

Nature's Queer Performativity*

BY KAREN BARAD

How can the possibility of the queerness of one of the most pervasive of all critters – atoms – be entertained? These “ultraqueer” critters with their quantum quotidian qualities queer queerness itself in their radically deconstructive ways of being. The aim is to show that all sorts of seeming impossibilities are indeed possible, including the queerness of causality, matter, space, and time.

“Oozing through Texas Soil, a Team of Amoebas Billions Strong” (Yoon 2009), is a news story title teeming with powerful imaginaries that collectively exude a fearful, if not at least faintly moralistic, scent that permeates the article. The body of the article is crawling with hints of the kinds of phenomena that are at issue in this paper: concerns over foundations, stability and instability, reconfigurations and shape shiftings, nonhuman agency, queer critter behaviors, fear and moralism, and nature/culture, micro/macro, temporal, and spatial boundary crossings.

“Scientists found the vast and sticky empire stretching 40 feet across, consisting of billions of genetically identical single-celled individuals, oozing along in the muck of a cow pasture outside Houston”.² The mixture of morality, politics, and bodily fluids – the aggregation of night terrors of a collective underground movement and revulsions of the flesh – form a tantalizing cocktail. The descriptive language is poignant and

* the authorized version¹

evocative – “vast and sticky empire ... oozing along in the muck” – and the imagery, held in colloidal suspension right there on the surface, is ripe with the musty odors of fear. One doesn’t have to read very far beneath the surface to witness the merger of political anxieties and scientific curiosity into a more complex multi-cellular organism:

Though amoebas would seem unlikely to coordinate interactions with one another over much more than microscopic distances, the discovery of such a massive clonal colony, [Kevin Foster, a Harvard evolutionary biologist] said, “raises the possibility that cells might evolve to organize on much larger spatial scales.”

... In fact, like the colony of social amoebas, the giant amoebas could be everywhere underfoot without anyone’s noticing.

“I used to joke,” Dr. Schliwa said, “that there might be a giant organism in the soil spanning the entire continent and whenever you dig up a shovelful you get a piece of it.” So where will the next giant amoeba be found hiding? Dr. Schliwa points out that the original discovery of the amoeba-to-end-all-amoebas was made in the 1940s by a researcher named Ruth N. Nauss. She discovered the species in a New York City park.

Drawing back the curtain on the workings of her own dramatic rendering, the author of *The New York Times* article presses one of the article’s subterranean imaginaries to the surface, outing the thinly veiled ghost of the 1958 horror classic “The Blob”, a Cold War movie about the creeping threat of communism. The anti-communism theme percolates through the article and creeps into the (presentation of the) scientific details: “Only an apparent oxymoron, social amoebas are able to gather in organized groups and behave cooperatively, some even committing suicide to help fellow amoebas reproduce”. The sacrifice of the individual self for the good of the whole fits the red-scare theme like a glove,

and “suicide” – an interesting term given all that it implies about intentionality and the metaphysics of individualism – is in fact a common way that scientists and science reporters speak of the fate of “individual” amoebas in the process of aggregation. But is it not a rather peculiar reading of the behavior of an organism initially named after the shape-shifter god Proteus – *Proteus animalcule* – “a blob with no defined shape, bits of which could break off to take up a life of their own”, an organism that morphs from a seemingly uncoordinated group of genetically identical single cells to an aggregate “slug” with an immune system and other organismic functionality characteristic of multicellular species with different roles played by identical cellular units?³ As Professor John Tyler Bonner, who has spent a lifetime studying slime molds puts it, slime molds [of which social amoebas or cellular slime molds (*Dictyosteliida*) are classified as one kind] are “no more than a bag of amoebae encased in a thin slime sheath, yet they manage to have various behaviours that are equal to those of animals who possess muscles and nerves with ganglia – that is, simple brains”.⁴ What is or isn’t an “individual” is not a clear and distinct matter, and that seems to be precisely the scientific sticking point: the question of the nature of identity is ripe here – it’s what’s so spectacularly exciting from a scientific point of view. No wonder that social amoebas are taken to be model organisms in molecular biology and genetics for studying communication and cell differentiation. Social amoebas queer the nature of identity, calling into question the individual/group binary. In fact, when it comes to queering identity, the social amoeba enjoys multiple indeterminacies, and has managed to hoodwink scientists’ ongoing attempts to nail down its taxonomy, its species-being defying not only classification by phylum but also by kingdom.⁵ Nonetheless, the rhetorical bias favors the story line of the individual sacrifice for the good of the whole. No

wonder the reader doesn't have to exert much effort to unearth the political and moralistic undercurrents.

While this journalist is clearly having lots of fun with her subject matter, the affective response stimulated by the playful conjuring of this specter is not purely nostalgic, for The Blob – a sticky oozing illimitable protean creature that consumes everything in its path, a particularly vivid literalization of the fear of being consumed by the Other in a xenophobic panic over the spread of foreign elements – did not die off with McCarthyism, but thrived during the Vietnam War years and on through the Reagan years. Rabid anticommunism isn't the only form this fear assumes. Over the course of history it has mutated and multiplied its forms to take on the shape of other rank societal fears, setting up the conditions for panicked reactivity and the spread of loathing and contempt for the Other. For example, The Blob has gone viral in recent years, producing a combination of panic and neglect rather than compassion and reasoned response during recent health crises, such as the AIDS epidemic, the mad cow disease epidemic, and the avian flu epidemic, which has resulted in the willful sacrifice of humans (particularly gay men, IV-drug users, and adults and children living in Sub-Saharan Africa), nonhuman mammals (particularly cows), and birds (particularly chickens), respectively. The systemic incitement of fear and loathing is also evident in the spread of racial, religious, and ethnic dis-ease, as in the pernicious spread of Islamophobia in the US and Europe, the stunning reawakening of virulent strains of anti-Semitism in Europe a mere fifty years after the Holocaust, and the latest round of unabashedly racist anti-immigration legislation in Arizona, to name but a few. Whatever specific form it takes, fear of The Blob is very much alive on the contemporary political scene.

When trekking in the slimy muck of morality, politics, and bodily fluids, there's

nothing innocent about the playful stimulation of the fear response. An aggregate of angst and dread labors beneath the surface and when the conditions are favorable it oozes out into the open. Fear and moralism make a caustic brew.

In fact, when it comes to social amoebas one doesn't have to look very far to find all manner of moralizing rhetoric. "Amoebic Morality", an article whose title betrays all subtlety, is not in the least bit out of step with science reporting in its use of moral descriptors like "noble", "cheaters", "leeches", "cooperating with strangers", "self-sacrifice" to describe amoebic behaviors. It goes on to explain that amoebas are being deployed in laboratory studies of altruism, as if it's the most natural follow up investigation, with no acknowledgement of the circularity at work.⁶ All of which raises the question whether Nature is an exemplary moral actor or a commie activist (or, heaven forbid, both)! That said, it would be a serious error to conclude that I am out to recount the sins of anthropomorphizing. On the contrary, I am deeply interested in 'anthropomorphizing' as an intervention for shaking loose the crusty toxic scales of anthropocentrism, where the human in its exceptional way of being gets to hold all the "goodies" like agency, intentionality, rationality, feeling, pain, empathy, language, consciousness, imagination, and much more. That is, I am interested in troubling the assumptions that prop up the *anthropos* in the first place, including the assumed separation between "the human" and its others. What I am suggesting is not strategic anthropomorphism per se, but using the anthropomorphic moment to call the question, not in order to reiterate the habits of projection, but rather, in fracturing the presumptions of the 'anthropos' of "anthropocentrism", and in so doing opening up a space for response – that is, making an invitation to the other to respond by putting oneself at risk and doing the work it takes to truly enable a response, thereby

removing (some of) the weight of the encrusted layers of nonhuman impossibilities (or at least drilling a hole through and allowing some air to circulate).⁷

As such, I would suggest that the difficulty at hand does not lie in the attribution of moral virtues to nonhumans per se, but rather in the forceful and stinging character of moralism, particularly as it is directed at securing the nature/culture divide.⁸ Given that moralism fashions humans as the only moral agents on the scene, the nature/culture divide is not just any old boundary but the very air it breathes. It's no wonder then that moralism sees itself as duty-bound to protect this sacred boundary with the utmost ferocity. There is, however, a kind of sweet justice in the irony that to the degree that fear and moralism are whipped up into a fevered state aimed at safe-guarding the nature/culture divide, a compulsive breeching of that very divide inevitably breaks through, like some uncontrollable tic.

Consider the following example: the (il)logics of the notion of "Crimes against Nature", a legal term referring to "sexual intercourse contrary to the order of nature", including all "acts of bestial character whereby degraded and perverted sexual desires are sought to be gratified".⁹ Most commonly it refers to "sodomy", and in particular, to sex acts between persons of the same sex. Today, criminal penalties for committing sexual acts "against nature" are as severe as life in prison (see for example the statutes of the state of Idaho) or even death.¹⁰

The perverse coupling of nature, sexuality, and morality is vividly illustrated by the following claim: "sodomy is to be condemned because the rational ground of all morality is nature, and sodomy is against nature". This statement by Harry V. Jaffa, the Henry Salvatori Research Professor of Political Philosophy at Claremont McKenna College and the Claremont Graduate School, is taken from an opposite the edi-

torial page piece published in the *The Los Angeles Times* on January 14, 1989. An on-line position paper entitled "Homosexuality and Natural Law", posted on the website of the ultra-right-wing The Claremont Institute in southern California, quotes the line from the opposite the editorial page piece and finishes the thought: "To regard 'the generative distinction between male and female' as arbitrary, [Jaffa] continued, 'is to regard all the distinctions upon which all morality rests – e.g., those which condemn slavery and genocide – as arbitrary. It implies that we are free to choose whether there are objective limitations upon human action, objective standards of right and wrong'".¹¹ So according to Jaffa, if homosexuality is not criminalized, the morality floor drops out: the illegality of homosexuality is the very foundation of morality. This (il)logic neatly coheres with the perverse fact that the most heinous crime against nature, at least by the lights of many different cultures, is not mass killings of nonhumans or those deemed "less-than-human" human Others, but "unnatural sexual acts", as in non-reproductive sexual acts, especially sodomy, in other words "homosexual acts".

Moralism, which feeds off of human exceptionalism, and, in particular, human superiority (indeed, being moral agents is one way that humans are said to be better than the beasts), props up the specific moral injunction against "unnatural" human behaviors. There is a price to pay for going against the "ways of nature" and her laws. But if the crime is against Nature herself – the whole of Nature, that is, if the act is so egregious as to go "against all that is natural" – then it must have been committed by some agent who is outside of Nature, presumably a human agent, one cognizant of his sins. Now, if the act is against Nature, and the actor is not of Nature, but outside it, then all acts committed by this actor must be "not in accordance with or determined by nature; contrary to nature" – that is, "unnatural", by definition.¹² And at the

same time, if the moral injunction is against “unnatural” human behaviors, including acting like a beast, then this is because one is acting like nature – performing “natural” acts. Hence, the (il)logic at work trips over the very divide – the nature/culture divide – it seeks to secure. In fact, it is the law itself – in fashioning some human acts as bestial in nature – that breeches the sacred divide, opening up the possibility of humans engaging in nonhuman acts.¹³ So it is the law that violates its own injunction, forcefully penetrating the nature/culture divide, committing the ultimate violation.

