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The Cogito and the Limits of Neo-materialism and Naturalized Objectivity

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Abstract

Naturalistic objectivity has recently been defined as a practice that takes objective judgments to be those that are "accountable" to how the world "really is" through an analysis of particular practices that are empirical, historical, and socially situated. Along these lines, Karen Barad has called for accountability within the framework of reconfiguring the material-discursive apparatuses of bodily production, including the boundary articulations and exclusions that are marked by those practices. Barad extends her argument in the context of quantum mechanics in physics, claiming that the concept of position is a specific physical arrangement and calls for the process of "intra-action," which refers to the relationship between an object to be measured and the "measuring agencies" that do the measuring. This essay examines these arguments in the light of Barad's material-discursive practices and the ontological and ethical claims she makes for one account of a 'quantum' reality.

Introduction: Naturalizing Objectivity

[1] In her 2007 book review titled, "Naturalizing Objectivity," Rebecca Kukla examines two contemporary books addressing the question of objectivity in the wake of feminist standpoint theory. Kukla argues for a post-feminist standpoint epistemology that rejects the idea of objectivity as the transcendental *view from nowhere*, and instead, raises empirical questions about the conditions for objective judgment, arguing that the latter cannot be separated from the material and social contexts of epistemic practices (286). Kukla calls this *naturalistic objectivity*, and defines it as a practice that takes objective judgments to be those that are "accountable" to how the world "really is" through an analysis of particular practices that are empirical, historical, and socially situated (*ibid.* 287). A naturalized account of objectivity according to Kukla, will include such key components as: concrete practices (or performativity); natural activities, that is, activities performed by natural beings in the natural world; concrete, epistemic practices that emerge bottom-up out of micropractices; a naturalized metaphysics and ethics of the self; and most importantly, genuine accountability to the real (*ibid.* 287-90).

[2] Forgoing analysis of these components, for our current purposes, the concept of naturalistic objectivity never the less raises an important question—namely, what happens when scientists are wrong? If their

standards of objectivity rely on what they actually *do* and what they do is all on the microlevel—and if objectivity is a performance by natural beings in the natural world whose metaphysical and ethical principles are also somehow natural—then how can a scientist ever know if she has gotten something wrong? The answer from Kulka is that different bodies of epistemic practices—different judging selves or cogitos—will assess one another and determine which results most accurately get the world "right." This is said to overcome the need or urge for adopting a transcendental position from which all practices can be judged as really right or wrong (*ibid.* 299). Nevertheless, under these conditions, knowledge never rises above the knowledge of the practitioner, a historically and socially situated concrete self. Certainly this presents a problem, which is, not surprisingly, the problem of how to achieve objectivity. What would make the knowledge of any one practitioner or even a group of them objective? The solution to this problem for Kulka is that the concrete historical and social self must strive to minimize all traces of itself so as to produce knowledge that is maximally reproducible (*ibid.* 300).

[3] One can imagine several possible outcomes. First, if the scientist does not do this, she remains embedded in micropractices or local knowledges whose objectivity remains in question. But then, even if she does do this, it seems that what she has produced is at most a generalization. Competing micropractices, even reproducible ones, may in the end all be merely variations of a single structure. Lacking some external standard, it will be difficult to ascertain whether or not competing micropractices really are different practices on a structural level. From below, it does not seem likely that anyone could theorize that common structure, and even if they were able to, what would make that structure objective? It seems that the quest to eliminate all traces of the self and to reproduce a practice would have no determinate end. The inability to repeat experimental results is generally a dead end in the sciences but merely being able to repeat experimental results, *empirical adequacy*, without a strong belief in the existence of an external world whose properties are independent of humanity as a whole because they are encoded in eternal physical laws, is to fall below the level of what many scientists, especially physicists, mean when they use the word "objective" in the natural sciences.^[1]

[4] And yet, if we were to accept this, we would find ourselves returning to the view from nowhere, and moving away from standpoints that are intended to produce empirically more accurate descriptions if not theoretically richer explanations. Whatever route we take seems to be fraught with difficulties. Given that one of the books in Kulka's review, Karen Barad's *Meeting the Universe Halfway*, is described as a quantum mechanical account of naturalized objectivity, let us turn to this work. Barad's work has also been called 'neo-materialism' or 'New Materialism,' but it is clear from Kukla's essay that many of the fundamental tenets of naturalized objectivity are endorsed by Barad. Given this, we can, minimally, examine her work to determine if Barad has successfully managed the difficulties stated above, and if so, how. If Barad's approach has been successful, her work will be useful for purposes of solving this and other problems. If not, then we may nevertheless find in it some useful guidelines for moving forward in our thinking.

