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Intractosoma: Toward an Epistemology of Complexity Based on Intra-acting Bodies

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Abstract
In this essay, I argue for an epistemology of complexity that is centered on intra-acting—*always already* interacting and becoming—bodies. I utilize analyses of the politics of knowledge concerning honey bee declines and gene-environment interaction research to outline a feminist-oriented epistemology in terms of multisensorial corporealities that I call "intractosoma." I argue that re-organizing the production of observation, reduction, and difference along the lines of an intractosomal epistemology of complexity would lead to a more accurate understanding of complex phenomena, and entail a different politics in which the constructed distance between observers and observed can no longer absolve observers of "response-ability." By shifting the locus of concern to always already enmeshed bodies, I seek to open analyses to a plurality of observers with their associated blind-spots and power dynamics, and a multiplicity of forms of knowing and becoming, beyond instrumentation, computation and quantification.

Keywords
politics of knowledge and ignorance; feminist epistemologies; complexity; human-nonhuman relations; body; posthuman

Introduction
This essay asks *how* is, instead of what is, complexity. I argue for an epistemology of complexity that is centered on intra-acting—*always already* interacting and becoming—*bodies*. By framing this epistemology of complexity in terms of multisensorial corporealities—as opposed to entities such as individual, society, system and assemblage—I seek to open it to a multiplicity of forms of knowing and becoming, beyond instrumentation, computation and quantification. Conceptually, I draw on feminist approaches to technoscience in order to begin sketching the contours of an epistemology of complexity that incorporates the dynamics in which observers make choices about what, and how, to count. Somewhat provocatively, I suggest the concept of *intractosoma* to signify an intra-acting complex of bodies in flux, including those of observer(s), and seek to

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develop a post-humanist epistemology of complexity that goes beyond constructed binaries—between human and nonhuman, observer and observed, culture and nature, and subject and object—while **not** flattening the distinctions and asymmetries that are entailed in such bodily encounters.

In the following pages, I utilize the case of heightened honey bee deaths, which I argue is an exemplar of the inextricably intertwined quality that is a mark of complex phenomena. I show how the prevalent "control-oriented" approach taken by honey bee scientists, which I call an "epistemology of separation," is limited because it ignores the always already enmeshed character of the issue and beekeeper's embodied ways of understanding bee health. I go on to offer an "intractosomal" epistemology of complexity, whose features I develop using the honey bee case. I conclude with a reflection on how we might begin to realize an intractosomal approach to complex phenomena given the hegemony of control-oriented science.

Complex Phenomena and Epistemological Politics

Healthy honey bees are crucial components of agricultural and ecological webs in their roles as honey producers and plant pollinators (Crane 1999). For over a decade now, beekeepers in various parts of the world have been suffering losses of honey bee colonies at rates much higher than what they have been used to (e.g., Steinhauer et al. 2016). While some potential culprits have been identified—newer kinds of insecticides, parasites, microbial pathogens, lack of diverse nutrition—entomologists and beekeepers more or less agree that the widespread decline in honey bee health is the outcome of *a complex combination of multiple factors*. Which combinations are more relevant and how they might be interacting remain to be understood and agreed upon, even as beekeepers struggle to adapt to a "new normal" of honey bee deaths. This lack of resolution about which factors are more influential and how they might be interacting to affect honey bee health is in part due to the social organization of knowledge production (Suryanarayanan and Kleinman 2016). Scientific studies of honey bee decline are dominated by "control-oriented" research norms and practices whose object of analysis is strictly relegated to individual-level and colony-level bodies of honey bees. In practice, however, one cannot realistically observe honey bee bodies in isolation from other bodies—human and nonhuman.

Honey bee bodies are *always already enmeshed* with other bodies in spatio-temporally dynamic ways. Honey bee development, genetics, physiology, and behavior are heavily shaped by shifting practices of beekeeping, honey bee science, and agri*culture* (Crane 1999). A typical honey bee colony is a complex "super-organism" (Hölldobler and Wilson 2009), whose functioning relies on tens of thousands of intertwined bee bodies co-existing in dynamic encounters with other microbial, parasitic, **and human** bodies. Indeed, most contemporary honey bee colonies do not develop independently of encounters with human "managers"—beekeepers. Beekeepers tend to keep colonies in "Langstroth" hive-boxes that are built in such a way that beekeepers can interchangeably move parts of the nest without drastic damage to the colony, and thus manipulate the development of colonies for honey production and crop pollination. Not just particular kinds of honey bee bodies, but also particular kinds of human bodies and