Furthermore, the discourse on “crimes against nature” always already takes liberty in the confidence that Nature is herself a good Christian, or at least traffics in a kind of purity that the human has been excluded from ever since the Edenic fall of man. But what if Nature herself is a commie, a pervert, or a queer? Opening with evolutionary biologist J.B.S. Haldane’s famous quote “The universe is not only queerer than we suppose, it is queerer than we can suppose”, Bruce Bagemihl writes that the world is “teeming with homosexual, bisexual, and transgendered creatures of every stripe and feather” (Bagemihl 2000: 9). Citing the scientific literature on mammals, birds, reptiles, amphibians, fishes, insects, and other invertebrates, he writes: “homosexual behavior occurs in more than 450 different kinds of animals worldwide, and is found in every major geographical region and every major animal group” (ibid.: 12). But even this extraordinary zoological catalogue of queer animals covers only a small fraction of the universe – even if we stick to the earth, there are all kinds of critters that don’t make the list, like all manner of nonanimal life forms (amoebas, plants, viruses) and the multitudinous forms of existence we deem as ‘inanimate’.

It is my contention that the world in its exuberance is far more queer than all the numerous citations to Haldane’s quote seem to intend. In this article, I will even

entertain the possibility of the queerness of one of the most pervasive of all critters – atoms. These “ultraqueer” critters with their quantum quotidian qualities queer queerness itself in their radically deconstructive ways of being.¹⁴ Indeed, given that queer is a radical questioning of identity and binaries, including the nature/culture binary, this article aims to show that all sorts of seeming impossibilities are indeed possible, including the queerness of causality, matter, space, and time. Queer is not a fixed determinate term; it does not have a stable referential context, which is not say that it means anything anyone wants it to be. *Queer* is itself a lively mutating organism, a desiring radical openness, an edgy protean differentiating multiplicity, an agential dis/continuity, an enfolded reiteratively materializing promiscuously inventive spatiotemporality. What if queerness were understood to reside not in the breach of nature/culture, per se, but in the very nature of spacetime mattering?

In concluding this prelude, I would like to thank the amoeba, an exceptional comrade able to cooperate over long distances and spans of history, for assisting me here in helping to foreground the subterranean diffusion of moralizing cultures that spread the disease of genocidal hatred and undermines ecologies of diversity necessary for flourishing. When moral indignation is seeping through the groundwork of society, surely this is the case.

NATURE’S QUEER PERFORMATIVITY¹⁵

A motely crew of queer co-workers – social amoebas, neuronal receptor cells in stingrays, lightning, a phantom species of dinoflagellates, academics (a strange companion species), and atoms among them – assist in this discussion of nature’s queer performativity. The approach used here is not to invite nonhuman others into the fold of queerness, but to interrogate the binaries that support the divisions that are at

stake. So before they enter, a few more preliminaries are in order, including a more in-depth discussion of how the nature/culture divide, especially in the specific guise of human exceptionalism, undermines attempts to think and grow ecologies of difference that have a chance of flourishing. Since the very nature of spacetime-mattering is at issue, let's begin then, as with all beginnings, with a reiteration. And so this beginning returns again for the first time...

"Acts against nature" – what beastly images are conjured by this phrase? When "acts against nature" are committed, the crimes are of no small measure. Moral indignation is oozing forth, like amoebas through Texas soil, and lives are at stake (maybe literally).¹⁶ What kinds of acts against nature inspire moral outrage? Queer pleasures for sure, even some forms of heterosexual sex, and an assortment of other human practices. Clearly, the nature/culture divide is at issue and at stake, but the logic that tries to hold it in place is quite perverse. On one hand, it is clear that humans are understood to be the actors, the enactors of these "acts against nature". The sense of exteriority is absolute: the crime is against Nature herself, against all that is natural. Nature is the victim, the victimized, the wronged. At the same time, humans who commit "acts against nature" are said to be acting like animals. In other words, the "perpetrator" is seen as damaging Nature from the outside, yet at the same time is reviled for becoming part of Nature. Bestiality is surely both a spoken and an unspoken infraction here, but the "real crime", as the accusers would have it, is the breach of the nature/culture divide, which has not simply been ruptured but has itself been wronged. In other words, those who would prosecute the "perpetrators" of "crimes against nature" trip over the very divide they seek to secure. To make matters worse, "acts against nature" truly deserving an enraged response for grave injustices enacted are traditionally ex-

cluded from counting as any kind of infraction within the (il)logic of this moralizing practice. A case in point: given the usual associations of humans with culture and animals with nature, one might think that forms of violence against animals perpetuated by industrial meat production – that is, the mass extermination of "Others" made killable – would qualify in this logic as "acts against nature" worthy of our provoking moral outrage.¹⁷ And yet, it is particular sexual acts that are criminalized and labeled immoral, while the mass extermination of animals goes unnoticed and unpunished, and is normalized, naturalized, and sanitized as part of the cost of food production. If logic falters, what difficulty of the nature/culture divide is being indicated at this juncture where queer theory and eco-criticism meet?

Performativity has been essential to queer theory.¹⁸ And yet, performativity has been figured (almost exclusively) as a human affair; humans are its subject matter, its sole matters of concern.¹⁹ But human exceptionalism is an odd scaffoldings on which to build a theory that is specifically intended to account for matters of abjection and the differential construction of the human, especially when gradations of humanness, including inhumanness, are often constituted in relation to nonhumans.

A case in point is the well-honed tactic of dehumanization – through the identification of an oppressed group of humans with despised nonhuman others "whereby it [becomes] possible not only to set a group apart as an enemy, but also to exterminate it with an easy conscience" (Mamdani 2001, quoted in Raffles 2006: 521).²⁰ Heinrich Himmler, head of the elite Nazi force the SS, was no stranger to this tactic. He is unflinchingly explicit about the kinds of consequences such equivalences are meant to effect:

Antisemitism is *exactly the same* as delousing. Getting rid of lice is not a question of ideolo-

gy. It is a matter of cleanliness. In just the same way, antisemitism, for us, has not been a question of ideology, but a matter of cleanliness, which now will soon have been dealt with. We shall soon be deloused. We have only 20,000 lice left, and then the matter is finished within the whole of Germany (Himmler April 1943, quoted in Raffles 2006: 521. Emphasis added).

The effects on human life of such identifications or (en)forced equivalencies between humans and nonhuman others have been, and continue to be, devastating. At the same time, we would be remiss if the acknowledgment of the differential constitution of the human in relation to the nonhuman only served to refocus our attention, once again, exclusively on the human.

One response to the kind of genocidal arithmetic used by Himmler has been to reject such comparisons by invoking the singular superiority of humans. But this reaction not only crosses out the equivalence relation by further devaluing one side of the equation – the nonhuman at the expense of the human – but it does so by repeating the very same calculus of racialization deployed in the first place. This kind of response echoes the problem it seeks to address, underwriting an ethical and moral position engaged in erasure – a lack of accountability for the (unavoidable) constitutive exclusions enacted. That is, the equivalence relation between human and nonhuman is canceled out in this rendering, but only by eliding the material conditions and effects of how different differences matter. One dimension that is erased is the unquestioned killability of nonhumans. Nonhumans do not figure in this kind of moral computation.²¹ But the contrary positions – the reassertion of an equivalency between humans and nonhumans in the name of animal rights, or the privileging of animal rights over human rights (by inverting the usual inequality that takes human superiority for granted) – rest on the same kinds of

difficulties and do nothing more to promote accountability.²²

What is needed is a starting point for analysis that does not presume that the terms on either side of equivalence relations are given, but instead directly takes up the matter of the cuts that produce distinctions between “humans” and “nonhumans” – where the differential constitution of both terms is important, and so are their respective constitutive exclusions – before any such comparisons get off the ground. That is, what is needed is accountability for the cuts that are made and the constitutive entanglements that are effected. In particular, the “posthumanist” point is not to blur the boundaries between human and nonhuman, not to cross out all distinctions and differences, and not to simply invert humanism, but rather to understand the materializing effects of particular ways of drawing boundaries between “humans” and “nonhumans”.²³ Crucially, then, such an analysis cannot figure cuts as purely a matter of human practices of differentiating, that is, as cultural distinctions. Whatever a “cut” is must not assume a prior notion of the “human”.

Alternatively, we could ask: What about the nonhuman when it comes to performative accounts of abjection, subjection, agency, and materialization? Surely nonhumans as well as humans must figure in, but widening the radius of performativity’s applicability to include nonhumans is not what is at issue. Rather, the point is that the very practices of differentiating the “human” from the “nonhuman”, the “animate” from the “inanimate”, and the “cultural” from the “natural” produce crucial materializing effects that are unaccounted for by starting an analysis after these boundaries are in place. In other words, what is needed is an account not only of the materialization of “human” bodies but of all matter(ings)/materializations, including the materializing effects of boundary making practices by which the “human”

and the “nonhuman” are differentially constituted. This must include not merely natural forces and social forces but the differential constitution of forces as “natural” or “social”.²⁴

Consequently, my subject matter here is not nonhuman performativity per se but the materializing practices of differentiating, where one cannot take for granted that all the actors, actions, and effects are human. Of interest then are not only practices by which humans make distinctions but also practices of differentiating engaged in by nonhumans, whereby nonhumans differentiate themselves from their environments, from other nonhumans, and from humans, as well as from other others. To be more precise, the point is not merely to include nonhumans as well as humans as actors or agents of change but rather to find ways to think about the nature of causality, agency, relationality, and change without taking these distinctions to be foundational or holding them in place. What is needed then is a way of thinking about the nature of differentiating that is not derivative of some fixed notion of identity or even a fixed spacing. Indeed, what is the nature of difference if differentiating doesn’t happen in space and time but in the making of spacetime-mattering?²⁵ What strange causality is operative in per formative constructions? What temporality constitutes (and/or is constituted by) its operation? What does it mean for constitutive exclusions to be part of the very fabric of spacetime-mattering?