[5] In a recent published interview of theorists who accept the designation, 'New Materialism,' physicist-turned-philosopher, Karen Barad, is asked to speak about her concept of agential realism. She prefaces her reply with the statement that agential realism is not the "same old humanist" notion of agency, thereby raising the question of what that same old humanist agent might be (Dolphijn and van der Tuin 54). It turns out to be the idea that human beings have agency and grant agency to others, and that agency is a "property" of persons or things, which is, she says, "an ironic notion, no?" (ibid. 54). If it is ironic, it is literally the opposite of what is really the case, implying that in reality, human beings do not have agency and do not grant agency to others, and that it is not a property of persons or things. Presumably, this is because, for Barad, agency has in the past been defined as that 'old humanist ploy' of independently existing individuals who possess the liberal right of choice. In place of this ironic notion, she puts forward the concept of agential realism, which is not agency, and has to do instead with possibilities; possibilities that nevertheless are said to give rise to accountability within the framework of what she calls "reconfiguring the material-discursive apparatuses of bodily production, including the boundary articulations and exclusions that are marked by those practices" (ibid. 54).

[6] Bodily boundaries are central to Barad's undoing of her version of the humanist notion of agency. Elsewhere, she adds that phenomenologists, who concern themselves with the nature of conscious subjective experience, are among those theorists who do question the apparent visual self-evidence of bodily boundaries, which she identifies with the mechanistic conception of embodiment, but there are others, called Cyborg theorists, who also find it *ironic* to stop with just this (See e.g. Haraway *Simians*; Barad 155). In other words, in spite of the phenomenologist's questioning of the apparently visual self-evidence of bodily boundaries, there might still be a fundamental opposition between what phenomenologists concern themselves with—that being, the nature of conscious subjective experience—and what is real.

[7] As noted above, if these positions are ironic, they are literally the opposite of what is really the case, and the claim that humanism and a philosophy that stops upon reaching the questioning of visual bodily boundaries are ironic does give rise to a series of questions. First, there is the question of how to characterize human agency, and whether or not it necessitates independently existing individuals and liberal choice. Second, there is the question of how to understand subjectivity or the idea of a self. Third, there is the question of whether the possibility of agency commits one to mechanistic conceptions of embodiment. And fourth, there is the matter of whether or not agential realism is in fact a theory without irony, that is, one that gives an account of what is real.

[8] This opposition regarding agency and bodily boundaries is closely related to the conception of materiality operating in Barad's concept of agential realism, but materiality is itself caught up in the quantum notion of entanglement, possibly the ultimate foundation of Barad's position. Making sense of her use of entanglement requires some basic understanding of the quantum reality upon which this notion is based, so it is with this that we must begin our analysis. In the simplest possible terms, quantum physics describes the behavior of atoms that appear in two fundamentally different modes. When an atom is being observed, the observer can see a tiny particle and describe its position and momentum (called spin) (Herbert 143-4). However, when an atom is not being observed, it no longer

exists as an actual object but as a "possibility wave," that is, the atom can only be represented—by a mathematical formula, a *wave function*—as being in many places at once, or as the possibility of being in one place rather than another, although the wave's amplitude is highest nearest to where the atom was last observed (*ibid.* 144).