relationships—commercial, affective, and power-laden—emerge through these encounters. For example, queen breeders and "package bee" producers mass-produce artificially inseminated queens and young bees, which they ship to thousands of beekeepers spanning backyard operations and huge commercial pollination outfits trucking millions of colonies across large distances. That said, honey bee bodies are not infinitely malleable—their range of responses shapes what human interlocutors such as beekeepers and bee scientists can and cannot do, and mediates the kinds of relationships beekeepers develop with others. For example, honey bees from a colony can fly over distances of up to 6 kilometers with little regard for property lines, and in the process mediate relationships—convivial and conflictual—between beekeepers and landowners who may or may not want honey bees buzzing on their property. Honey bee colonies also cannot develop independently of the proximate plant communities on which bees forage for nectar, pollen, and resin. These plants in turn gain a means to cross-pollinate, reproduce and propagate. Indeed, flowering plants are believed to have co-evolved with pollinators such as honey bees (Price 1997). Which plants honey bees develop associations with are in turn shaped by interactions between lands and human land managers such as growers.

The dominant scientific orientation of those investigating heightened honey bee deaths, which is based on what I call an *epistemology of separation*, ignores the always already entangled complex of bodily encounters constituting contemporary honey bees. In excluding matters such as the organization of beekeeping and agriculture from matters of honey bee health, the prevalent epistemology of separation operates by constructing binary divides between the social and biological, culture and nature, and human and nonhuman. In honey bee science, this binary constitutes the basis for "control-oriented" research norms and practices, where emphasis is placed on experimental control of potentially confounding environmental variables. While this is valuable for generating precise information about the direct effects of isolated factors (such as a single insecticide) on honey bee health, it precludes serious analyses of the synergistic multiplicities in which honey bees are exposed—not just to one insecticide but to a plethora of pesticides and other factors circulating through always already intertwined networks of beekeeping and farming. Consequently, the prevalent control-oriented variety of honey bee science contributes to ignorance about the complex processes that fuel honey bee deaths (Kleinman and Suryanarayanan 2013).

This dominance of an epistemology of separation in matters of what we know and don't know about dying honey bees goes hand in hand with a politics of separation, which promotes the marginalization of certain communities, such as those of beekeepers, and their alternative ways of acting on honey bee health and disease. Beekeepers have developed many alternative ways of gauging the development and health of honey bee colonies, which have evolved in close concert with their shifting commercial and livelihood stakes (Suryanarayanan and Kleinman 2013). These include: (1) visual measures, such as a colony's "brood pattern," the pattern of distribution of similar-aged immature offspring on a hive-comb, indicating the health of the brood and of the egg-laying queen; (2) smells, such as "a nice, sweet waxy bee smell" indicative of a healthy colony; (3) sounds, such as "a high-pitched noise made by adult bees when the beehive is queen-less"; and (4) "intuition and feeling". These alternative modes of observation

and analysis generate useful knowledge for beekeepers about multiple inter-connected aspects of a colony's health and development, which include—and do not exclude—"human" matters such as the commercial and local features of the settings in which beekeepers care for bees. Consequently, attending to these alternative ways of becoming with honey bees could help us to better understand the always already enmeshed circumstances in which honey bees are dying at higher than expected levels. However, for most scientists these are too imprecise and uncontrolled to merit serious consideration, and many scientists working on the problem of honey bee deaths are dismissive of beekeepers' associated claims and positions about how and why bees are becoming sicker.

Even though researchers' approaches to honey bees are themselves deeply embodied, intuitive and affect-laden (e.g., Swan 2014), historically established norms and techniques of establishing objectivity and experimental control divide them from the honey bees they manipulate and from the beekeepers they seek to help. The intertwined construction of objectivity and expertise provides the basis for an asymmetric dynamics of power between observing scientists, observed bees, and non-scientist beekeepers, in which professional scientists have the power to enact or define what does and does not count, and how to count the factors affecting honey bee health. While the fundamental divisions and exclusions enacted by epistemologies of separation such as the ones we see in the honey bee case have been enormously productive and constitutive of contemporary lives in the "anthropocene," they have arguably also been a key factor enabling treadmills of (over)consumption and (over)production in which beekeepers, working for growers have turned honey bees into "pollination workhorses," helped to prop up a chemically intensive mode of monocrop farming and fomented the current crisis of vanishing insect pollinators. Along with a binary fragmentation of complex phenomena, an epistemology of separation fosters a kind of interactionism that purports to achieve fuller understanding of complex issues by looking at the interaction of entities that have already been categorized by observers as separate from each other. In the honey bee health case, such interactionism is based on bringing together the work of social scientists relegated to "policy-related" issues with the work of biologists narrowly focused on honey bees.