Elsewhere I have given a detailed exposition of a posthumanist performative account of materialization that does not limit its concerns and analysis to the realm of the human.²⁶ On my agential realist account, all bodies, not merely human bodies, come to matter through the world’s performativity – its iterative intra-activity.²⁷ Matter is not figured as a mere effect or product of discursive practices, but rather as an agential factor in its iterative materialization, and identity and difference are radically re-

worked. In particular, I have argued that what we commonly take to be individual entities are not separate determinately bounded and propertied objects, but rather are (entangled “parts of”) phenomena (material-discursive intra-actions) that extend across (what we commonly take to be separate places and moments in) space and time (where the notions of “material” and “discursive” and the relationship between them are unmoored from their anti/humanist foundations and reworked). Phenomena are entanglements of spacetime-mattering, not in the colloquial sense of a connection or intertwining of individual entities, but rather in the technical sense of “quantum entanglements”, which are the (ontological) inseparability of agentially intra-acting “components”.²⁸ The notion of *intra-action* (in contrast to the usual “interaction”, which presumes the prior existence of independent entities/relata) marks an important shift, reopening and refiguring foundational notions of classical ontology such as causality, agency, space, time, matter, discourse, responsibility, and accountability. A specific intra-action enacts an *agential cut* (*in contrast to the Cartesian cut – an inherent distinction – between subject and object*) *effecting a separation between “subject” and “object”*. *That is, the agential cut enacts a “local” resolution within the phenomenon of the inherent ontological indeterminacy.*²⁹ *Crucially then, intra-actions enact agential separability – the local condition of exteriority-within-phenomena. Thus, differentiating is not a relation of radical exteriority, but of agential separability, of exteriority-within. Intra-actions cut things together-apart (as one movement). Identity is a phenomenal matter; it is not an individual affair. Identity is multiple within itself; or rather, identity is diffracted through itself – identity is diffraction/différance/differing/deferring/differentiating.*³⁰

In this article I want to explore these issues further by considering acts of nature – that is, nature’s intra/activity, its queer per-

formativity – in making alliances with, indeed in seeing “ourselves” as always already a part of nature, of all manner of beings that the category “acts against nature” claims to save or defend but in reality erases and demonizes. In the next section I introduce some rather “queer critters”. The point in referring to them as “queer” is not to use an eye-catching term when “odd” or “strange” would have sufficed, nor is it to make a case that these critters engage in queer sexual practices (though some do, at least on some countings), but rather to make the point that their very “species being”, as it were, makes explicit the queering of “identity” and relationality.³¹ (It is not enough to simply assert that identity is a relation, if the relation in question is between or among entities that are understood to precede their relations.)

To speak of “queer critters” is to cut across the cuts that define these terms. For on the one hand, we can understand “queer” as a verb acting on the noun “critter”. The queering of critter is important, since the term “critter” already enacts exclusions of the kind that are being troubled. Critter, in one sense of the term, is an animate being, where the line between “animate” and “inanimate” is taken as given, rather than an effect of particular boundary-drawing practices. On the other hand, “critter” is already internally queer, having contrary associations as a term defined both in contrast to or as distinct from humans (as in its reference to animate non-humans), and, in relation to humans (e.g., as a term of reprobation or contempt, but also sometimes as term of affection or tenderness).³² In an important sense then, critters are inherently destabilizing and do not have determinate identities, by definition.

QUEER CRITTERS, QUANTUM CAUSALITY, AND NATURE'S PERFORMATIVITY

The queer critters that will be introduced

in this section include lightning, neuronal receptor cells in stingrays, a phantom species of dinoflagellates, academics (a strange species), and atoms. Keeping an eye (or, if you're a brittlestar, your whole being) focused on their uncanny communicative abilities, or more precisely, on the bizarre causal relatings they exhibit as a result of the phenomenal/entangled nature of “their” being, will help make evident the agentially intra-active, that is, queer performative, nature of (their) being/becoming.³³

In engaging our queer co-workers here, it is crucial that we are mindful of the fact that the point here is not merely to use non/humans as tools to think with, but in thinking with them to face our ethical obligations to them, for they are not merely tools for our use but real living beings (and I include in this category “inanimate” as well as “animate” beings).³⁴ A related point is to avoid the pitfall of positioning everything in relation to the human and to embrace a commitment to being attentive to the activity of each critter in its ongoing intra-active engagement with and as part of the world it participates in materializing.

Lightning's Stuttering Chatter

Lightning inspires fear and awe. It jolts our memories, flashing images of the electrifying origins of life in our mind's eye: images of lightning's energizing jump start, its enlivening of the primordial ooze as it is shocked into a soup of organic materials for brewing earth's first organisms, and images of nature gone awry in man's usurping of the power to give life, famously animated by Dr. Frankenstein's monster. Lightning gives life and takes it away.

Lightning is a striking phenomenon. It is an archetypal “act of nature” causing “more direct deaths than any other weather phenomenon” (Uman 1986: 17). Approximately ten thousand forest fires in the U.S. are ignited by lightning each year (Uman

1986: 5). According to the National Weather Service, “at any given moment, there are 1,800 thunderstorms in progress somewhere on the earth”, or some 16 million lightning storms annually.³⁵

Lightning is both an everyday occurrence and a complex phenomenon in its own right, challenging scientists in their grasp of the physics at every turn. One of my other co-workers, poststructuralist theorist Vicki Kirby, beautifully animates the queer nature of lightning’s performances:

As I live in something of an aerie whose panorama includes a significant sweep of the Sydney harbor and skyline, it is common to see electrical storms arcing across the city. As I’ve waited for the next flash, trying to anticipate where it might strike, I’ve wondered about the erratic logic of this fiery charge whose intent seems as capricious as it is determined. The assumption that lightning does exhibit a certain logic is evident in the common wisdom that lightning never strikes in the same place twice. But as Martin Uman, one of lightning’s foremost interpreters tells us, the situation is quite the opposite. “Much of what is known about lightning today has been discovered precisely because lightning *does* strike the same structure over and over again . . . The Empire State Building in New York City is struck by lightning an average of about 23 times a year...” (Uman 1986, 47). Reading about electricity’s predilection for tall buildings, lone trees on golf courses, tractors and bodies of open water, I also learned that quite curious initiation rites precede these electrical encounters. An intriguing communication, a sort of stuttering chatter between the ground and the sky, appears to anticipate the actual stroke. A quite spectacular example is the phenomenon of St. Elmo’s Fire, a visible light show that can sometimes be seen to enliven an object in the moment, *just before the moment*, of the strike. . .

But let’s begin with something whose behavior we might expect to be significantly more straightforward than the contentious

nature of St. Elmo’s fire and its associations with those “mobile luminous spheres” called ball lightning.³⁶ For example, if we begin by considering a lightning stroke, the flash that we are used to observing in an electrical storm, we will probably assume that it originates in a cloud and is then discharged in the direction of the ground. However, if this directional causality were true, it would be reasonable to ask how lightning can be apprised of its most economical route to the earth before it has been tested. According to experts, the path of lightning is one of arcing disjuncture that runs in both an upward and downward direction (Uman 1986, 73). Buildings and other objects on the ground can initiate strikes by sending out what are called upward moving “leaders” of invitation to a visually undetected downward traveling spark, called a “stepped leader” – or vice versa. Uman explains this moment of initiation in terms of speech acts. “What is important to note . . . is that the usual stepped leader starts from the cloud without any ‘knowledge’ of what buildings or geography are present below. In fact, it is thought . . . that the stepped leader is ‘unaware’ of objects beneath it until it is some tens of yards from the eventual strike point. When ‘awareness’ occurs, a traveling spark is initiated from the point to be struck and propagates upward to meet the downward moving stepped leader, completing the path to ground” (1986, 49-50). We might well ask what language drives this electric conversation that seems to get ahead of itself in the final instant (or was it the first instant?) of divine apprehension – “when awareness takes place”? (Kirby 2011: 10-11).

What kind of bizarre communication is at work here? What strange causality is effected? A lightning bolt is not a straightforward resolution of the buildup of a charge difference between the earth and a storm cloud: a lightning bolt does not simply proceed from storm cloud to the earth along a unidirectional (if somewhat erratic) path. The path that lightning takes is not only

not predictable, it does not make its way in some continuous fashion between sky and ground. There is, as it were, some kind of nonlocal communication effected between the two. By some mechanism scientists have yet to fully explain, a storm cloud becomes extremely electrically polarized – electrons are stripped from the atoms they were once attached to and gather at the lower part of the cloud closest to the earth. In response, the earth's surface becomes polarized with these earth-bound electrons burrowing into the earth. A strong electric field between earth and cloud results, and all that remains to be accomplished now is a conductive path joining the two. The first inklings of a path have a modest beginning offering no indication of its explosive end. "It begins as a small spark inside the cloud five miles up. A spurt of electrons rushes outwards, travels a hundred meters then stops and pools for a few millionths of a second. Then the stream lurches off in a different direction, pools again, and again. Often the stream branches and splits. This is not a lightning bolt yet" (Discovery Channel 2007).³⁷ These barely luminous first gestures are called "step leaders". But the buildup of negative charges (electrons) in the lower portion of the cloud does not resolve itself by a direct channel of electrons making their way to the earth in this fashion. Instead, *the ground* responds next with an upwards signal of its own. "When that step leader is within ten or a hundred meters of the ground, the ground is now aware of there being a big surplus" of charge, and "certain objects on the earth respond by launching little streamers up toward the step leader, weakly luminous plasma filaments, which are trying to connect with what's coming down". It is as though objects on the ground are being hailed by the cloud's interpellative address. When one of the upward responses is met by the downward address, the electrical circuit is closed and a powerful discharge is effected in the form of a lightning strike. But even

after the path has been carved, as it were, the discharge does not proceed in a continuous fashion: "The part of the channel nearest the ground will drain first, then successively higher parts, and finally the charge from the cloud itself. So the visible lightning bolt moves up from ground to cloud as the massive electric currents flow down".

An enlivening, and indeed *lively*, response to difference if ever there was one. What mechanism is at work in this communicative exchange between sky and ground when awareness lies at the crux of this strangely animated inanimate relating? How does this exchange get ahead of itself, as it were? How is the ground animated into an awareness of its would-be interlocutor? And what does it mean for the sender to transmit a message to a recipient that is both particular to the given recipient in its exacting localized connection and yet unspecified at the moment of its transmission?

What are we to make of a communication that has neither sender nor recipient until transmission has already occurred? That is, what are we to make of the fact that the existence of sender and receiver follows from this nonlocal relating rather than preceding it? If lightning enlivens the boundary between life and death, if it exists on the razor's edge between animate and inanimate, does it not seem to dip sometimes here and sometimes there on either side of the divide?³⁸

Clairvoyant Neuronal Receptor Cells in Stingrays

Neuronal receptor cells in stingrays seem to possess "some mysterious clairvoyancy":

They are able to anticipate when a message which has yet to arrive, will have been addressed to them, for they unlock themselves in readiness. It is as if the identity and behavior of any *one* observable receptor cell is somehow stretched, or disseminated, in a space/time enfolding; as if they are located

here, and yet also there, at the same time. If the separation between sender and receiver is strangely compromised in this biological example, so too is the status of the message. To consider this more carefully, if the interval between the two is no distance, then what difference could a message effect, and what would it be? *Strange stuff, this action at a distance that confounds the logic of causality* (Kirby 2001: 59, my italics).³⁹

Lest we conclude that these two examples of paradoxical communication (as exhibited by lightning and neuronal receptor cells in stingrays), paradoxes which ultimately implicate structures of temporality and causality, only apply to a select few phenomena, let's widen the frame and take in more of the story as Kirby tells it. Kirby begins this tale of neuronal chatter in stingrays by describing the situation she finds herself in when she is in receipt of this astonishing scientific result.

