

By the way, what is a computer? A machine that emits, receives, stores and processes information, a strange machine with four universal rules – a universal machine, which functions as a thing of the world or as you and me.

## INFORMATION, SOMETHING NEW

Common to everything that has had the chance to exist, information has nothing in common with what we call by that name; media channels overwhelm us every day with it. It is often reduced to dreary repetitions, ad nauseam, to announcements of corpses and disasters of power and death, while war and violence are ranked at the bottom of global causes of human deaths. The information that I am speaking of, instead, is closer to a rarity. Léon Brillouin defines it as the opposite of entropy, which is the characteristic of high energies. He even terms it ‘negentropy’.<sup>4</sup> At the same time that the Industrial Revolution, based on thermodynamic science, comes to an end, a concept from that same science, but contradicting entropy, takes the relay. Just as entropy, in fact, reigns the ‘hard’, so is information equivalent to what I call the ‘soft’.

By soft age, I would willingly comprehend a time in which we finally understand that the four rules that I have set forth govern, and they always have governed, and they without doubt forever will govern all that, being contingent, has the rare chance to exist. This information circulates in the world of things and between living things as well as between us – humans – and it constitutes the bedrock of thinking.

Information, in its everyday sense, contradicts that sense several times: the repetitions are opposed to its rarity, as the identical is opposed to the new and death to life. In the sense of information theory, the information of the media thus provides mostly no information. Inversely, thinking means inventing: getting hold of rarity, discovering the secret of that which has the huge and contingent chance to exist or to be born tomorrow – *natura*, nature, means that which will be born.<sup>5</sup> Such a secret allows us to understand that inventing or discovering requires the same effort for a similar result since everything that exists, contingently, has a given quantity of rarity, that is to say, something new.

## ANCIENT NETWORKS

Where does this information circulate? Basically, in networks. For a long time, I've been surprised by this recent form of circulation that is nonetheless quite ancient. The Roman roads already made one such information network, and a sizeable one, all around the Mediterranean, from Iran to Scotland, from the Danube to the Nile and to the Atlas Mountains. I would not be surprised if one day a specialist discovered the vague traces of comings and goings of our hunter-gatherer ancestors, depending on the seasons, fruits and game, before the agrarian settlement of the Neolithic period. For their part, ethnologists recognize the traces of various tribes in the Amazon rainforest whose marks reflect immemorial gaps, tied with ephemeral housings, through a forest allegedly known as 'virgin', though these identifiable passages reveal it to have been 'cultivated' and thus 'cultural' for a long time. From those distant moments and through ever-expanding spaces, we have continued to cover our landscapes and the portolans of the Silk Routes, of the Incas or of spices – of land, maritime, rail or air ways. We still decorate the planet with a web of hertz – an electronic web – with a thousand and one names, repeating, thereby, a hominid practice that is at least a thousand years and at most a million years old.

Even better, every life constructs itself from admirable networks whose number of paths and connections defies the combinatorial explosion and whose delicacy surprises us. Earth physics, or even chemistry, extracts refined details from it. These tangles bridge the hard sciences and the soft sciences, and the long duration of their form still distances them, a billion years from us. Nothing truly new under the sun, under the 'yellow dwarf'<sup>6</sup> lost in the giant network of singularities known by astrophysicists.

## MATTER AND INFORMATION

Information circulates through the inert, living and human world, where everything and everyone emits it, receives it, exchanges it, conserves it and processes it. Interactions are thus not only material, or hard, but they are also informational, or soft: interactions, for sure, of causes, forces and energies – but also interferences, interpretations and intersections of signs, codes, images, co-possibilities and filters.

Something powerfully new has emerged in our vision of the world: the universe is made up of matter and information, paired and without doubt inseparable. This means that all things express, in some way, other things and the world; all things conspire and consent to it. All things, in some way, perceive – see, write, read – just like us.

No, we are not so exceptional; we are not the only ones endowed with the capability to see, read or write: the wind traces its musical partition over the waves of the sea and the dunes of the desert; running water weaves rich branches of river-like arborescence; dust engraves cliffs that are already sculpted or drawn by erosion; by their distinctive style, earthquakes, fractures, hot spots, the low plate tectonics define the higher relief. The living leave their remains, be it only bones. Magnetism marks itself and remains etched on soft rock on its way to crystallization, indicating the time of its hardening; radioactivity counts time; the climate leaves traces in dust buried in the deep ice of the poles and the ice sheets; evolution deploys itself on organisms, more disparate than systemic. We are not the only ones endowed with the capability to count or remember; the trees calculate their years, crowned in their wood. Nor are we the only ones endowed with the capability to code; everything ultimately gets spelled out in the language of mathematics. I have already said that we think like the world; now I am saying that the world thinks like us.

The world, so here it is.

