

culture. Nor should we conclude that the quality of the results is diminished in proportion to the permeability of this barrier. This kind of thinking mistakenly reifies culture and nature and gender and science into separate categories. But the fact is that the world isn't naturally broken up into social and scientific realms that get made separately. There isn't one set of material practices that makes science, and another disjunct set that makes social relations; one kind of matter on the inside, and another on the outside. The social and the scientific are co-constituted. They are made together—but neither is just made up. Rather, they are ongoing, open-ended, entangled material practices. The goal is therefore to understand which specific material practices matter and how they matter. What we find in this particular case is that gender performativity, among other important factors including nature's performativity, was a material factor in this scientific outcome.<sup>56</sup>

This example not only illustrates the dynamic nature of scientific practices and the lack of a determinate outside boundary to the apparatus but also clearly suggests that humans enter not as fully formed, preexisting subjects but as subjects intra-actively co-constituted through the material-discursive practices that they engage in. I will explore this suggestion further in the next section.

#### THE NATURE OF AN APPARATUS AND A POSTHUMANIST ROLE FOR THE "HUMAN"

Physicists and poststructuralists offer very different reasons for their mutual rejection of humanism. As far as physicists are concerned, the human has no place in a respectable physical theory that claims to explain the workings of nature. Indeed, it is the distasteful centrality of human interventions in the form of conceptual frameworks and measuring instruments—the artifactual contrivances of laboratory exercises—in the foundations of quantum physics that constitutes the basis for the most common complaints against Bohr's interpretation of quantum mechanics.<sup>57</sup> Poststructuralists, on the other hand, object to the liberal humanist prejudice that positions the subject as fully constituted before its engagement in social practices. The defect here lies in the elision of the role of power in the very constitution of the "subject."<sup>58</sup> In both cases, the offending humanist elements are linked to a failure to account for the practices through which boundaries are produced, including an examination of how the constitutive exclusions of boundary-making practices matter.

Significantly, each of these critical perspectives is entangled in its own

*DM expands field of agency  
mat. practices  
institute field  
city  
of  
I AM  
Ready  
myself  
dissolved  
Bored!*

anthropocentrism. While Foucault's genealogical analysis focuses on the production of human bodies, to the exclusion of nonhuman bodies whose constitution he takes for granted, Bohr is attentive to the production of nonhuman phenomena and takes for granted the prior existence of a human observer. Paradoxically, the latter assumption is not a difficulty for many of Bohr's critics who would jettison the human observer from the physical universe altogether, staging him in some exterior position as the condition for the possibility of objective knowledge—hence ironically according the human a unique position among physical systems.<sup>59</sup> Each of these formulations presumes human-nonhuman, nature-culture, and social-scientific dichotomies. Each stops short of understanding humans and nonhumans in their mutual constitution, as integral parts of the universe—not as beings in the universe. *I think a place - Bridge*

As we have seen, apparatuses are not inscription devices, scientific instruments set in place before the action happens, or machines that mediate the dialectic of resistance and accommodation between human and nonhuman laboratory actors. Apparatuses do not possess inherent outside boundaries limiting them to laboratory spaces or experimental practices.<sup>60</sup> Indeed, a given apparatus need not be specifically implicated in any practice that goes by the name "scientific." But neither are they to be understood purely as technologies of the social (as opposed to the natural) in the sense suggested by theorists of political and social practices (following either Althusser or Foucault, for example, in their very different uses of the term). It is worth noting the degree to which these scholars exclude "scientific" practices in their consideration of "social" practices, and likewise the degree to which many scholars who write about scientific practices exclude relevant social dimensions (including self-avowed social constructivists and actor network theorists who neglect crucial social variables and relations of power such as those related to race, gender, and sexuality).<sup>61</sup> Apparatuses are neither neutral probes of the natural world nor social structures that deterministically impose some particular outcome. Significantly, in an agential realist account, the notion of an apparatus is not premised on inherent divisions between the social and the scientific, the human and the nonhuman, nature and culture. Apparatuses are the practices through which these divisions are constituted. This formulation makes it possible to perform a genealogical accounting of the material-discursive practices by which these important distinctions are produced.