[9] Strictly speaking, in its wave state, the atom's position does not change over time nor is the atom at rest or in motion. All of these activities are possible but none are actual until the atom is observed. If waves are sent through a narrow slit of comparable width to the wavelength, the wave emerges on the other side in a diffraction pattern, fanning out in waves the location and intensity of which depend on the original wavelength and the width of the slit (*ibid.* 191). Waves vibrate at frequencies that depend on their energy content. If two waves encounter one another, their amplitudes are added together thereby increasing or decreasing the wave's chances of being in one place or another (*ibid.* 145). This results in the characteristic *diffraction pattern*, whereby waves that are in phase with one another increase in amplitude and waves out of phase interfere and decrease in intensity (Barad 79).

[10] As a significant physical phenomenon in quantum theory, diffraction becomes a key metaphor for Barad's materialism. The concept of diffraction was originally adopted by Donna Haraway as a counter to the metaphor of the mirror reflection, which is supposed to produce an accurate representation of the reality it mirrors, and serves as a trope for knowing and thought about the self and sameness (Haraway *Modest_Witness* 273, cited in Barad 71). Reflection and representation are supposed to take place independently of the object being represented, thereby maintaining the knower and the known in separation from one another for the sake of objectivity (Barad 87). By contrast, diffraction is used by Barad to characterize patterns of difference (*ibid.* 71-2). She states that diffraction patterns mark the effects of difference, possibly because they are fundamental physical constituents that make up the world and that make "the downfall of classical metaphysics explicit" (*ibid.* 72). This is presumably the case because diffraction—which occurs when waves encounter one another—is correlated with superposition, the idea that a physical system is both a particle and a wave, and with the quantum phenomenon of entanglement. On the quantum scale, when single photons (light particles) pass through a pair of slits, the single photon seems to go through both slits and forms a diffraction pattern, an interference wave pattern, on a surface on the opposite side, an event clearly impossible in what physicists refer to as the classical model, the model governed by Newtonian laws, which predict the motion of atoms.^[2] In other words, the particle exhibits wave behavior.

[11] This seemingly impossible superposition, the idea that a photon or electron or any number of other fundamental quantum particles can be both a particle and a wave is the model for Barad's ontology of diffraction and also entanglement. Throughout her work, she claims that insofar as there are *physical* systems that are both particles and waves, it is also possible for there to be phenomena that are both discursive and material, both nature and culture, without dualism. Of course, the crucial question that must be asked here is, in what manner and in what ontology is such superposition possible? In other words, is there an ontology that accounts not merely for the superposition of particle and wave, but also for the superposition of discourse and matter?

[12] Quantum reality remains to a large extent, a mystery. The still unanswered question is, when a wave of oscillating possibilities is observed, why does it collapse into a particle with definite attributes? Barad's position, that discourse and matter follow this model, requires an interpretation of quantum physics that makes it possible for something like discourse, something with syntax and semantics; something thought, written and spoken, to become matter; to be material. Her account of the superposition of discourse and matter relies on a particular interpretation of quantum reality. Interpretations of quantum physics are not a simple matter. Physicists have proposed numerous interpretations of quantum reality, so the interpretation put forth by Niels Bohr, which is also the one utilized by Barad, is only one among a number of yet unproven possibilities. In other words, no one knows if it is how the world really is. This may be particularly the case because, for Bohr, our ordinary phenomena of sensation are real, but atoms are not. According to this view, atoms cannot be grasped by human beings who live in the phenomenal world through sensory experience because atoms can only be known indirectly through measurement (Herbert 146-7). Atoms must be observed, but an observer of atoms is not a human being. An observer of atoms is a device that makes a record, a collection of irreversible changes observed in the natural world (Herbert 148).

[13] This view is part of the *Copenhagen interpretation* of quantum theory. Barad develops this interpretation at great length in her work. It begins with the reminder that particles are localized objects; they occupy a specific location at a specific moment in time, and waves are not entities – they are disturbances in a field (Barad 100). When an electron is simply aimed at a partition with two slits, the result is a wave pattern—unless a measurement is made of the electron—in which case it always appears as a particle (*ibid.* 104). That this effect is an epistemological and ontological departure from the Newtonian world of physical bodies following deterministic laws and having predictable outcomes in a continuous process is not in question. But there are also other non-classical (non-Newtonian) behaviors that become apparent. Central among these is that energy transformations of quantum reality are not continuous but consist of discrete quantum "jumps." Moreover, unlike the atoms of classical physics, quantum entities have a determinate size. Light can be reduced no further than to the size of a photon. Beyond that it cannot be measured. And, just as disturbing, for quantum realities, if one measures position, momentum remains unknown and vice versa.