I was waiting in line with a small group of scholarship recipients, each of us charged with the task of explaining our various intellectual projects to an assembled association of benefactors. I'd been called upon to justify my enthusiasm for deconstructive criticism to a non-academic audience which, quite properly, expected to hear it was getting value for its investment. Needless to say, I was somewhat apprehensive about my ability to convince them. As it happened, however, with no particular fuss or fanfare, the young biologist who spoke before me conveyed the peculiar stuff of my question eloquently. The object of her special passion was the stingray and, as I recall, her interest in how cells talk to their neighbors was facilitated by the ease of observation which the neuronal structures of these particular creatures enabled. . . . Her fascinated listeners were informed that receptor cells, which operate like locks that can only be opened by the right key or message, seem possessed of some mysterious clairvoyancy (Kirby 2001: 58–59).

After remarking on the strange causality evidenced in this result, Kirby continues:

I had, of course, heard it all before. Indeed, with some amusement I could see that the entangled identity of *one* cell within another had even assumed human proportions in regard to individuation. Was this biologist already in receipt of my intellectual labours before our meeting, even as I tried to articulate the results that she, of course, had inevitably discovered? What infectious algorithm had already brought us together before our actual meeting? (Kirby 2001: 59).

Kirby's account of these two nonlocal communicative happenings – engaging in a seemingly improper (nay, scandalous) mixing of phenomena at apparently different scales and realms of applicability (seemingly conflating natural and cultural forces, as if forces come in such markedly different kinds) – pays no homage to shared humanist and antihumanist indulgences in human exceptionalism. In her book, *Quantum Anthropologies*, in which Kirby argues for a materialist reading of Derrida's grammatology, she notes that the quantum paradoxes exhibited by lightning, stingrays, and humans are persistently denied any empirical purchase, as though the thought of allowing nature such a radical degree of ontological complexity is too much to bear, and that such bewildering matters must, in the end, be a result of culture's perverse framing of something significantly more tame. Arguing that deconstruction should be understood as a positive science, Kirby unleashes the liveliness of the world in a way that speaks to my agential realist account of worlding. That is, the entangled relations of natureculture don't stop with the intra-action between Kirby and the biologist whose account precedes hers in a radical undoing of "precedes".⁴⁰ Always already in receipt of each other's materialist interventions, Kirby's materialist readings of Derrida's grammatology and my quantum

physics re-thinking of matter/ing (making evident physics' own deconstructive undoing of its classical foundations) have been in conversation with one another since before we met. This untimely collaboration is one of a multitude of entangled performances of the world's worlding itself.

Pfiesteria's Phantom Performances

In the summer of 1997 the *Washington Post* ran a story with a headline worthy of the *National Inquirer*: "The Feeding Frenzy of a Morphing 'Cell from Hell.'" The article describes these devilish micro-organisms this way: "Invisible to both scientist and fish is the creature itself, a bizarre one-celled predator that can appear to transform itself from animal to plant and back again. Called *Pfiesteria piscicida*, this killer dinoflagellate captured the attention of scientists worldwide when it emerged six years ago [1991] from the murk of North Carolina's coastal estuaries, the phantom suspect in a string of mass killings that destroyed more than a billion fish" (Warrick 1997. In Schrader 2010: 175-276).

Dinoflagellates are microscopic, usually unicellular, often photosynthetic protists with whiplike appendages. "Dinos" are thought to be the cause of red tide and are suspected of being toxic to certain fish. They are neither plant nor animal, but can act as both:

While it has been believed that about half of the described dino species act as photosynthesizing plants and the other half are heterotrophic (obtaining energy by eating other organisms), there is a growing awareness that many species are actually mixotrophic, changing their nutritional habits between plant- and animal-like with varying environmental conditions (Coats 2002: 417; Hackett, et al. 2004: 1523). Also depending on environmental conditions, dinos can change the way they reproduce, most often asexually, but not always. "A sexual phase has also been docu-

mented for many dinoflagellates and involves the fusion of asexually generated gametes to produce a motile zygote, the planozygote". (Coats 2002: 418) (From an earlier, unpublished version of Schrader 2010. Used with permission from the author).

A toxic species of dinos – *Pfiesteria piscicida* ("fish killer") – has caught the attention of science studies scholar Astrid Schrader.⁴¹ Schrader explains that a kind of "*Pfiesteria* hysteria" has gripped the scientific community, which has been unable to identify the most basic features of *Pfiesteria* after more than two decades of research. There is no agreement about either *Pfiesteria*'s life cycle or whether or not they are the causative agents responsible for the death of millions of fish and major estuary damage and destruction. Far from being a matter of mere scientific curiosity, the real-world concerns at stake in answering these questions have economic and ecological implications on a global scale.⁴²

The lack of scientific consensus concerning the inherent features of *Pfiesteria* has prompted policy makers to adopt a wait-and-see stance. But Schrader warns that this (allegedly non-position) position is as dangerous as it is misinformed, since it is based on a gross error concerning the nature of science: policy makers (and most scientists) believe that a lack of definitive evidence necessarily marks an uncertainty, a gap in the current state of knowledge that will eventually be filled in. By contrast, in examining the different laboratory practices in detail, Schrader argues that scientists' inability to pin down the nature of *Pfiesteria* has precisely to do with the nature of the critter itself – namely, that its very species being is indeterminate. In other words, Schrader makes the case that what scientists and policy makers take to be an *epistemological uncertainty* is in actuality an *ontological indeterminacy*: "*Pfiesteria*'s species beings are not simply multiple or fluid, reducible to variations along some preconceived flow

of time, but inherently indeterminate. There is no moment in time in which *Pfiesteria* could be unambiguously delineated from its environment” (Schrader 2008B). Schrader fleshes out the point in this way:

In addition to an inseparability of “organism” and “environment”, spatial (synchronic) and temporal (diachronic) changes in *Pfiesteria*’s life-histories are thoroughly intertwined. There is no moment in time in which *Pfiesteria* can be captured in their entirety. Thus, part of the conundrum that drives the controversy, I suggest, is that the questions “who *Pfiesteria piscicida* are” and “what toxic *Pfiesteria* do” are inseparably entangled (Schrader 2010: 283).

Pfiesteria exclusively cultured on algae prey cannot be made to kill fish. Ironically, they need the fish around in order to become their killers. Toxic *Pfiesteria* only “are” in relationship to fish and specific environmental conditions. In simpler terms: without fish there is no fish killer. If you want to know who *Pfiesteria* are by themselves – if that were possible at all – you will inevitably produce nontoxic *Pfiesteria*, but not *Pfiesteria piscicida*, the fish killer (Schrader 2010: 285).

Like our other queer co-workers, *Pfiesteria*’s worldly performances are not localizable in space or time. Examining a range of laboratory approaches to studying the toxicity and species being of *Pfiesteria*, Schrader makes the case that approaches that insist on a “simplistic emitter-transmitter-receiver model” fail to establish the toxicity of *Pfiesteria* because their procedures – which embody particular ways of defining toxicity and particularly rudimentary understandings of causality and temporality – preclude by design the kinds of toxic agential performances in which *Pfiesteria* engage.

By contrast, the procedure designed by one laboratory, the laboratory of Burkholder et al., does not suppress *Pfiesteria*’s ma-

terial agency by trying to impose a deterministic model of causation as the mechanism of fish kills. Instead, their approach allows *Pfiesteria* to engage in heterogeneous temporal and nondeterministic causal relations:

[The] agential definitions [used in Burkholder’s lab] don’t presuppose toxicity as an inherent property of a particular life stage. Rather, the various toxic *Pfiesteria* strains refer to performances of an assemblage of morphs, described as temporal manifestations of a variable life cycle that cannot be isolated from the intra-actions that bring them about. Since the strains are not fixed categories but can transform into one another, their kind of toxicity cannot be solely controlled by present environmental parameters but is dependent on *Pfiesteria*’s history; that is, on the effects of indeterminable intra-action that have led to *Pfiesteria*’s current material mode. The dinos act differently towards fish dependent on how recently they have been in contact with fish. In Burkholder’s terms, *Pfiesteria* have a biochemical memory for recent stimulations by live fish, which introduces a variable temporal dimension into the relationship between the organisms and their environment (From an earlier, unpublished version of Schrader 2010. Used with permission from the author).

Hence, what Schrader is able to demonstrate is that responsible laboratory practices must take account of the agential performances of the organism in making the specific nature of causal relations evident. *Responsibility entails providing opportunities for the organism to respond.* Dinosaurs do not respond to deterministic models of causality. They insist that their agential performances be taken into account. But not just any performative account of scientific practice will do. Understanding that the objects of investigation are effects rather than causes does not settle once and for all the matter of causation as one of acausality or of

no causal relationship whatsoever in the space vacated by determinism. That is, the choices are not simply deterministic causality, acausality, or no causality. What *Pfisteria* make evident is a mode of *causality as iterative intra-activity* (Barad 2007). And indeed, it is precisely the fact that “causality as iterable intra-activity thus becomes an inheritance that *temporalizes* the phenomenon in ‘cutting together’ deadly traces and hinges on the inclusion of specific matters of concern as part of the experimental referent, which renders the experiments repeatable” that evidences the inseparability of matters of epistemology and ethics (Schrader 2010: 297). The responsible practice of science is simultaneously a matter of good scientific practice (epistemologically sound science) and justice-to-come.

The Atom's Queer Performativity

“No one understands these queer quantum things”, writes Alan Grometstein in *The Root of Things* (Grometstein 1999: 4). What could be more queer than an atom? And I don't just mean strange. The very nature of an atom's being, its very identity, is indeterminacy itself.⁴³

There seemed to be something queer about the quantum from the beginning.⁴⁴ Or rather, it became evident from the start that quantum causes trouble for the very notion of “from the beginning”. More than a decade before the advent of the quantum theory, physicist Niels Bohr made the imaginative theoretical move of applying Max Planck's idea of energy quantization to matter itself, and in particular to each bit of matter, that is, each atom. The Bohr model of the atom is a quantum variant of the solar system model of the atom proposed by Ernst Rutherford. In the Bohr model, each atom has a nucleus (made up of protons and neutrons) with the electrons residing in discrete (i.e., quantized) “orbitals” around the nucleus. Each electron in an atom occupies one of a finite number

of discrete energy levels. When an electron “jumps” from a higher energy level to a lower energy level, a photon (a quantum of light) is emitted with a frequency (color) corresponding to the difference in energy between the two levels.⁴⁵ Since each kind of atom in the periodic table has a unique configuration of discrete orbitals, the atomic spectrum uniquely identifies the atom that produces it, much like an atomic fingerprint.⁴⁶

Bohr's model was able to account for the stability of matter, and it accurately predicted the emission spectrum of hydrogen. The stunning successes of this model earned Bohr the Nobel Prize in physics. However, upon careful examination it becomes clear that there is something inherently queer about the nature of matter.