In an agential realist account, apparatuses are specific material configurations, or rather, dynamic (re)configurations of the world through which bodies are intra-actively

materialized. That is, apparatuses are the practices of mattering through which intelligibility and materiality are constituted (along with an excluded realm of what doesn't matter). Or to put it another way, apparatuses are material (re)configurings or discursive practices that produce material phenomena in their differential becoming. Phenomena are produced through specific causal intra-actions involving multiple apparatuses of bodily production. Intra-actions are causal (but nondeterministic) enactments through which matter-in-the-process-of-becoming is sedimented out and enfolded in further materializations.<sup>62</sup> That is, apparatuses are material-discursive practices—causal intra-actions through which matter is iteratively and differentially articulated, reconfiguring the material-discursive field of possibilities and impossibilities in the ongoing dynamics of intra-activity that is agency. Apparatuses are not bounded objects or structures; they are open-ended practices. The reconfiguring of the world continues without end. Matter's dynamism is inexhaustible, exuberant, and prolific.

In agential realism's reconceptualization of materiality, matter is agentive and intra-active. Matter is a dynamic intra-active becoming that never sits still—an ongoing reconfiguring that exceeds any linear conception of dynamics in which effect follows cause end-on-end, and in which the global is a straightforward emanation outward of the local. Matter's dynamism is generative not merely in the sense of bringing new things into the world but in the sense of bringing forth new worlds, of engaging in an ongoing reconfiguring of the world. Bodies do not simply take their places in the world. They are not simply situated in, or located in, particular environments. Rather, "environments" and "bodies" are intra-actively co-constituted. Bodies ("human," "environmental," or otherwise) are integral "parts" of, or dynamic reconfigurings of, what is.<sup>63</sup>

Importantly, apparatuses are themselves phenomena. To take a specifically scientific example, apparatuses are not preformed, interchangeable objects that sit on a shelf waiting to serve a particular purpose, as any experimentalist will confirm. Apparatuses are constituted through particular practices that are perpetually open to rearrangements, rearticulations, and other reworkings. This is part of the creativity and difficulty of doing science: getting the instrumentation to work in a particular way for a particular purpose (which is always open to the possibility of being changed during the experiment as different insights are gained). Furthermore, any particular apparatus is always in the process of intra-acting with other apparatuses, and the enfolding of (relatively) stabilized phenomena (which may be traded across laboratories, cultures, or geopolitical spaces only to find themselves differently materializing) into subsequent iterations of particular practices

yes! the system const. from practice;  
Practice const. from world /  
Boundary shift  
place  
PPL  
sit

constitutes important shifts in the particular apparatus in question and therefore in the nature of the intra-actions that result in the production of new phenomena, and so on. Boundaries do not sit still.

Agential intra-actions are specific causal material enactments that may or may not involve "humans." The question is: what does this "involvement" entail? First, I briefly review some of the difficulties posed by some of the more usual approaches to understanding human subjects; then I will explain the nature of the posthumanist role of the human.

The contention that apparatuses are productive of phenomena may be the source of some discomfort for those who are accustomed to humanist and antihumanist accounts. Humanist accounts understand this production as a direct consequence of human actions, choices, intentions, commitments, ideas, values, concepts, beliefs, presuppositions, goals, and the like. Contrary to this view, I would argue that determinately bounded and propertied human subjects do not exist prior to their "involvement" in naturalcultural practices. Also problematic is the antihumanist view that encourages, or does not sufficiently discourage, the mistaken belief that human bodies and subjectivities are the effects of human-based discursive practices. Like their humanist counterparts these accounts reinscribe the nature-culture, human-nonhuman, animate-inanimate binaries and other Enlightenment values and stakes that antihumanism seeks to destabilize.