The always already enmeshed character of these phenomena and the implications of ignorance of them on the part of prevalent epistemologies of separation have import beyond the world of honey bee science. Take for example gene-environment interaction (GEI) researchers, who seek to study the relative contributions of genes and environments to etiological complexity. Ackerman et al. (2016) show compellingly how collectively negotiated commitments to particular methods of quantification and measurement at the molecular level lead GEI researchers "to move away from the social, environmental and historical dimensions of disease risk as legitimate domains of inquiry" (198). GEI researchers' predilection for consistently measurable environments comparable to genomic measurements leads, in practice, to the elimination, rather than investigation, of actual, lived environments. While GEI studies typically assume that the G side (genetic) and E side (environment) are separable entities whose interaction leads to complex etiologies, how to define what is "gene" and what is "environment," and how to count the G side and E side are loci of struggles between scientists. An increasing number of biologists and

philosophers argue that genes and environments are always already enmeshed in inseparable ways—a view that Susan Oyama calls "constructivist interactionism" (Oyama 2000).

A Feminist-oriented Epistemology of Complexity

My agenda here is to begin laying the conceptual groundwork for an alternative epistemology that is based not on the binary separations mentioned above but on the always already "co-presencing" (Haraway 2008) of bodies that are in the process of becoming. Karen Barad's (1998) concept of "intra-action" is particularly useful for thinking through the always already complex of swirling issues involved in phenomena such as honey bee decline. For Barad, intra-action signifies a fundamental inseparability of "objects" and "agencies of observation," and is in contrast to a kind of *inter*-actionism that reinstates the very binaries that it seeks to do away with. The honey bee case is an exemplar of naturecultural phenomena in which distinct categories of nonhuman and human are constituted together both through bodily intra-actions that are historically shaped, contingent and involve multiple scales, levels, and modes of observation and analysis, and through knowledge/power dynamics in which certain "epistemic forms"—ways of approaching questions, methods, data and analyses (Suryanarayanan and Kleinman 2013, 219)—are privileged over other, and shape winners and losers. Based on the always already character of honey bees that I sketched earlier, an intra-actional approach here would entail an epistemic shift from honey bees *per se* to a fundamentally different locus of analysis— the dynamic, near-simultaneous encounter of bee-beekeeper-plant-land manager-observer. This shift in observation immediately brings into focus entanglements between the political economies of beekeeping, land management, and the development of honey bees. It also enfolds the partial perspectives of observers and their modes of observation, situating their constructions of objectivity and associated blind-spots within this relational dynamic. To delineate this locus of intra-action in honey bee health is an attempt to identify inextricably intertwined knots, where honey bee ecologies are always already implicated in the histories and politics of beekeeping, farming and bee science. Any analysis that ignores the always already nature of this fundamental intra-active unit of honey bee health risks misrepresenting the phenomenon.

Bodies, and complexes of bodies, are themselves precarious, transitory aggregates that become distinct from "objects" and other bodies through intra-actional encounters immersed in knowledge/power dynamics. By anchoring *how is complexity* to sensorial bodies, as opposed to abstracted bodies—such as the genome (Ackerman et al. 2016) or society, I privilege a certain phenomenological domain of becoming and being—one that is accessible to "the body multiple" (Mol 2002). The intra-active epistemology of complexity is centered on bodies that can perceive, and are perceptible, at an aggregate level, not only through instrumentation, computation and quantification but also through other sensorial and (pre)cognitive schemata of smells, sounds, tastes, and affect. In the honey bee case, this would mean paying much more serious attention to beekeepers' embodied ways (some of which I illustrated earlier) of gauging bee health and disease. Enabling the phenomenon of honey bee decline to be opened to a multiplicity of observing bodies— such as beekeepers, growers, ecologists, and entomologists— equipped with

a plurality of epistemic forms and blind-spots, creates the basis for a fuller *and* fairer understanding of the phenomenon. Broadly speaking, this intra-active epistemology advances Sandra Mitchell's "epistemology of integrative pluralism"—"an expanded epistemology of science that embraces both traditionally reductive and multilevel context-dependent approaches to scientific explanation and prediction" (2009, 2).