Consider the process by which a single emission line in the atomic spectrum is produced. Each spectral line (of a given color or frequency) is the result of an electron making a “leap” or “jump” from a higher energy level to a lower energy level. What precisely is the nature of this “leap”? The expression “quantum leap” has become a part of everyday speech, where it has taken on the meaning of a large change, when actually the change we are talking about here couldn't be *smaller*. “Quantum”, in the sense used by physicists, signifies the “minimum amount of a physical quantity which can exist, and in multiples of which it can vary”.⁴⁷

So a quantum leap is very small, but that's not its signature feature. What's most unique about it is that, unlike any ordinary experience of jumping or leaping, when an electron makes a “quantum leap” it does so in a *discontinuous* fashion (belying the very notion of a “leap”): in particular, the electron is initially at one energy level and then it is at another *without having been anywhere in between!* *A quantum leap is a discontinuous movement.* Quantum phenomena are famous for their uncanniness. But for all the fanfare and the display of an in-

creasing array of astonishingly strange phenomena, and all the sophisticated mathematical machinery used to describe it, the crux of these paradoxes is right here in this quantum discontinuity.

Let's consider the situation closely. Initially the electron is in a higher energy state E_2 ; finally it is in a lower energy state E_1 . At what point is the photon emitted? According to the classical physics model proposed by Rutherford, an atomic electron continuously loses energy as it orbits the nucleus, a continuous spectrum of light is emitted, and the atom quickly decays in a flash of light (i.e., atoms are unstable in this model, which is one of its weaknesses). By contrast, Bohr's quantum model has two important features that diverge from the classical model: (1) atomic electrons do not orbit around the nucleus like planets around the sun, but rather each must occupy one of a set of discrete energy levels at a time, and since each "orbital" corresponds to a fixed energy, and electrons that reside in a given orbital do not radiate energy (light), (2) when electrons make a transition from a higher energy level to a lower one, the excess energy is emitted in a discrete packet called a "photon". As such, a continuous transition between energy levels isn't possible. But now a problem arises. If a photon can only result from the leap itself, at what point during this leap is the photon emitted (recall that a photon is a quantum of light, and hence, light is not being emitted continuously but rather in a discrete amount as a particle of light)? The emission of the photon can't take place when the electron is on its way from E_2 to E_1 because it is never anywhere in between the two energy levels; nor can the photon be emitted when it is at energy level E_1 or E_2 because no energy change has (yet) taken place. And furthermore, something is deeply amiss about the nature of causality, for if the atom were to emit a photon of a given color as it leaves E_2 (on its way to E_1) *it will have had to already wind up where it*

was going (i.e., E_1) before it left, so the proper frequency of photon would be emitted to conserve energy – a strange causality indeed! Thus, the paradoxical nature of quantum causality derives from the quantum discontinuity – the very fact there exists an inherent discontinuity (constitutive of all intra-actions).

What constitutes a quantum discontinuity? This discontinuity that queers our presumptions of continuity is neither the opposite of the continuous, nor continuous with it. Quantum "leaps" are not mere displacements in space through time, not from here-now to there-then, not when it is the rupture itself that helps constitute the here's and now's, and not once and for all. The point is not merely that something is here-now and then there-then without ever having been anywhere in between – that's bad enough, of course – but that here-now, there-then have become unmoored: there's no given place or time for them to be. Where and when do quantum leaps happen? If the nature of causality is troubled to such a degree that effect does not simply follow cause end over end in an unfolding of existence through time, how is it possible to orient oneself in space or in time? Can we even continue to presume that space and time are still "there"?

This queer causality entails the disruption of dis/continuity, a disruption so destabilizing, so downright dizzying, that it is difficult to believe that it is that which makes for the stability of existence itself. Or rather, to put it a bit more precisely, if the indeterminate nature of existence by its nature teeters on the cusp of stability and instability, of possibility and impossibility, then the dynamic relationality between continuity and discontinuity is crucial to the open-ended becoming of the world which resists acausality as much as determinism.

I don't want to make too much of a little thing, but the quantum, this tiny disjuncture that exists in neither space nor time,

torques the very nature of the relation between continuity and discontinuity to such a degree that the nature of change changes with each intra-action. Change, to the extent that any general characterization can be given, is a dynamism of an entirely different sort which functions in an entirely different way from that which is presumed to operate on matter situated *in* space and *in* time (e.g., one important difference is that existence is not simply a manifold of being that *evolves* in space and time); rather, what comes to be and is immediately re-configured entails iterative intra-active becomings of *spacetime-mattering*.⁴⁸ Iterative intra-activity configures and reconfigures entanglements. Entanglements are not the interconnectedness of things or events separated in space and time. *Entanglements are enfoldings of spacetime-matterings*.

Queer Identities, Quantum Erasures, and Im/Possibilities for Changing the "Past"

Quantum entanglement is the characteristic trait of quantum mechanics, the one that enforces its entire departure from classical lines of thought. – Erwin Schrödinger: "The Present Situation in Quantum Mechanics"

The concern is not with horizons of modified – past or future – presents, but with a "past" that has never been present, and which never will be, whose future to come will never be a *production* or a reproduction in the form of presence. – Jacques Derrida: *Margins of Philosophy*

We choose to examine a phenomenon which is impossible, absolutely impossible, to explain in any classical way, and which has in it the heart of quantum mechanics. In reality, it contains the only mystery. – Richard Feynman: *Six Easy Pieces*

Physicists now claim to have empirical evidence that it is possible not only to change the past, but to change the very nature of

being itself in the past. The experiment in question is the so-called quantum eraser experiment.⁴⁹

According to Niels Bohr, quantum physics makes evident the fact that entities (atoms, photons, electrons, etc.) do not have an inherent ontological identity (as either particles or waves, that is, either as localized objects or as extended disturbances in a field).⁵⁰ On Bohr's account, identity is not given, but rather performed. This can be demonstrated using a simple device called a two-slit apparatus, which is basically a screen with two holes in it. According to classical physics, if you want to know if an entity is a wave or a particle you simply send it through two open slits, over and over again (or, alternatively, send many identical entities through the slits), developing a pattern over time. If a scatter pattern appears with most of the entities landing directly across from one slit or the other, it's a particle. If a diffraction pattern appears – a result of some disturbance (like that of a water wave), making its way through both slits simultaneously – it's a wave.⁵¹ This distinguishing feature is important: a diffraction pattern is the result of an interference of that which emerges through multiple slits at once (rather than one slit or the other as in the case of a particle). Waves and particles produce distinctly different two-slit patterns, and so from the point of view of classical physics, this is a definitive test of an entity's nature.

Quantum physics calls into question the classical ontological classification of entities into two distinct kinds: waves and particles. Experiments at the beginning of the twentieth century produced results that were inexplicable in terms of classical notions of identity, and the two-slit experiment is sufficient to reveal these nonclassical behaviors. Send an electron through the double slits hundreds of times (or send hundreds of electrons through the slits one at a time), and the pattern that emerges is a diffraction pattern characteristic of waves. The

same experiment can be done with atoms or neutrons or photons, and a diffraction pattern is produced in each case. But unlike water waves, particles don't "interfere" with one another (they can't occupy the same place at the same time), and in any case, since they are being sent through the slits one at a time they aren't given a chance to encounter one another in any way. So what accounts for the wave behavior? Each particle should be going through one slit at a time (by definition), and yet a diffraction pattern is the result of an entity (like a water wave) going through both slits at once.

To help resolve the paradox suppose we devise a device to "look and see" what is happening at the slits, to "watch" as each electron goes through the slits on its way to the screen. In fact, Einstein, who rejected quantum theory and was committed to a classical ontology, proposed such a "which-slit" device to show that quantum physics was conceptually self-contradictory in that the entity would be revealed to be particle at the slits (going through one or the other) and a wave at the screen, and entities can't be both waves and particles simultaneously. Bohr adamantly disagreed with Einstein and argued that Einstein's which-slit experiment beautifully demonstrated his idea of complementarity, according to which an entity *either* behaves like a wave *or* a particle depending on how it is measured (i.e., on the nature of the measuring apparatus it becomes entangled with). In the case of a two-slit apparatus with a which-slit detector, Bohr argued that the pattern that would be exhibited would in fact be a scatter pattern, characteristic of particle behavior. That is, although an entity performs like a wave with a simple two-slit experiment (no which-slit detector), it performs like a particle with a two-slit apparatus modified to include a which-slit detector. *So the very nature of the entity – its ontology – changes (or rather becomes differently determinate) depending on the experimental apparatus used to determine its na-*

ture. For Bohr, complementarity saved the theory from contradictions and enabled objective results to be obtained. His explanation is that the objective referent for concepts, like "wave" and "particle", is not a determinately bounded object with inherent characteristics (as the ontology of classical physics would have it), but rather what he called a *phenomenon* – the entanglement/inseparability of "object" and "apparatus" (which do not preexist the experiment but rather emerge from it). Bohr came to this understanding by a very unorthodox approach for a physicist – he focused his attention on how *concepts* work (a radically unusual step for a scientist!), on how they do the work they do, and how they come to mean what they mean.⁵²

The two-slit experiment was thus the focus of heated debates and endless discussions by the founders of quantum physics beginning in the 1920s, and it continues to be of great interest to this day. It was *the* gedanken (thought) experiment of its time. Einstein and Bohr argued endlessly about it. Today the experiment that was never to be (it could exist only in the rarified realm of pure thought) can, in fact, be performed in the lab: welcome to the world of experimental meta/physics.

Without going into too many details of the experiment, suffice it to say that we can design a very clever two-slit device with a which-slit detector (composed of a laser and two cavities). This device performs the which-slit measurement without disturbing the "external forward motion" of the atom by manipulating the "internal parts" of the atom only. The atom, as it makes its way to the double slits, passes through a laser beam, thereby exciting one of its atomic electrons to a higher energy level. Two "micromaser cavities" are set up at each slit, designed to force this electron to "jump" back down to the lower energy level as the atom passes through the cavity, thus emitting a "tell-tale" photon, which is left in the cavity – marking which slit the

atom went through on its way to the screen.

Running the experiment without the which-slit detector reveals a diffraction pattern – that is, the atoms behave like waves. If the experiment is run again with the which-slit detector in place, the pattern is that of particles, just as Bohr predicted. This is direct empirical evidence that identity is not fixed and inherent, but performative.