In an agential realist account, human subjects are neither outside observers of apparatuses, nor independent subjects that intervene in the workings of an apparatus, nor the products of social technologies that produce them. Nor is the issue merely a matter of incorporating both humans and nonhumans into the apparatus of bodily production. The point is as follows: to the extent that concepts, laboratory manipulations, observational interventions, and other human practices have a role to play, it is as part of the larger material configuration of the world. That is, the phenomena produced are not the consequences of human will or intentionality or the effects of the operations of Culture, Language, or Power. Humans do not merely assemble different apparatuses for satisfying particular knowledge projects; they themselves are part of the ongoing reconfiguring of the world. The particular configuration that an apparatus takes is not an arbitrary construction of "our" choosing. Which is not to say that human practices have no role to play; we just have to be clear about the nature of that role.<sup>64</sup> Apparatuses are not assemblages of humans and nonhumans; they are open-ended practices involving specific intra-actions of humans and nonhumans, where the differential constitutions of human and nonhuman designate particular phenomena that are themselves implicated in the dynamics of intra-activity, including their en-

folding and reconstitution in the reconfiguring of apparatuses.<sup>65</sup> That is, human bodies, like all other bodies, are not entities with inherent boundaries and properties but phenomena that acquire specific boundaries and properties through the open-ended dynamics of intra-activity. Humans are part of the world-body space in its dynamic structuration.

Does this mean that humans have no responsibility for the outcomes of specific practices? If the liberal humanist conception of the subject who chooses a particular apparatus that enacts a cut delineating the object from the agencies of observation is found wanting, does that mean that human subjects are merely pawns in the game of life, victims of the same practices that produce the phenomena being investigated? Are we not back to square one, to the Enlightenment ideal of the detached observer, the modest witness, who intervenes as needed, either willfully or in accordance with some master plan, and when all is said and done simply stands back and watches what temporally emerges? The answer to each of these questions is decidedly no. On the contrary, it is the liberal humanist conception of the subject, not the agential realist one, that encourages the notion that responsibility begins and ends with a willful subject who is destined to reap the consequences of his actions. Agency is not something that humans and even nonhumans have to varying degrees. And agency is not a binary proposition, either on or off. Furthermore, responsibility is not the exclusive right, obligation, or dominion of humans (see later sections in this chapter and chapter 8). To repeat, human subjects do have a role to play, indeed a constitutive role, but we have to be clear about the nature of that role.

An agential realist understanding of the notion of agency entails a significant reworking of the traditional conception. I will discuss this in detail hereafter and respond to the questions concerning responsibility articulated here. But a related question arises that I want to address first: If the human cannot be presumed from the outset and is no longer cemented into the foundations of the theory, then what happens to objectivity? That is, in our undoing of the humanist conception of the subject, haven't we nullified all of Bohr's hard work to secure the objectivity of science, since he places the human at the center of his intersubjective rendering of objectivity? Has objectivity been sacrificed?

#### OBJECTIVITY AND AGENTIAL SEPARABILITY

Bohr understood the question of objectivity to constitute one of the primary challenges—if not the primary challenge—of the new quantum theory. For Bohr, the issue was quite straightforward: if quantum physics teaches us that

measurements necessarily entail subjective elements (which enter into the physical considerations by way of their embodiment in apparatuses), then the very possibility of the objectivity of science is at stake. In what follows, I offer a more detailed discussion of how Bohr meets this challenge, and I argue that my ontological rendering of Bohr's notion of phenomenon is the basis for a stronger ontological understanding of objectivity, indeed a posthumanist conception, in contrast to Bohr's epistemic human-based rendering.