Intractosoma

It may be useful to conceptualize the aggregated intra-active unit of analysis I described above as *intractosoma*, signifying an intra-acting complex of bodies in spatio-temporal flux. The neologism intractosoma, which plays on the ultimately intractable quality of complex phenomena, brings feminist theories of embodiment to bear on a dense world of complexity-oriented concepts such as assemblage (Deleuze and Guattari 1987), network (Latour 2005), mesh (Morton 2010), and system (Luhmann 1995). Within this world, the decentering of anthropocentric epistemologies has generated concerns about the disappearance of bodies and lived realities into networks of actants, system-environment differentials, assemblages and object-oriented ontologies, and a concomitant flattening of real-world asymmetries and hierarchies leading to an insufficient attention to uneven relations of power (e.g., Wolfe 1998). I am offering the concept of intractosoma as a complementary approach for studying complex phenomena without losing sight of views "from below," of the lived experiences of *always already* enmeshed bodies that are forged in encounters that cut through multiple levels and scales to constitute asymmetric realities—actual and virtual.

Difference, and how difference is constructed, are key components of the epistemology and politics of intractosomal complexity. Every act of observation is an act of distinguishing (Luhmann 1995) and "vision is *always* a question of the power to see" (Haraway 1991, 192). Importantly, what constitutes distinction and how it is constituted are functions of the observer(s) involved in the intra-action. For example, for several beekeeper-observers, the most meaningful honey bee "body" with which they develop commercial, affective, and embodied relationships is the colony as a whole, not the individual bees in that colony. Commercial beekeepers' distinction and privileging of the colony as the bodily entity with which they reckon shape their quality of affections and violence toward individual honey bee bodies, and by corollary, their norms and practices of beekeeping. An intra-actional epistemology enfolds the contingency, context-dependency and politics of observers and is at the same time anchored at a level of sensorial bodies, where diverse modes of difference making are permitted. Consequently, it constructs manifold meaningful differences that highlight interconnected blind-spots and asymmetries between observers, and enable observers to observe together what they otherwise would not see in isolation.

While an intractosomal epistemology of complexity is not devoid of reduction—any attempt at understanding complex realities entails reduction—I think that its distinction and advantage over other epistemologies are apparent by the way that it displaces, not replaces, reduction and difference. By taking seriously the always already enmeshed character of complex

phenomena—something that epistemologies of separation, I have suggested, do not do—an intra-actional epistemology shifts observation to a different plane of individuation. In the honey bee case, for example, observation, reduction and difference operate at the level of bee-human-plant relations, instead of honey bees *per se*. By yoking this intra-actional plane to sensorial bodies in becoming, the emerging problem-space is opened to a multiplicity of observing bodies with interlinked but different blind-spots. Additionally, observers are no longer independent—epistemically and politically—from their objects of observation.

Conclusion: Reorganizing Knowledge Production

I have argued in this brief essay that re-organizing the production of observation, reduction and difference along the lines of what I am calling an intractosomal epistemology of complexity would lead to a more accurate understanding of complex phenomena, **and** entail a different politics in which the strategically constructed distance between observers and observed cannot absolve observers of "response-ability"—the obligation of care and "sharing suffering" that accompanies the never-innocent enterprise of knowledge production (Haraway 2008). This is not to negate the epistemologically productive power of constructing distance between observer and observed that allows for a space where knowledge and ignorance emerge. Rather, an intractosomal epistemology displaces that space of separation to a different locus--between observers, each with their own blind-spots and in intra-actions with their observed objects.

Undoubtedly, such an intractosomal epistemology would need to go hand in hand with a rather different organization of knowledge and nonknowledge production (Gross 2010), the contours of which I hope will be of broad concern. For a start, it would mean prompting a fundamental restructuring of the institutional norms and practices governing "good" science through mechanisms that entail a fuller inclusion of other embodied ways of knowing, and more meaningful participation by the bearers of those alternative epistemic forms. In the honey bee case, this would mean expanding the epistemic culture of honey bee biology to better include beekeepers' approaches. Beyond honey bees, one can think of several other domains where the re-organization of knowledge production to include non-scientists could significantly benefit how we understand and act on complex technoscientific matters of high political, economic, and health stakes, including disease phenomena where patients and citizen-activists can offer alternative understandings of bodies (e.g., Epstein 1996), and growers' affective and intuitive ways of knowing plant-being (e.g., Müller 2015). Beyond this, an intractosomal epistemology requires careful, public deliberation on more just ways of departing from the traditional model of the university, where the study of "nature" tends to remain divided from the study of "culture." In this respect, I believe that systematic interventions being undertaken by science and technology studies scholars to catalyze transdisciplinary collaborations between academic communities in the sciences and the humanities and historically marginalized non-academic communities constitute an important horizon of possibilities for developing future research on intra-acting bodies and response-able observers (e.g., Allen and Ottinger 2016).

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