Bohr explained the performative nature of things in terms of *quantum entanglements* of the measurement apparatus and the object of measurement: according to Bohr, it is not so much the case that things behave differently when measured differently; rather, the point is that there is only the phenomena – the intra-action of “apparatus” and “object” in their inseparability. Now, if Bohr’s hypothesis that phenomena are quantum entanglements holds, then some evidently impossible things become possible. Suppose that the which-slit detector is made in such a way that evidence of which slit the entity in question (in this case an atom) goes through can be erased *after* it has gone through the slits.⁵³ It turns out that if the which-slit information is “erased”, then a diffraction pattern characteristic of waves is once again in evidence (as in the case without a which-slit detector). In fact, it doesn’t matter at what point the information is erased – in particular, it could be erased *after* the entity in question has already gone through the entire apparatus and made its contribution to the pattern. In other words, whether or not an entity goes through the apparatus as a wave or a particle – through both slits simultaneously or one slit or the other, respectively – can be determined *afterwards* – *after* it has already gone through the apparatus. That is, it is not simply that the past behavior of some given entity has been changed because of something that happens in the future, but that the entity’s very identity has been changed. Thus, we have empirical evi-

dence of the fact that the atom’s *identity, its ontology, is never fixed, but is always open to future and past reworkings!*

The physicists who proposed the quantum eraser experiment interpret these results as the possibility of “changing the past”. The language they use speaks of a particular read on these results that does not square with Bohr’s philosophy-physics: in particular, they refer to the which-slit information as having been “erased” (hence the name of the “quantum eraser” experiment), and the diffraction pattern as having been “recovered” (as if the original pattern has returned). But, as I have argued, this interpretation is not as careful as it might be, and furthermore, it is based on assumptions that are being called into question by this very experiment, assumptions concerning the nature of being and time.

If one assumes a metaphysics of presence, that the pattern results from the behavior of a group of individually determinate objects, then it seems inexplicable that the “erasure” of information about which slit each individual entity went through, *after* the individuals have gone through the slits, could have any effect. Otherwise, what notion of causality could account for such a strange occurrence? What could be the source of such instantaneous communication, a kind of global conspiracy of individual actors acting in concert? What kind of spooky action-at-a-distance causality is this?! The difficulty here is the mistaken assumption of a classical ontology based on a belief in a world populated by independently existing things with determinate boundaries and properties that move around in a container called “space” in step with a linear sequence of moments called “time”. But the evidence indicates that the world does not operate according to any such classical ontology.

I have argued elsewhere (Barad 2007) that in diffractively reading insights from physics and poststructuralist theory through one another it is possible to “ex-

tend” and further elaborate the ideas of Butler’s performativity theory beyond the realm of the human (that indeed one *must* do so in taking account even of the human in its materiality), if certain key notions like materiality, discursivity, agency, and causality are suitably revised in light of the radical revision of classical understandings of matter and meaning-making suggested by these findings. Examining the quantum eraser evidence in light of this posthumanist performative understanding of the nature of nature resolves some of the evident paradoxes and gives deconstructionism empirical traction. To put the point differently, this move makes the wager that the radical reverberations of deconstructionism are not merely perverse imaginings of the human mind or of culture but are, in fact, *queer happenings of the world*.⁵⁴

Returning to the evidence in question, the quantum “eraser” experiment gives empirical weight to the deconstructionist claim that the concern is “not with horizons of modified – past or future – presents, but with a ‘past’ that has never been present, and which never will be, whose future to come will never be a production or a reproduction in the form of presence” (Derrida 1994). The evidence is in fact consistent with this point, that it’s not that (in erasing the information after the fact that) the experimenter changes a past that had already been present. Rather, *the point is that the past was never simply there to begin with and the future is not simply what will unfold*; rather, the “past” and the “future” are iteratively reworked and enfolded through the iterative practices of spacetime-mattering – including the which-slit detection and the subsequent “erasure” of which-slit information – are all one phenomenon. Space and time are phenomenal, that is, they are intra-actively produced in the making of phenomena; *neither space nor time exists as a determinate given outside of phenomena*.⁵⁵

As I mentioned, the evidence is against

the claim made by some physicists that all trace of the event is “erased” when the which-slit information is destroyed and that the previous diffraction pattern is “recovered”. On the contrary, the diffraction pattern produced as a result of the local erasure of information (as to which slit the atom went through) is not the same as the “original” (that is, as the diffraction pattern produced before a which-slit measurement was made). Unlike the original, the new diffraction pattern is not plainly evident without explicitly tracing the (extant) entanglements. *The trace of all measurements remains even when information is erased; it takes work to make the ghostly entanglements visible*. The past is not closed (it never was), but erasure (of all traces) is not what is at issue. The past is not present. “Past” and “future” are iteratively reconfigured and enfolded through the world’s ongoing intra-activity. There is no inherently determinate relationship between past and future. Phenomena are not located in space and time; rather, *phenomena are material entanglements enfolded and threaded through the spacetime-mattering of the universe*. Even the “re-turn” of a diffraction pattern does not signal a going back, an erasure of memory, a restoration of a present past. *Memory – the pattern of sedimented enfoldings of iterative intra-activity – is written into the fabric of the world*. The world “holds” the memory of all traces; or rather, the world *is* its memory (enfolded materialization).

CONCLUSIONS

My co-workers and I have presented a host of challenges to classical ontology – a worldview that posits the existence of discrete entities that interact with one another in a locally determinate causal fashion, wherein change is the result of one event (the cause) causing another event (the effect) and causes effect the motion of entities moving through space in accord with the linear flow of time. The assumptions

that support this view include the following: the world is composed of individual objects with determinate properties and boundaries, space is a given volume in which events occur, time is a parameter that advances in linear fashion on its own accord, and effects follow their causes. All of these assumptions have been called into question by nature's queer performances: lightning bolts, neuronal receptor cells in stingrays, a dinoflagellate animalplant life-form found in North American estuaries, atoms, and humans are among nature's critters whose practices, identities, and species being cannot be accounted for within a classical ontology.

We saw, for example, how classical conceptions of causality and identity fail in each case, and how their uncanny communicative abilities, their queer causal relations, are inexplicable if their identities are understood in terms of independently existing entities. These critters cannot be understood as discrete agents interacting with an environment or other external or separate agents, not when the presumed succession of effect following cause is out of joint and causality seems to take on some kind of uncanny character. Each of the critters we have considered not only "challenge[s] our conception of time as [a] homogenous flow of self-identical moments, in which a cause by definition precedes its effect" (Schrader 2010: 278-79), but also the notion of identity "itself" and its derivatives, including questions of causality, responsibility, and accountability.

In its place, I have proposed an agential realist ontology, or what one might call a "quantum ontology", based on the existence of phenomena rather than of independently existing things (Barad 2007). These performatively materializing entanglements of spacetime-mattering are able to account for the causally complex performances we have considered here.

Elsewhere, I have repeatedly emphasized that the ontological shift suggested by

these findings is not necessarily circumscribed by the scale of the microscopic realm.⁵⁶ But somehow my exhaustive repetition and development of this point does not ward off panicked attempts to contain, tame, or normalize nature's queerness, which will not be quarantined and is always threatening to leak out and contaminate "life as we know it" – turning the fun-house, freak show of atoms' perverse putterings into an anxiety-inducing largescale "catastrophe". My hope is that in examining these (further) examples involving macroscopic entities, such as the queer quantum ontological performances of *Pfisteria* and lightning, nature's pervasive queerness might be appreciated across divisions of scale and familiarity. So, for example, although *an everyday macroscopic phenomenon*, like lightning, might yield certain regular features of its behaviors to an explanation based on the laws of classical physics, it nonetheless *exhibits the kinds of queer behaviors that atoms do in the microcosmic domain*. Unlike more "exotic", less familiar phenomena, like that of atoms, whose queer behaviors refuse to be civilized by the laws of classical physics, *this everyday macroscopic phenomenon poses a set of quandaries, displaying an array of queer/quantum happenings, from within the very domain of "classical" physics*. What closet indeterminacies might be lurking in the presumably straightforward classification of micro and macro?

Behaving much like an electron or a ghost, deconstruction tunnels in and out of this essay implicitly or explicitly in each section. Together with Kirby and Schrader, I give room for Derrida's ideas to engage in serious play with these queer critters.⁵⁷ Without going into more detail about these deconstructive elements than the length of this essay would allow, it may seem surprising, or even disconcerting, that I mention the possibility of *empirical* support for deconstructive ideas like *différance*. While the suggestion that deconstruction might have

empirical support may appear blasphemous to some (especially given the common mis/understanding that deconstruction has fully deconstructed empiricism and put it to rest, as it were), we are insisting on materialist readings of deconstruction that open up the empirical to reworkings that unmoor it from conventional understandings and do not presume that it can (or even ought to) be put to rest. According to my agential realist account, not only are empirical claims not ruled out, they are understood to be particular intelligible articulations of the world (with all due regard to all the various qualifications required to make good sense of this claim). In particular, empirical claims do not refer to individually existing determinate entities, but to phenomena-in-their-becoming, where becoming is not tied to a temporality of futurity, but rather a radically open relatingness of the world worlding itself.

In this brief brush with deconstruction, it may be helpful to keep in mind that agential realism is not a straight read of physics, as it were, but a diffractive investigation of differences that matter, where insights from physics and poststructuralist and deconstructivist theories have been read through one another.⁵⁸

As I have pointed out before, physics wonderfully deconstructs itself, reopening and refiguring foundational issues such as agency, causality, space, time, matter, and responsibility as it goes.⁵⁹

I now want to return to the questions raised at the beginning, or rather they return here once again as much as they percolate throughout the essay, and draw out some of the key ethical issues and matters of concern threaded throughout the discussion of causality, temporality, and entanglement as informed by the queer performative enactments of these nonhuman critters.

Derrida's notions of "justice-to-come" and *différance* haunt this essay for good reasons. On my agential realist account, differentiating is not merely about cutting

apart but also cutting together as one movement: cutting together-apart. Differentiating is a matter of entanglement. Entanglements are not intertwinings of separate entities but rather irreducible relations of responsibility. There is no fixed dividing line between "self" and "other", "past" and "present" and "future", "here" and "now", "cause" and "effect". Quantum dis/continuity is no ordinary disjunction. *Agential cuts* do not mark some absolute separation but a cutting together/apart – a "holding together" of the *disparate* itself ... without wounding the dis-juncture, the dispersion, or the difference, without effacing the heterogeneity of the other ... without or before the synthetic junction of the conjunction and the disjunction" (Derrida 1994: 29). Agential cuts – intra-actions – don't produce (absolute) separation, they engage in agential separability – differentiating and entangling (that's one move, not successive processes). Agential cuts radically rework relations of joining and disjoining. Separability in this sense, agential separability, is a matter of irreducible heterogeneity that is not undermined by the relations of inheritance that hold together the disparate without reducing difference to sameness.