The sustained and impassioned debate between Bohr and Einstein reached its pinnacle in 1935 when Einstein, Podolsky, and Rosen (EPR) published a paper that was intended to shake physicists' growing confidence in quantum theory.<sup>66</sup> The EPR challenge raises the question of the nature of reality and what quantum mechanics tells us about it. Physicists and philosophers of physics have noted that the EPR paper expresses Einstein's displeasure that quantum mechanics seems to allow spatially separated states to communicate with one another (i.e., exchange information) instantaneously, in seeming violation of the special theory of relativity. Don Howard, a philosopher of science, argues that Einstein's primary concern actually touches on a deeper, more fundamental issue: a violation of the metaphysical commitment to spatial separability. For Einstein, spatial separability is nothing less than the condition for objectivity. Howard explains:

Like so many realists before him, Einstein speaks of the real world which physics aims to describe as the real “external” world, and he does so in such a way as to suggest that the independence of the real—its not being dependent in any significant way on ourselves as observers—is grounded in this “externality.” For most other realists this talk of “externality” is at best a suggestive metaphor. But for Einstein, it is no metaphor. “Externality” is a relation of spatial separation, and the separability principle, the principle of “the mutually independent existence of spatially distant things,” asserts that any two systems separated by so much as an infinitesimal spatial interval always possess separate states. Once we realize that observer and observed are themselves just previously interacting physical systems, we see that their independence is grounded in the separability principle along with the independence of all other physical systems. (Howard 1985, 192–93)

In other words, absolute exteriority is the condition of objectivity for Einstein. Spatial separation ensures ontological separability; any two systems spatially separated by so much as an infinitesimal spatial interval always possess separately determinate states.<sup>67</sup> Hence, in Einstein's way of thinking, the spatial separation of observer and observed guarantees their ontological separability and consequently secures the condition for the pos-

sibility of objectivity. But if the condition for objectivity—the requisite relation of exteriority between observer and observed as secured by the existence of distinct states of spatially separated systems—is what is being called into question, then objectivity seems to hang precariously in the balance.<sup>68</sup>

Bohr did not find Einstein's concerns troubling because Bohr did not share the same metaphysical beliefs. For Bohr, the so-called instantaneous communication between spatially separated systems is explained by the fact that these allegedly separated states are not really separate at all, but rather "parts" of one phenomenon.<sup>69</sup> Furthermore, for Bohr, objectivity is not secured by spatial separability. For one thing, in Bohr's account, Einstein is not entitled to help himself to spacetime descriptions outside the requisite conditions for their existence. Furthermore, individuation is not a given but the result of specific cuts enacted by the experimental arrangement. Bohr suggests a different set of criteria for objectivity. In Bohr's account, objectivity is a matter of the unambiguous communication of the results of reproducible experiments.<sup>70</sup>

That is, objectivity for Bohr is not a matter of being at a remove from what one is studying, a condition predicated on classical physics' metaphysical belief in individualism, but a question of the unambiguous communication of the results of reproducible experiments. What secures the possibility of reproducibility and unambiguous communication is the Bohrian cut enacted by the apparatus.<sup>71</sup> The crucial point is that when an experiment is performed and the determinate values of the "permanent marks . . . left on bodies" are read by a human observer, an unambiguous description of the phenomenon is made possible by the fact that the apparatus provides both a resolution of the inherent indeterminacy between object and agencies of observation within the resulting phenomenon and a resolution of the inherent semantic indeterminacy, so that there exist well-defined concepts that can be used to objectively describe the results. That is, both the phenomenon and the embodied concepts that are used to describe them are conditioned by one and the same apparatus (which resolves the inherent ambiguities).<sup>72</sup>