[14] Given, for example, an experiment using a flash camera mounted on a tripod in a dark room in order to measure the position of a particle "the concept of position cannot be taken for granted" (*ibid.* 111). The photographic plate must be fixed with respect to the tripod. This means, says Barad, that the concept of position—a concept often understood in the current literature as a standpoint—must be defined by the circumstances required for the measurement. Barad extends her argument here, claiming that the concept of position is a specific physical arrangement. This is a claim with important consequences that we cannot overlook. For if it were always to be the case that the concept of position or standpoint—defined by circumstances—is a specific physical arrangement, then we have to question what it means to ask someone what their position on some specific ethical or political or educational question might be? They could only answer that they have positioned themselves in a specific physical arrangement and that some specific physical arrangement is the totality of their ethics or politics, and that lacking certain

specific physical arrangements, certain ethical or political "positions" or standpoints would be impossible to uphold. This idea, that a position or standpoint must be a physical arrangement is commensurate with the claim that theoretical concepts are material.

[15] Barad maintains that this is a case of revealing what a phenomenon is through the process of "intra-action," which refers to the relationship between the object to be measured and the "measuring agencies" that do the measuring (ibid. 128). Such intra-action surely exists. We can see, or at least imagine, intra-action between the particle and the flash camera-tripod apparatus. Referring to this apparatus as a measuring agency brings forth the question as to whether or not it is ontologically viable to refer to a measuring apparatus as an "agency." That is, what is meant here by the concept of agency? Moreover, we have to ask if Barad constructs a false dichotomy when arguing that the only alternative to the claim that a phenomenon is a specific intra-action of an object and its measuring agencies is the claim it is a thing-in-itself, merely perceived in its phenomenal appearance, ideas which Barad attributes to Kantians and phenomenologists. If this particular disjunct is a false dichotomy, a fallacy, then we would have to propose some possibilities outside of this dichotomy. We will also have to inquire if it is the case, as Barad seems to argue, that representationalism—which she defines as belief in the power of words to mirror pre-existing phenomena while standing outside of or above the world - can only be countered by a materialist posthumanist performativity as practices of engagement (ibid. 133-5).

Material-Discursive Practices

[16] Let us begin with the claim attributed to Bohr, that concepts are actual physical arrangements. If concepts are actual physical arrangements, discourse is freed from reliance on human ideas. This seems to be the basis of Barad's position that apparatuses are discursive practices. Apparatuses, she maintains, are material "reconfigurings" through which both objects and subjects are produced. This gives us a definition of agency. Apparatuses are the material conditions of mattering, of subjects and objects, enacting what matters and what is excluded from mattering. They are the "agency" determining the boundaries and properties of entities, and it is apparatuses that make phenomena determinate and meaningful. Human involvement is determined to be real or not, meaningful or not on the basis of the determinations of apparatuses which intra-actively perform the real and the meaningful. Neither things nor persons exist until agentially enacted through the stabilizing and destabilizing process of iterative material interactivity (ibid. 146-51).

[17] To be clear, Barad defines phenomena as the "*ontological inseparability of intra-acting "agencies*," that is, phenomena are ontological entanglements, basic units of existence otherwise known as apparatuses (ibid. 333). They are also material performances *of the world*; as such, meaning is a performance of the world and intelligibility is a feature of the world, its responsiveness to material performances (ibid. 335). These definitions circle back to the nature of the apparatus which, when it intra-acts, also enacts something called an agential cut, a separation between cause and effect, between a causal aspect—the object of the apparatus—which leaves a pattern of marks—and a measuring agency, the effect of the phenomena. Measurement is thus the entanglement between these two components, the intra-active marking of one part of a phenomenon by another (ibid. 333-8).