The quantum dis/continuity queers the very notion of differentiating. It offers a much-needed rethinking of ac/counting, taking account, and accountability that isn't derivative of some fixed notion of identity or even a fixed interval or origin. Ac/counting – a taking into account of what materializes and of what is excluded from materializing – cannot be a straightforward calculation, since it cannot be based on the assumed existence of individual entities that can be added to, subtracted from, or equated with one another. Accountability cannot be reduced to identifying individual causal factors and assigning blame to this or that cause. Indeed, causality is an altogether queer matter. Rather, accountability is an ethico-onto-epistemological commitment to understand how differ-

ent cuts matter in the reiterative intra-activity of worlding, that is, of the entanglements of spacetime-matterings. Taking account entails being accountable, for all ac/countings are from within, not without. There is no pure external position, only agential separability, differences within, *différance*. Accountability cannot be based on a mathematics of identity. Simple substitutions, equivalence relations, or transitivity among individual elements are undone.

Ironically, in an important sense, there are no “acts against nature”, not if they entail the sense of absolute exteriority that is usually assumed. In this radical reworking of nature/culture, there is no outside of nature from which to act; there are only “acts of nature” (including thinking and language use), which is not to reduce culture to nature, but to reject the notion that nature is inherently inadequate, and in particular, lacking in value and meaning, and so requires culture as its supplement (Kirby). What if we were to understand culture as something nature does?⁶⁰ This reworking of the nature/culture and human/non-human binaries frees up space for moral outrage directed at specific acts of violence against humans and nonhumans, including material(izing) effects of how they are differentiated (and then equated).

Entanglements are not a name for the interconnectedness of all being as one, but rather for specific material relations of the ongoing differentiating of the world. Entanglements are relations of obligation – being bound to the other – enfolded traces of othering. Othering, the constitution of an “Other”, entails an indebtedness to the “Other”, who is irreducibly and materially bound to, threaded through, the “self” – a diffraction/dispersion of identity. “Otherness” is an entangled relation of difference (*différance*).

An ethics of entanglement entails possibilities and obligations for reworking the material effects of the past and the future. There can never be absolute redemption,

but spacetime-matter *can* be productively reconfigured, reworking im/possibilities in the process. Changes to the past don’t erase marks on bodies; the sedimenting material effects of these very reconfigurings – memories/re-member-ings – are written into the flesh of the world. Our debt to those who are already dead and those who are not yet born cannot be disentangled from who we are. What if we were to recognize that differentiating is a material act that is not about radical separation, but on the contrary, about making connections and commitments?⁶¹

NOTES

1. There is a previously unauthorized version of this paper that appears in the graduate student run journal *Qui Parle* (2011/19/2 University of Nebraska Press). I am grateful to Hilda Rømer Christensen and the editors of *Women, Gender, & Research* for allowing me the opportunity to bring the authorized version of the paper to light.
2. All quotes in this section are from the cited *New York Times* article unless otherwise indicated.
3. How cool is it that “In response to the cAMP distress call, up to one hundred thousand of the amoebas assemble. They first form a tower, which eventually topples over into an oblong blob about two millimeters long. The identical amoebas within this *pseudoplasmodium* – or slug – begin to differentiate and take on specialized roles” (Otte 2007, see ref fn 6).
4. Quote attributed to Professor John Tyler Bonner, from Wikipedia entry on Slime Molds.
5. “First discovered in a North Carolina forest in 1935, *Dictyostelium discoideum* was at first classified under ‘lower fungi’ and in subsequent years into the kingdoms Protocista, Fungi and Tubulomitocondrae. By the 1990s, most scientists accepted the current classification. Amoebozoa are now considered by most to form a separate kingdom-level clade, being more closely related to both animals and fungi than to plants” (Wikipedia entry on Dictyostelid). I thank Fern Feldman for sharing my delight in the indeterminacies of social amoebas and for pointing out the elusiveness of its biological classification.
6. By Carol Otte, posted October 9, 2007

(<http://www.damninteresting.com/amoebic-morality/>, accessed November 5, 2010). This is a “damn interesting” article, a well-written compilation of lots of different research findings on social amoebas. Otte’s use of language or morality is not an added flourish to attract readers; rather, questions of morality circulate with great regularity in the scientific literature on social amoebas, which is a very interesting phenomenon.

7. For example, if the notion of the “social amoeba” as an oxymoron rings true, that is, if there is a belief operative that single-celled organisms are simply too primitive to engage in social relations or any form of cooperative behavior (especially over large distances), then setting aside the prohibition on thinking of sociality and agency as non-human capacities is surely an important step in dislodging some of the sedimenting effects of human exceptionalism.

8. Indeed, the very possibility of the moral nonhuman opens up a rethinking, a *queering*, of morality such that it is not founded on the nature/culture divide, but rather calls that very divide into question. With this reorientation, “amoebic morality” would not constitute one more colonialist move to covertly cement humans into the equation (the inequality) by setting the nonhuman up for epistemological resourcing, making everything into a question of what the Other can teach us, or even about who ‘we’ ought to speak for as a substitute for response-ability, that is, making it possible for the other to respond.

9. From the legal code of the state of North Carolina

(<http://www.ncgala.org/guide/guidecan.htm>).

10. http://www.everything2.com/index.pl?node_id=1009724

11. <http://famguardian.org/Subjects/SexualImmorality/Homosexuality/HomoAndNaturalLaw.htm>

12. From the Online Dictionary: <http://www.vocabulary.com/definition/unnatural>

The indeterminacy of meaning of “natural” and “unnatural” produces interesting instabilities.

13. If one understands the law as guarding against humans parodying animals, not *actually* engaged in “bestial acts” per se, but in acts of mimicry, that is, acting *as if* one is a (nonhuman) animal, a human in sheep’s clothing as it were, then it is the law that would have humans engage in a rather sheepish form of cross-dressing by marking specific human acts as a form of drag that crosses the nature/culture divide. The playful ironic edge in my response to this weaker claim is fully intended, for the malicious use of such equivalence relations

turns on how the “as if” gets played. The use of such equivalence relations across species boundaries that moralism heavily traffics in do not intend anything as “innocent” as an “as if”. Indeed, as Hugh Raffles points out, Himmler’s remark that “anti-Semitism is exactly the same as delousing” is not a “mere” suggestion that “anti-Semitism is ... *like* delousing, nor is it merely *a form* of delousing. It is *exactly the same* as delousing” (Raffles 2010: 142). The purposefully inflammatory statement is not “merely” that Jews act like lice, what is being set forth by Himmler is an equivalence relation: Jews *are* lice. Raffles goes on to point out that

“Although the Nazis imposed the borders with unprecedented ferocity, they did not initiate the expulsion of Jews from the kingdom of humanity. In early-modern France, for example, ‘since coition with a Jewess is *precisely the same* as if a man should copulate with a dog’, Christians who had heterosexual sex with Jews could be prosecuted for the capital crime of sodomy and burned alive with their partners – ‘such persons in the eye of the law and our holy faith differ[ing] in no wise from beasts’ (who were also subject to trial and execution). In a minor key, long-standing German identification of Jews with dogs (mongrels) and, sometimes, pigs, persisted through the Nazi era. More destructive – and more insinuating – was the association of the Jew with the shadowy figure of the parasite, a figure that infests the individual body, the population, and of course, the body politic, that does so in both obvious and unexpected ways, and that invites innovative interventions and controls” (ibid, p.145).

Hence, in the next section of the article, I emphasize the necessity of radically disrupting the calculus of exterminism and killability (the immorality of making killable, see Haraway 2008). If this murdering arithmetic is left in place, by trying to deny the equivalence by defending only one side of the equation and holding the other in disdain, for example, it will surely come around to haunt and harm all matter of beings, human and nonhuman alike. How we signify the Other matters. It is important to be clear that equivalence relations of this kind do not trouble the nature/culture divide – they feed off of it.

14. See also Barad 2010. Some may raise the objection that queerness necessarily has something to do with desire and that this disqualifies atoms, electrons, space, and time. But this objection based on human exceptionalism begs the question: what form must desire take such that only some beings or forms of existence are entitled to it and not others?

15. The remainder of this article (aside from the first paragraph of the section entitled "Nature's Queer Performativity") is the final version of the article "Nature's Queer Performativity", as submitted to *Qui Parle*. Unfortunately, this is not the version *Qui Parle* sent to the publisher, and attempts to have the error corrected failed.

16. In the original version there was a footnote describing *The New York Times* article "Oozing through Texas Soil, a Team of Amoebas Billions Strong". That (part of the) footnote became the inspiration for the opening section of this paper, and thus has been removed. The invocation of "stake" in this sentence, as it came forth, in the sense of "investment", conjures an historically important sense of the word relevant to this discussion: the historical fact that "acts against nature" were actively prosecuted by the Church during the Middle Ages, and that one form of capital punishment used was burning at the stake. On the one hand, we might call this an act of the unconscious; alternatively, without denying the existence of the unconscious, but given that we will reopen the matter of communication in this paper, we might wonder what the mechanism of this reverberation, this excitation of meaning, is, and whether what is at issue is an entanglement (in time as well as space) that is inherent in the materiality of remembering rather than being yet another feature that is unique to the human. Or at least this twist to the usual story is the kind of human/nonhuman reworkings this article hopes to provoke.

17. On the important ethics notion of "making killable", see Haraway 2008.

18. See especially classic works by Butler 1993 and 1990 and Sedgwick 1995, 2003, and 2005 and the productive and queer legacy of this significant engagement with the notion of performativity.

19. Engagements with performativity theory that explicitly challenge its singular focus on the human include Barad 2007 and 2003; Birke, Bryld, and Lykke 2004; Giffney and Hird 2008; Kirby 1997 and 2006, and Schrader 2010.

20. The Stanton report on stages of genocide identifies dehumanization (stage 3) as a stage marked by the identification of groups of humans with nonhumans. Dogs, rats, cockroaches, lice, vermin, insects, and parasites are commonly enlisted as the despised others for this purpose.

21. "But what of the death of animals? Is that death 'as such' and do they have access to it, or perhaps we through them? What exactly might an animal death do for us, not in terms of what it might supply us as food or clothing, but rather might there be any 'knowledge' gained from see-

ing an animal die, if not from killing it ourselves?

The question comes partly out of what we know to be the relative invisibility of the enormous numbers of animal killings that take place daily in slaughter yards, science labs, and animal shelters – killings that, before the middle of the nineteenth century, most often took place before our eyes, on the streets if not in the kitchen" (Weil 2006: 90). Recently, we have witnessed a sharp increase in the acknowledgement of the mass murder of animals, which had been ignored; see, for example, Derrida 1991 and 2008; Wolfe 2003; Szybel 2006; Spiegel 1997; Agamben 2004 and 1999.

22. When accounting and accountability are at issue it is important to be attentive to any underlying mathematics. Notice that the vulnerability of the abject constitutive other is not necessarily predicated on the existence of hierarchical rankings. Equivalence relations can be effectively enrolled.