Drawing out the ontological dimensions of Bohr's framework provides the possibility of strengthening the notion of objectivity, providing a more robust conception rather than mere intersubjectivity. It also has the added benefit of not depending on a human observer. Significantly, the alternative I propose provides the possibility of removing problematic humanist elements in Bohr's account and avoiding some of the most controversial elements of Bohr's philosophy-physics without sacrificing objectivity.<sup>73</sup> In my agential realist elaboration, what replaces (Einstein's favored) spatial sepa-

rability as the ontological condition for objectivity is *agential separability*—an agentially enacted ontological separability within the phenomenon.<sup>74</sup> Objectivity is not sacrificed with the downfall of metaphysical individualism. No classical ontological condition of absolute exteriority between observer and observed (based on the metaphysics of individuated separate states) is required. The crucial point is that the apparatus enacts an *agential cut*—a resolution of the ontological indeterminacy—within the phenomenon, and *agential separability*—the agentially enacted material condition of exteriority-within-phenomena—provides the condition for the possibility of objectivity. This agential cut also enacts a local causal structure in the marking of the measuring instrument (effect) by the measured object (cause), where "local" means within the phenomenon. If the apparatus is changed, there is a corresponding change in the agential cut and therefore in the delineation of object from agencies of observation and the causal structure (and hence the possibilities for "the future behavior of the system") enacted by the cut. Different agential cuts produce different phenomena. Crucially, then, the apparatus is both causally significant (providing the conditions for enacting a local causal structure) and the condition for the possibility of the objective description of material phenomena, pointing toward an important reconciliation of the Cartesian separation of intelligibility and materiality, and all that follows.

The implications of this proposed understanding of the conditions for objectivity are substantial and far-reaching. I discuss these implications following a discussion of the agential realist understanding of agency.

#### THE NATURE OF PRODUCTION AND THE PRODUCTION OF NATURE: AGENCY AND CAUSALITY

What is the nature of causality according to this account? What possibilities exist for agency, for intra-acting in and as part of the world's becoming? Where do the issues of responsibility and accountability enter in?

Causality is most often figured as a relation between distinct entities. For example, in the interaction between distinct entities the one that modifies (e.g., leaves its mark on) another entity is said to be the cause of the effect left on the other. But according to agential realism, separately determinate entities do not preexist their intra-action. So how are we to think about causality on this account?

On an agential realist account, causal relations cannot be thought of as specific relations between isolated objects; rather causal relations necessarily

entail a specification of the material apparatus that enacts an agential cut between determinately bounded and propertied entities within a phenomenon. The larger apparatus (e.g., the specific configuration of barriers, slits, particle sources, and screens) is causally significant. It is not that a preexisting entity receives a mark from a separately determinate entity but rather that the marking or specific materializing "effect" identifies the agencies of observation as agentially separable from its "cause" (the "object") within the phenomenon. The marks left on the agencies of observation (the effect) are said to constitute a measurement of specific features of the object (the cause). In a scientific context, this process is known as a measurement. (Indeed, the notion of measurement is nothing more or less than a causal intra-action.)<sup>75</sup> Whether it is thought of as a measurement, or as part of the universe making itself intelligible to another part in its ongoing differentiating intelligibility and materialization, is a matter of preference.<sup>76</sup> Either way, what is important about causal intra-actions is that "marks are left on bodies": bodies differentially materialize as particular patterns of the world as a result of the specific cuts and reconfigurings that are enacted. Cause and effect emerge through intra-actions. Agential intra-actions are causal enactments.

This causal structure differs in significant respects from the common choices of absolute exteriority and absolute interiority and of determinism and free will. Some forms of cultural and social constructivism rely on a geometry of absolute exteriority. For example, in the inscription model of constructivism, culture is figured as an external force acting on passive nature. There is an ambiguity in this model as to whether nature exists in any prediscursive form before its marking by culture. If there is such an antecedent entity, then its very existence marks the inherent limit of constructivism. (In this case, the rhetoric might usefully be softened to more accurately reflect the fact that the force of culture "shapes" or "inscribes" nature but doesn't materially "produce" it.) On the other hand, if there is no preexistent nature, then it behoves those who advocate such a theory to explain how culture can materially produce that from which it is allegedly ontologically distinct, namely, nature. What is the mechanism of this production? The other usual alternative is also not attractive: the geometry of absolute interiority amounts to a reduction of the effect to its cause, or in this case nature to culture, or matter to language, which amounts to one form or another of idealism.