[18] We have seen two examples of an apparatus: the apparatus of the double-slit experiment and that of the camera and tripod. Apparatuses apparently do include human beings, at least their physical bodies, but without regard for their human biological origins, their human birth or the social world in general. Against the so-called humanist view of human actions, choices, intentions, ideas, values, etc., Barad argues that humans are effects of apparatuses. Whatever humans do, they do it under the influence of the "larger material configuration of the world" (*ibid.* 171). What does this mean? Possibly it means that human bodies can be conceptualized on the model of those of Brittlestars. The Brittlestar is an invertebrate sea creature related to starfish, a creature that is all eyes. The approximately ten thousand spherically domed calcite crystals covering the five limbs and central body of the Brittlestar function as microlenses that collect and focus light directly onto nerve bundles which are part of the Brittlestar's diffuse nervous system, giving it compound-eye capability. The Brittlestar's microlenses are optimized to maximize visual acuity, enabling them to discern predators or discover hiding places. All of this activity takes place in a creative tension between the resolution of detail and diffraction effects, and between geometrical and physical optics. Scientists, she notes, are studying the Brittlestar in the hopes of mimicking its technique for producing vision.

[19] Of special interest is the information that the Brittlestar is a creature without a brain; it is simply a visualizing apparatus, a metamorphosing optical system. As Barad forcefully notes, "there is no *res cogitans* agonizing about the postulated gap (of its own making) between itself and *res extensa*" (*ibid.* 379). There is no optics of mediation, no noumena/phenomena distinction, no question of representation. Instead, the Brittlestar is the model of *intra-action*, constantly breaking off and regenerating its bodily boundaries as it enfolds bits of its environment within itself and expels parts of its own body into the surrounding environment. Given this, the claim is made that the Brittlestar does not exist as an autonomous entity positioned inside a space-time frame of reference; neither that of a Euclidean container nor that of a dynamical manifold specified by classical science. There is no pre-existent container or manifold within which the creature exists and moves along space-time coordinates while its body is made and remade. Instead, the Brittlestar undergoes what Barad refers to as "space-time-matter-in the making" (*ibid.* 369-80). Now, we must ask what this "living testimony to the inseparability of knowing, being," this creature of diffraction for which boundaries are indefinite and matter is directly accessed without the mediation of representation implies for epistemology, ontology, and ethics and we must think about what "ethico-onto-epistemological matter" might be (*ibid.* 380-1).

Contradictions of the cogito

[20] A key feature of Kukla's argument for naturalizing ontology is the claim that objectivity is a historically situated concept and ideal. To this end she reviews the work of Lorraine Daston and Peter Galison, whose book, *Objectivity*, fortifies such a claim. Daston and Galison maintain that there have been different types of objectivity through history (10). The first is the 18th century concept they call representation or truth to nature, then the mechanical objectivity of the 19th century and finally, the objectivity of trained judgment in the 20th century (*ibid.* 16; cited in Kukla 290). The stages do not neatly supplant one another but co-exist and challenge each other in offering an account of the way the world

"really is" (ibid. 16; cited in Kukla 291). However, each stage is characterized by its own type of cogito, a *judging self*, engaged in a specific epistemic practice. The cogito, the judging self, and its practices are then correlated with a "naturalized metaphysics and ethics of the self" which is further defined as a self that emerges out of its encounters with the objects of science and scientific practices (Kukla 289). The 18th century cogito is a sage with wisdom and insight who is capable of finding what is essential; the 19th century cogito had to excise the self from judgment in an act of self-abnegation that made possible the view from nowhere; and the 20th century cogito was given over to expertise, the ability to classify and manipulate objects and to pass this skill on to apprentices (Daston and Galison 332; cited in Kukla 292).