## THE CAVE STREAMED WITH LIGHT

Dazzled with the light after so long a darkness ... [the two heroes] thought at first they were the prey of some ecstatic illusion, so splendid and unexpected was the sight that greeted their eyes. They were in the center of an immense grotto. The ground was covered with fine sand bespangled with gold. The vault was as high as that of a Gothic cathedral, and stretched away out of sight into the distant darkness. The walls were covered with stalactites of varied hue and wondrous richness, and from them the light of the torches was reflected, flashing back with all the colors of the rainbow, with the glow of a furnace fire and the wealth of the aurora. Colors of the most dazzling, shapes the most extraordinary, dimensions the most unexpected, distinguished these innumerable crystals. They were not, as in most grottoes, pendants, monotonously similar to each other, but nature had given free scope to fancy, and seemed to have exhausted every combination of tint and effect to which the marvelous brilliancy of the rocks could lend itself.

Blocks of amethyst, walls of sardonyx, masses of rubies, needles of emeralds, colonnades of sapphires deep and slender as forest pines, bergs of aquamarine, whorls of turquoise, mirrors of opal, masses of rose gypsum, and gold-veined lapis lazuli all that the crystal kingdom could offer that was precious and rare and bright and dazzling had served as the materials for this astonishing specimen of architecture; and, further, every form, even of the vegetable kingdom, seemed to have been laid under contribution in the wondrous work. Carpets of mineral mosses soft and velvety as

or leftover, and, unlike a perception, the sensation ceases to have edges or borders, being fully submerged in consciousness. Such a consciousness has no location, indeed its location is infinitely extendable to the degree that it senses, conceives, affects, and is affected by its objects and co-occupies the object. The sensation is “true form” as much as consciousness itself is “true form.” This consciousness is ubiquitous, not able to be located in one place, existing without distance from itself. In this, consciousness remains, surprisingly, rather close to the peculiar non-localizable true form of subatomic particles, a consciousness before or without subjectivity, “subjectless subjectivity” as Bains describes it, a consciousness that makes human subjectivity possible and undermines its aspiration to the position of outside observer, knower.

### MNEMIC THEMES

It is significant that Ruyer does not locate consciousness in a human subject or identify it with the brain’s cognitive abilities, nor does he see it as a unique accomplishment of the highest forms of life. Consciousness in his specific sense—self-proximity, autoaffection—must already exist in the world, and especially in its most elementary particles insofar as consciousness exists in the world now. It does not appear magically, an emergent property of a certain degree of complexity in the organization of matter. This is the continuity in nature that Ruyer seeks, a continuity that links the most elementary material relations to the logic of sense, the order of values, and the domain of the future. Elementary particles, the atom, its subatomic constituents, and its relations with other atoms in the molecule, condition and make possible consciousness in its more recognizable forms. The atom and its constituents share with embryos and brains the capacity for immediate auto-overflight or self-survey. Atoms must be considered primary or true forms in continuous touch with their constituents, as must subatomic particles and quantum fields. These are forms, that is to say, structuring activities rather than passive or inert matter structured by something outside.

It is easy to see how Ruyer might be understood as a subjective idealist, one who projects the qualities of human consciousness onto the nonliving world. This is indeed how his work has been commonly dismissed. But, given his interest in post-Einsteinian and subatomic physics, it is difficult to accuse him convincingly of mistaking what is material for what is ideal. The ideal is not separate from materiality but materiality in its primary form. Life itself could not be possible without the self-forming and self-orienting properties of matter at its most elementary. The atom is Spinozan—it perseveres in its being and its activities adhere to a “norm” or a direction, the possibility of certain liaisons with other atoms or its own self-regulated activities. It performs itself, its identity or consciousness such that it directs the atom’s actions. The atom is what it does, and what it does is to maintain a certain cohesion and consistency, a distinctive “style” in its actions and in its potential and actual relations with other atoms. It acts according to an ideal, and when its actions are interfered with or perturbed from outside, as in scientific experiments, it attempts to restore its own natural orientation. In this sense, we can understand that even the atom is free—it acts according to its own modes of self-regulation, according to its own ends, which even the most advanced physicists are only now beginning to understand. This is not “free will,” the capacity to make a different choice under the same circumstances, but acting in accordance with what is self-regulated, according to a self-generated, self-affecting ideal.<sup>25</sup> An atom and all its constituents continuously form themselves into an autoaffecting form. They are not composed or decomposable mechanically. Indeed, for Ruyer, the atom is constituted by the cohesion of quantum fields, forces that are self-generating and immensely difficult to detangle or unravel from their constitutive interactions. The electron, for example, must be in continuous touch with all of the quantum field at any time. Wherever it occupies one location in a quantum field, it occupies all locations.<sup>26</sup>

We can say, as long as it is clear that we are not attributing a human version to the atom and its molecular combinations, that the atom has purpose and direction, has its own orientations and thus its own consciousness, one precisely as complicated as the actions it can accomplish.