Agential separability presents an alternative to these unsatisfactory options.<sup>77</sup> It rejects the geometries of absolute exteriority or absolute interiority and opens up a much larger space that is more appropriately thought of as a

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dynamic and ever-changing topology.<sup>78</sup> More specifically, agential separability is a matter of exteriority within phenomena. Note that since phenomena are material-discursive, no priority is given to either materiality or discursivity; neither one stands outside the other. There is no geometrical relation of absolute exteriority between a "causal apparatus" and a "body effected," or an idealistic collapse of the two, but rather an ongoing topological dynamics of enfolding whereby the spacetime-matter manifold is enfolded into itself. This topological dynamics/dynamic topology is a result of matter's dynamism, as I will explain. It may be helpful at this point to take in the fact that the apparatuses of bodily production, which are themselves phenomena, are (also) part of the phenomena they produce: phenomena are forever being reenfolded and reformed. → *transform & transform = infinite waves*

Crucially, matter plays an agentive role in its iterative materialization. This is an important reason, but not the only reason, that the space of agency is much larger than that postulated in many other critical social theories. Another crucial factor is that the agential realist notion of causality does not take sides in the traditional debates between determinism and free will but rather poses an altogether different way of thinking about temporality, spatiality, and possibility. Intra-actions always entail particular exclusions, and exclusions foreclose the possibility of determinism, providing the condition of an open future.<sup>79</sup> But neither is anything and everything possible at any given moment. Indeed, intra-actions iteratively reconfigure what is possible and what is impossible—possibilities do not sit still. One way to mark this is to say that intra-actions are constraining but not determining. But this way of putting it doesn't do justice to the nature of "constraints" or the dynamics of possibility. Possibilities aren't narrowed in their realization; new possibilities open up as others that might have been possible are now excluded: possibilities are reconfigured and reconfiguring.<sup>80</sup> There is a vitality to the liveliness of intra-activity, not in the sense of a new form of vitalism, but rather in terms of a new sense of aliveness.<sup>81</sup> The world's effervescence, its exuberant creativeness, can never be contained or suspended. Agency never ends; it can never "run out." The notion of intra-actions reformulates the traditional notions of causality and agency in an ongoing reconfiguring of both the real and the possible.

In an agential realist account, agency is cut loose from its traditional humanist orbit. Agency is not aligned with human intentionality or subjectivity. Nor does it merely entail resignification or other specific kinds of moves within a social geometry of antihumanism. The space of agency is no only substantially larger than that allowed for in Butler's performative:

count, for example, but also, perhaps rather surprisingly, larger than what liberal humanism proposes. Significantly, matter is an agentive factor in its iterative materialization. Furthermore, the future is radically open at every turn, and this open sense of futurity does not depend on the clash or collision of cultural demands. Rather, it is inherent in the nature of intra-activity—even when apparatuses are primarily reinforcing, agency is not foreclosed. Furthermore, the space of agency is not restricted to the possibilities for human action. But neither is it simply the case that agency should be granted to nonhumans as well as humans, or that agency can be distributed over nonhuman and human forms. What is at issue, rather, are the possibilities for the iterative reconfiguring of the materiality of human, nonhuman, cyborgian, and other such forms. Holding the category “human” (“nonhuman”) fixed (or at least presuming that one can) excludes an entire range of possibilities in advance, eliding important dimensions of the workings of agency.

Crucially, agency is a matter of intra-acting; it is an enactment, not something that someone or something has. It cannot be designated as an attribute of subjects or objects (as they do not preexist as such). It is not an attribute whatsoever. Agency is “doing” or “being” in its intra-activity. It is the enactment of iterative changes to particular practices—iterative reconfigurings of topological manifolds of spacetime-matter relations—through the dynamics of intra-activity. Agency is about changing possibilities of change entailed in reconfiguring material-discursive apparatuses of bodily production, including the boundary articulations and exclusions that are marked by those practices in the enactment of a causal structure. Particular possibilities for (intra-)acting exist at every moment, and these changing possibilities entail an ethical obligation to intra-act responsibly in the world’s becoming, to contest and rework what matters and what is excluded from mattering.