[21] In spite of her embrace of these historical cigos, Kulka admits that objectivity cannot merely be a function of what scientists actually do, their actual practices because, as I suggested in the introduction, their methods might be wrong and therefore, they might be wrong about what actually is the case in the "real" world (Kukla 298). This raises a crucial point—if the measure of success lies with how well different methodologies represent, that is, how well they accurately disclose real features of the world, it seems that we are left without any standard by which to measure the accuracy of those representations. And even though we may wish to agree with Kulka that "as natural beings engaged in natural epistemic practices, selves cannot adopt a stance outside of the nature they seek to know" (Kukla 299), this does not necessarily commit us to the position held by Barad that knowing is a material, interactive activity. In other words, it does not necessarily commit us to the position that *objective* knowing is *natural*. Nor, it seems, can we simply state and accept that what objectivity means is a process of self-erasure from the very scientific practices in which one engages without a clear understanding of how this is possible to enact. Equally, we might wonder if it is the case that the sole alternative to naturalizing objectivity is the one Kulka (and Barad) repeatedly describe as a transcendental activity that stands outside all possible bodies of epistemic practices in order to assess their objectivity 'from above'. Exactly who among scientists engages in this sort of activity is left up in the air and no specific philosophical positions embracing this point of view are addressed. Indeed, we are left with the possibility that it is a straw man, a position held by no one in particular, but a convenient site of opposition.

[22] Barad's position on the history of objectivity is quite similar to Kulka's, yet there are important differences. They agree that concepts change over time. Barad, specifically, points out that the very concept of what an atom is has undergone numerous reformulations from Democritus, to Newton, Dalton, Boltzmann, Einstein, Rutherford, Bohr, and Feynman but she attributes this to the change in apparatuses rather than a change in cigos. Indeed, Barad is quite taken by technological advances that are for her inseparable from the "object" being manipulated as well as from the "subject" whose ideas appear as manifestations of those manipulations.

[23] This makes for a rather dense materialist monism that opens the question of how technological advances happen at all. If it were true that "referentiality seems to have lost its self-evidentiary nature and givenness has lost its transparency" (Barad 360), in other words, if reference really is no more than an indication that something is self-evident and givenness is merely transparency, how could science have advanced at all? Why would there even be science? Would not questions that science asks about

the nature of reality be lost in the stew of self-evidence and transparency? Perhaps the bar has been set too low and these are not the actual assumptions made by scientists of the pre-quantum era.

[24] In opposition to what she defines as the self-evident and transparent, Barad uncovers her quantum phenomena via the "difference patterns through which space, time and matter come to be" (*ibid.* 58), and "different intra-actions [that] produce different phenomena" (*ibid.* 360), so that every new apparatus produces a new material phenomenon. Moreover, for her, scientific practices do not reveal something that is already there—instead they disclose the effect of intra-active engagements with and in the differential becoming of the world. In principle this releases 'us' from the Cartesian cogito, from the insistence that 'I' am a thinking thing. For Barad, it means that the Brittlestar is also a knowing being insofar as it is in direct material engagement in the dynamic material configuring of the world. And while it is relatively unproblematic to say that the Brittlestar brain—and so the human brain—are specific material configurations, this does not entail that they are somehow *the same* material configuration. Surely there must be some way to distinguish the uncogito or the Brittlestar brain from that of other species?

Are Material Ontology and Ethics Possible?

[25] The thesis of the materiality of the brain and its intra-active engagements with the differential becoming of the world opens up a number of questions. The basic unit of existence, Barad argues, is the phenomenon, but it is somewhat difficult to get a grasp on what this is: entanglements, intra-acting agencies, something that is not merely what is observed in laboratories, primitive relations without pre-existing relata, apparatuses, material articulations, material-discursive practices, all of which are simultaneously ontologically and semantically indeterminate (*ibid.* 333-4). Phenomena as entanglements describe matter and discourse, ontology and semantics. Philosophically, this is a lot of ground for one term to cover. Let us recall that for quantum physics entanglement has a very specific meaning. The distinctive feature of quantum entanglement is that once two quantum systems have interacted, their possibility waves remain entangled so that any action on one system instantly and without mediation causes a change in the other system. It is immediate, nonlocal interaction (Herbert 149). It is something that simply happens and involves no ethical questions or responsibilities because it takes place between two *physical systems*. Moreover, as instantaneous and without mediation, quantum entanglement implies an order and organization that greatly exceeds human existence and human capabilities. How then is it possible for there to be an ontology grounded in the entanglement of discourse and matter? Such an ontology can be successful only if discourse *is* matter. This implies, if not necessitates, that mind itself is matter; that it is not mind but brain and that discourse takes place in a purely material medium. This, in turn, would imply that human beings are like Brittlestars, not brainless but certainly mindless, an effect of the material entanglements that form them.