Its consciousness *is* the activity of these actions. As primary form, the atom is free, not in the sense that it can do anything, but in the sense that its own characteristics, its own internal constituents regulate themselves according to a path that has become relatively predictable to science, that is, which exhibit their own order, manner of acting, and modes of connection with other atoms. An atom “knows” what it is capable of, more than we are capable of understanding. This knowledge is not mechanical, *partes extra partes*, but internal, from within the atom, the electron and proton in their relations, in a quantum field. Bergson understands that there is what he calls “a spark of indeterminacy” at the atomic and subatomic level, but Ruyer enables this concept to be more carefully articulated.<sup>27</sup> It is not that there is an indeterminacy at the level of the atom (or below this level, with its subatomic ingredients); it is that the atom has its own qualities of “consciousness” that we can come to know at first mechanically and only later, with the development of more nuanced sciences, can we see that the atom must be as much in self-contact, have as much autoaffection or self-enjoyment, as those complexes that are created from atoms—molecules, macromolecules, living cells, organs, embryos, brains, and living beings.

Primary forms cannot be understood as such from any external viewpoint. They exhibit the characteristics of a field that brings into being connections that are regulated internally rather than added together externally, and whose internal bonds, while “invisible,” are always in immediate contact with each other. Molecules are created by the self-forming properties of interacting atoms, as atoms are themselves self-forming properties of interacting subatomic particles that do not provide them with a coherent identity so much as with a coherent behavior, a behavior or movement regulated from within, a pattern of actions, the connections it can make. When atoms combine to form a molecule, “the connecting and interacting electrons are not localizable.”<sup>28</sup> Molecules are not “made” or do not make themselves through the side-by-side placement of atoms: it is only to the extent that atoms of different kinds are capable of transforming themselves through the molecular bonds they form that a new kind of being is created, beyond its constituents, with different properties and qualities.

Ruyer develops his understanding of the qualities of living beings, individuals in the process of individuation, from microphysics.

The fundamental paradox, which is the origin of all the others, is that a domain of primary consciousness is in “absolute survey”—that is to say without any need of an external scanning—that it possesses a kind of *autovision without gaze*. This character has no analogy in classical physics, but it does in microphysics because the domains of consciousness come directly from microphysics, which are already in autosurvey. . . . In order to “speak” of primary consciousness, to evoke it, we must use expressions like “form perceiving itself,” a “form that sees itself without eyes.” . . . It is very difficult to admit that a protoplasm, a molecular edifice, an embryo, an organic tissue or a cortex, are conscious of themselves (possess their own form) before becoming, by added modulation, conscious of the form of other beings, and without being obliged to pass by this detour.<sup>29</sup>

Subatomic particles, atoms, molecules are the lowest levels of “agent,” or “consciousness,” the most elementary patterns of action without external supervision or observation, purposive action that has a self-given direction. They are centers of finalist activity. The atom, molecule, and their ingredients have the absolute overflight of form, which is to say that their actions are the forces of connection: they form themselves. While aggregates—molar relations, structures, mechanisms composed piece by piece—are the objects of Newtonian physics which views even atoms and their ingredients as passive solids, it is “microphysics,” the exploration of the subatomic realm, that reveals the operations of true form at its most elementary. All such primary beings—continuously in touch with all of themselves without distance, in autoaffection—can be distinguished from aggregates, which can be understood by the decomposition of their parts. Primary beings, by contrast, have parts only abstractly, and any decomposition results in their destruction. Primary forms are self-forming forms in auto-overflight, continuously in touch with all of themselves without distance or external perspective. They are virtual forms, capable of actualization in numerous, but constrained, directions.



## CELLS, ORGANS, BRAINS

There is a direct connection between the inorganic world, which consists in both primary forms and aggregates of various kinds, and the organic world. If primary forms are always in immediate self-proximity, in absolute overflight, and aggregates or structures exist with parts side by side without forming organic or internal connections, then, as Spinoza, Nietzsche, Deleuze, and Simondon affirm, there is an order that connects the most elementary (and dynamic) forms of matter to the operations of all forms of life, all forms of consciousness. In Ruyer's understanding, materialists have misunderstood the complexity of materiality to the extent that they conceive of matter as passive, receptive, or reactive. Matter is self-forming, either through its own internal forms and forces or through the operation of external forces that shape it into aggregates and structures, such as a rock, a cloud, a group, which exists by addition and can be analyzed by decomposition or calculation. To the extent that it is self-forming, the direction of primary forms is never random—this is Ruyer's objection to a Darwinism that sees the organism as mere responses to external or chance events or to a preformed (and eventually readable) but randomly mixed genetic code. Seeing life as the result of a random arrangement of genes, or as a response to the contingency of random events that serve to remove the less fit and distinguish them from the more fit (natural selection), can never explain how life arises or the coherent and operational forms it has always taken. Such an explanation ignores the orientedness of the biological body to its environment and the fact that, to the extent random events occur, they occur within a frame to which the living being is already oriented. Evolutionary evidence does not show creatures half formed or partially formed—every living being has a cohesion, a consistency, a speed, a mode of engaging with its milieu.

Ruyer talks of an “invisible world” of unseen and unseeable interactions that we sometimes mistakenly, through faith or superstition, attribute to God. He claims that this world is not divinely ordained, but makes itself, in all its levels and orders of complexity, according to

### 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.<sup>4</sup>

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*.<sup>5</sup> 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.