23. A posthumanist account calls into question the givenness of the differential categories of "human" and "nonhuman", examining the practices through which these differential boundaries are stabilized and destabilized (Barad 2003: 808). The notion of "effect", and of causal relations more generally, is reworked in this essay.

24. In other words, an element of an analysis is to rethink (humanistic) performativity, not simply widen the circle of its applicability. This includes understanding performativity as iterative intra-activity rather than iterative citationality.

25. The imploded phrase "spacetime-mattering" (without the usual hyphens to separate out the nouns) refers to the entangled nature of what are generally taken to be separate features. See Barad 2007.

26. See Barad 2007 and 2003.

27. To be contrasted with Butler's notion of performativity as iterative citationality (Butler 1993).

28. Phenomena are ontologically primitive relations – relations without preexisting relata. That is, relations are not secondarily derived from independently existing "relata", but rather the mutual ontological dependence of "relata" – the relation – is the ontological primitive. Relata only exist *within* phenomena as a result of specific intra-actions (i.e., there are no independent relata, only relata-within-relations).

29. In other words, relata do not preexist relations; rather, relata-within-phenomena emerge through specific intra-actions.

30. Diffraction, as a physical phenomenon, entails the entanglement/superposition of different times and spaces. See Barad 1993.

31. Indeed, the point is not merely that identity is multiple or fluid, but rather that identity itself is at stake and at issue in what matters and what doesn't matter, where accountability is part of the ethico-ontological relations and entanglements of worlding.

32. *OED Online*, <http://dictionary.oed.com:critter>, jocular var. "creature"

"creature":

2. a. A living "creature" or created being, an animate being; an animal; often as distinct from "man".

3. a. A human being; a person or individual (as in "every creature in the room"). Common in the phrase "our fellow-creatures". [So F. *créature*.]

b. With qualifications expressing (a) admiration, approbation, affection, or tenderness (sometimes playfully); (b) compassion or commiseration (sometimes with a shade of patronage).

c. Expressing reprobation or contempt.

33. See Barad 2007 for more details of the brittlestar's unique optical system. Brittlestars are one of my other queer co-workers.

34. Haraway has ingrained in us the need to take account of our obligations here. Her tenacious questioning of the human/nonhuman boundary has had an enormous impact on the field of "animal studies" (long before there was such a field) and beyond. Where would ecocriticism, feminist science studies, science and technology studies, feminist theory, and the rest be without her interventions? The line between the animate and inanimate may be the least questioned and most comfortable boundary of them all (at least for humans, surely not for brittlestar). Ironically, this echoes the current privileging of the biological over the physical in our technoscientific imaginaries, in the larger culture as well as in cultural studies, science studies, and animal studies. A reverberation of this cultural prejudice is that the category "nonhuman" is often just assumed to be equivalent to the category "nonhuman animals".

35. National Weather Service, "Lightning Safety", <http://www.lightningsafety.noaa.gov/science.htm>.

36. Kirby adds in a footnote: "Despite the title of Peter Coleman's book on the subject, *Ball Lightning: A Scientific Mystery Explained* (1998), it appears from the literature that ball lightning is a contentious subject and its account remains inconclusive".

37. All quotes in this paragraph are from the Discovery Channel television program "Discovery Wonders of Weather: Lightning Phenomena" (September 2007), <http://science.howstuffworks.com/nature/natural-disasters/lightning.htm>.

38. If the notion of a field is key to an explanation of this phenomenon, as it surely seems it must be, then the point here is to open up to examination the bizarre features of the field rather than to shut down the discussion by naming it. In any case, many puzzles still remain about the nature of the electric field that is animated. Kirby raises an interesting one: "If thunderclouds, even great big thunderclouds, don't have electric fields big enough to generate the giant spark that lightning actually is, where's all that energy coming from?" Researchers at this point are not reconsidering the nature of 'the field' as a division of separate polarities, the notion of 'location,' nor explanations that presume linear causation. Faced with the problem of finding lightning's origin they are now looking to outer space for the answer" (Kirby 2011: 138-139).

39. The notion of "action at a distance" is a reference to what is more aptly identified as "quantum entanglements" and appears again in the discussion of atomic performances below.

40. "Naturecultures" is of course one of Donna Haraway's incredibly evocative imploded terms.

41. See Schrader 2008A, 2008B and 2010.

42. *Pfiesteria* are thought to cause red tides, or what are now being called harmful algal blooms (HABs). "Algal booms are considered harmful in two distinct but overlapping ways – through the production of high biomass and the production of toxins. Of greatest concern to marine ecologists are those microorganisms called dinoflagellates ... An explosive increase in algae biomass can lead to the expansion of so-called 'dead zones.' Dead zones are oxygen-depleted zones in the ocean. When massive amounts of algae can no longer be consumed by predators, their bodies sink to the bottom of the ocean, where bacteria work on their decomposition. The bacteria consume so much oxygen that life for any other kind of ocean bottom-dweller becomes impossible. According to the latest estimate, about 400 'dead zones' worldwide suffocate major taxa of life in the ocean. . . . These so-called 'dead zones' are however not dead at all, in fact they are full of life – just not the kind of life 'we' want" (Schrader 2008B).

43. Queer theorist David Halperin writes: "Queer politics ... its efficacy and its productive political life can indeed still be renewed and extended, the first step in this procedure will be to try and preserve the function of queer identity as an empty placeholder for an identity that is still in progress and has as yet to be fully realized, to conceptualize queer identity as an identity in a state of becoming rather than as the referent for an actually existing

form of life. Queer politics, if it is to remain queer, needs to be able to perform the function of emptying queerness of its referentiality or positivity, guarding against its tendency to concrete embodiment, and thereby preserving queerness as a resistant relation rather than as an oppositional substance" (Halperin 1997: 112–113). As specified here, queerness's temporality is one of futural openness. Queer critters go a step further: the indeterminate "nature" of Nature not only has an open future but also an open past. (See especially the section in this paper on the quantum eraser.) Indeed, "past" and "future" are themselves subject to indeterminacy.

44. Most of the recent discussions of quantum causality cite Bell's inequalities (Bell 1964: 195) as the quintessential example. But the paradoxical nature of quantum causality is already evident in the very notion of a "quantum leap", which is the core feature of the Bohr's model of the atom (1913), the first quantum model of the atom (which preceded quantum mechanics).

45. The fact that the energy difference between the two levels is carried away as a photon is a result of the conservation of energy – energy is neither created nor destroyed. Conservation of energy (or of mass-energy according to the theory of relativity) is considered a fundamental law of nature, perhaps *the* fundamental law of nature.

46. Pictures are surely worth a thousand words here. To take a concrete case, the emission spectrum of hydrogen has four primary lines: red, light blue, dark blue, and violet. It is therefore possible to identify what elements are present in a glowing gas (even one at a great distance, like a star) by looking at its atomic spectrum and seeing what colors are present.

47. "quantum, n.5", *OED Online*, <http://dictionary.oed.com/cgi/entry/50194299>.

48. Space, time, and matter are not simply "there"; rather, they are constituted (and iteratively reconstituted) through the intra-active performances of the world.

49. I only summarize certain key features of the experiment here. For a more detailed description and analysis of this experiment, see Barad 2007: 310–17.

50. According to classical physics, everything in the world could be definitively placed in one category or the other; the nature of every entity (although the nature of "entity" is itself in question here) was such that it was either (inherently) a wave or a particle. I take liberty with the word "entity" here since it is precisely what is in question.

51. A classic diffraction pattern is the one produced by the interfering disturbances of water waves when two stones are dropped simultaneously into a pond. That is, it is a pattern of alternating regions of intensity.

52. See Barad 2007 for further details.

53. For details of how to make such a detector see Barad 2007, chapter 7.

54. Kirby argues for this very point (Kirby 2011) and gives compelling evidence that the story can be told from *within* deconstructive theory.

55. See also Barad 2010.

56. There are two distinct issues here. One is how entities and events are understood. These are questions of ontology. A separate issue is whether the behavior of the entity in question can be accounted for in terms of the laws of classical physics or quantum physics (or some other set of laws or patterns of engagement). Surely one can consider lightning, for example, to be a phenomenon (in the technical sense of the proposed quantum ontology) and still be able to explain certain regular features of its behavior using the laws of classical physics. Also, interestingly enough, those who challenge the importance of a quantum ontology for the macroscopic domain are happy to assume that it unquestioningly applies to *sub*microscopic domains all the way down to the smallest length scales. Furthermore, as I argue in Barad 2007, scale is also not a straightforward concept, and notions of "macro" and "micro", like "past" and "future", are not nested or ordered in simple ways.

57. See especially Kirby 2011; Schrader 2010, and Barad 2010. Barad 2010 might usefully be read as a companion piece to this article.

58. On diffraction as methodology and physical phenomenon see especially chapter 2 of Barad 2007. My notion of diffraction in a methodological vein, as against reflection, is indebted to Hara-way 1997. Diffraction as methodology is importantly different from social constructivist critique. In particular, it doesn't presume to take a position outside of science but rather constructively and deconstructively engages with science from the inside (not uncritically but not as critique). Ontology, epistemology, and ethics, as well as methodology, are at issue here.

59. This goes to Derrida's point that deconstruction is not a method but what texts do. (Derrida 1985).

60. Bohr takes the point that "we [humans] are a part of that nature we seek to understand" as a primary inspiration for this philosophy-physics. Kirby has relentlessly interrogated the nature/culture divide and has insisted on these points throughout

her work. She launches the provocation that Derrida's controversial claim "there is no outside of the text" should be understood as "there is no outside of nature" (Kirby 2011).

61. I am indebted to Vicki Kirby and Astrid Schrader for the inspiration of their work, and for their generosity in allowing me to invite in a few of their favorite nonhuman co-workers, to borrow sizable quotes from their work, and to include quotes from unpublished materials, for this article. I am solely responsible for any errors or misstatements in this paper. I am also very grateful to Fern Feldman for her patient reading of this paper and for her helpful suggestions and comments.

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SUMMARY

Nature's Queer Performativity

In this article, Karen Barad entertains the possibility of the queerness of one of the most pervasive of all critters – atoms. These “ultra-queer” critters with their quantum quotidian qualities queer queerness itself in their radically deconstructive ways of being. Given that queer is a radical questioning of identity and binaries, including the nature/culture binary, this article aims to show that all sorts of seeming impossibilities are indeed possible, including the queerness of causality, matter, space, and time. What if queerness were understood to reside not in the breach of nature/culture, per se, but in the very nature of spacetime mattering, Barad asks. This article also considers questions of ethics and justice, and in particular, examines the ways in which moralism insists on having its way with the nature/culture divide. Barad argues that moralism, feeds off of human exceptionalism, and, in particular, human superiority and causes injury to humans and non-humans alike, is a genetic carrier of genocidal hatred, and undermines ecologies of diversity necessary for flourishing.

Karen Barad, Professor of Feminist Studies, Philosophy, and History of Consciousness, University of California, Santa Cruz