[26] Kukla points out that when Barad appoints phenomena as entangled material practices to the role of "basic units of existence," she thereby claims a universal ontological status for them that they may not deserve, at least not from an approach that is supposed to focus on particular events (Kukla 295-6). In fact, even though, as we saw above, Barad differentiates the atoms of Democritus from those of Newton,

et. al., she nevertheless claims that her version of quantum physics is a privileged practice the ontological structure of which suffices for all, such as when she writes that:

the *world* is an open process of mattering through which mattering itself acquires meaning and form through the realization of different agential possibilities. Temporality and spatiality emerge in this processual historicity (Barad 141, emphasis added; cited in Kukla 296)

[27] Closely associated with Barad's privileging of her account of quantum phenomena is the very question of the nature of quantum reality. It is widely agreed among physicists that quantum facts are undisputable, as is quantum wave-particle theory. This means that predictions about the outcome of quantum experiments are accurate and correct. What remains highly contested is the nature of quantum reality; that is, there is no theory that brings together quantum facts or predictions and quantum theory to present a coherent picture of the world. This arises directly from wave-particle duality. The observed particle possesses definite values such as position, momentum and spin. It looks like a real object (Herbert 143-4). However, "if the physicist tries to describe the atom in between observations as a tiny object possessing definite attributes at all times, he finds that he cannot predict correctly the results of his [sic] second observation" (ibid. 144). If, however, the physicist describes the unobserved atom as a wave of possibilities, thus not as an object but as a wave function, which is in many possible places at the same time, the second observation will be correct (ibid. 144). Among physicists, the question remains as to whether the 'jump' from wave to particle is a *real physical process or not* (ibid. 146). Barad never raises this question. The wave nature of quantum phenomena is more or less unaddressed. However, many physicists recognize that there are numerous competing theories about the nature of quantum reality—theories that seek to explain the unobserved atom as well as to speculate on the process of measurement. Bohr's theory is only one of at least eight, at least one of which asserts that consciousness creates quantum reality (ibid. 146-55).^[3] Other theories posit that quantum reality must consist of as many universes as there are quantum possibilities, or that quantum reality is "a world teeming with numerous unrealized tendencies for action ... [so] there is no deep reality," only possibilities, tendencies and urges (ibid. 158-9).^[4]

[28] We have noted briefly that in Barad's work, phenomenology is identified with classical representation and humanism, because for her phenomenology is humanism and posits not a mindless, material human self, but a transcendental cogito with a priori knowledge of the world. Kukla and Barad both draw on a caricature of phenomenological models of consciousness. Kukla says that Barad is correct to put apparatuses in the place of minds because it is not the case that "'we' or 'our minds' constitute how things are, because we and our minds are not ourselves independently determinate prior to our practices of encountering things, any more than the things are" (Kukla 295). This bizarre formulation of the noetic – noematic constitution of experience in the lifeworld (Husserl), or of the lived experience of an embodied subject (Merleau-Ponty), or of the situated woman (Beauvoir), aside, Kukla herself inadvertently notes the obvious objection to Barad's formulation. It is that for Barad, objectivity arises as an effect of the so-called 'agential cut' between agent and object. It is a kind of choice carried out in setting up an apparatus that organizes concrete intra-actions between subject and object. As such, the intervention of the *self* in

the apparatus is a condition for the possibility of the question of objectivity arising in the first place (*ibid.* 295). For Kukla, this is a judging self, a type of cogito; for Barad the self disappears into the apparatus that it sets up.

[29] So, when Barad points out that the boundaries and properties of the component parts of phenomena become determinate only through "enactment of an agential cut," in which a "measured object" delimits a "marking agent" (Barad 337), is she saying anything more than that a *self* makes a decision and from that decision something is revealed about the world, which in turn reveals something about living beings, human or non-human? One assumes that in the context of quantum physics, it is a human self that sets up the apparatus, making the decision that makes the cut possible. This intra-action is quite different from that of the Brittlestar, which mindlessly loses body parts and regenerates them in relation to its environment. When setting up an apparatus, the human self also mingles with its environment of quantum particles, but it must do so in rather different ways than the sea creature mingles with the sea. Given these fundamental differences in intra-activity it seems that it must also be possible to make fundamental cognitive distinctions between Brittlestars and human scientists—and to distinguish between the matter of quantum particles and the discourse of human scientists. In other words, entanglement is a characteristic of quantum phenomena and discourse (not merely communication) is a human cognitive function. The two do not *naturally* entangle and no metaphor can make them do so.

[30] Equally important in this account is the transition from unmeasured to measured phenomena, that is, between what is possible and what is actual. We have noted that unobserved, quantum objects possess no attributes; they are not things. When a "choice" is made as to which of any pair of quantum attributes to measure, a choice is made about which attribute will become real, making the *observer* a co-creator of reality *along with nature* (Herbert 175-6). Thus, if an observer measures position, they forgo measuring momentum—and if they measure momentum, they forgo measuring position. "In the unobserved world of pure possibility, incompatible attributes can exist without contradiction," but by deciding which attribute to measure, human observers invite that attribute to manifest itself in the actual world (*ibid.* 177).

[31] All of this comes even more urgently into view when we examine the question of ethics. For Barad, the ethical implications of these conceptions follow from the entanglements of the apparatus which, she argues, preclude the intentionality of consciousness. Following Levinas, Barad argues that in the face of the Other, which can only be the apparatus, the self must respond. It is difficult to understand how such concepts can arise from or operate within the context of her materialist ontology, which fundamentally prohibits such a distinction (Barad 394). That is, bodies matter, and there is no discrete 'I' able to be separated from the interactive becoming of the material world (*ibid.* 394). Thus any sense of self or Other would be the effect of a material intra-action which alone could determine what is and is not possible. It is difficult to see how responsibility could be anything other than material responsiveness. Like the Brittlestar, if one loses one's sense of self or sense of the Other, the solution would be to await its material regeneration.

Conclusion

[32] In the introduction, Karen Barad's *Meeting the Universe Halfway* was described as a quantum mechanical account of naturalized objectivity. Kukla's review was cited for its account of what must be the key components of this type of theory. These components included concrete practices (or performativity); natural activities performed by natural beings in the natural world; concrete, epistemic practices that emerge bottom-up out of micropractices; a naturalized metaphysics and ethics of the self; and genuine accountability to the real, to what 'really is.' Given these criteria, it was asked, what happens when scientists are wrong. In other words, if standards of objectivity rely on what scientists actually do and what they do is all on the microlevel; if objectivity is a performance by natural beings in the natural world whose metaphysical and ethical principles are also somehow natural, then how can a scientist ever know if she has got something wrong? Kukla suggests that what she refers to as the *natural ontological attitude*—which she ascribes to Barad, and whose components Barad herself subscribes to at least initially—answers this question by focusing on the concrete historical circumstances that ground the judgment in question (Fine 101). Yet, Barad also exceeds this position by making ontological and ethical claims for one account of quantum reality. By stating that the world 'matters' in a specific way, she has possibly asserted a very different position, that of the realist—a position Neils Bohr did not hold. Whether Barad is, in the end, a materialist or a realist or neither is tangential to this essay, the purpose of which is primarily to examine the contradictions and consequences of a materialist or naturalist ontology and epistemology—a position whose limits and limitations do not seem to undermine the concept of a self and possibly not even that of a cogito.

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Notes

1. I have addressed a number of issues that arose after the publication of Sokal's essay in chapter 1 of my book, *Postmodern Philosophy and the Scientific Turn* (2012).
 2. «<http://physicsworld.com/cws/article/news/2013/mar/14/feynmans-double-slit-experiment-gets-a-makeover>»
 3. Herbert, *Elemental Mind*, pp. 146, 155. This theory is that of the mathematician John von Neuman (p. 158).
 4. Herbert, *Elemental Mind*, pp. 158-159. These theories are those of Hugh Everett and Werner Heisenberg respectively.
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