Since different agential cuts materialize different phenomena—different marks on bodies—our intra-actions do not merely effect what we know and therefore demand an ethics of knowing; rather, our intra-actions contribute to the differential mattering of the world. Objectivity means being accountable for marks on bodies, that is, specific materializations in their differential mattering. We are responsible for the cuts that we help enact not because we do the choosing (neither do we escape responsibility because “we” are “chosen” by them), but because we are an agential part of the material becoming of the universe. Cuts are agentially enacted not by willful individuals but by the larger material arrangement of which “we” are a “part.” The cuts that we participate in enacting matter. Indeed, ethics cannot be about responding to the other as if the other is the radical outside to the self. Ethics is not a

geometrical calculation; “others” are never very far from “us”; “they” and “we” are co-constituted and entangled through the very cuts “we” help to enact. Intra-actions cut “things” together and apart. Cuts are not enacted from the outside, nor are they ever enacted once and for all.

Re focusing from within the fold?

### RE(ON)FIGURING SPACE, TIME, AND MATTER

Dynamics are about change. To specify or study the dynamics of a system is to say something about the nature of and possibilities for change. This includes specifying the nature of causation, the nature of the causes that effect change, the possibilities for what can change and how it can change, the nature and range of possible changes, and the conditions that produce change. The study of dynamics, as it is generally conceptualized within the natural sciences, is concerned with how the values of particular variables change over time as a result of the action of external forces, where time is presumed to march along as an external parameter. Agential realism does not simply pose a different dynamics (substituting one set of laws for another); it introduces an altogether different understanding of dynamics. It is not merely that the form of the causal relations has been changed, but the very notions of causality, as well as agency, space, time, and matter, are all reworked. Indeed, in this account, the very nature of change and the possibilities for change changes in an ongoing fashion as part of the world’s intra-active dynamism.

Intra-actions are nonarbitrary, nondeterministic causal enactments through which matter-in-the-process-of-becoming is iteratively enfolded into its ongoing differential materialization. Such a dynamics is not marked by an exterior parameter called time, nor does it take place in a container called space. Rather, iterative intra-actions are the dynamics through which temporality and spatiality are produced and iteratively reconfigured in the materialization of phenomena and the (re)making of material-discursive boundaries and their constitutive exclusions. Exclusions are constitutive elements of the dynamic interplay (intra-play) of determinacy and indeterminacy. Indeterminacy is never resolved once and for all. Exclusions constitute an open space of agency; they are the changing conditions of possibility of changing possibilities. Where change is not a continuous mutation of what was or the unraveling of what will be, or any kind of continuous transformation in or through time, but the iterative differentiations of spacetime mattering. In what follows, I elaborate on these claims.

Time is not a succession of evenly spaced individual moments. It is not simply there as substance or measure, a background uniformly available to all beings as a reference or an ontological primitive against which change and stasis can be measured. In my agential realist account, what is at issue is not merely that time and space are not absolute but relative (following Einstein); rather, it is that intra-actions themselves matter to the making/marketing of space and time. In other words, spatiality and temporality must also be accounted for in terms of the dynamics of intra-activity.<sup>82</sup>

As discussed in a previous section, materialization is not the end product or simply a succession of intermediary effects of purely discursive practices. Materiality itself is a factor in materialization. The dynamics of mattering are nonlinear: the specific nature of the material configurations of the apparatuses of bodily production, which are themselves phenomena in the process of materializing, matters to the materialization of the specific phenomena of which they are a part, which matters to the ongoing materialization of the world in its intra-active becoming, which makes a difference in subsequent patterns of mattering, and so on; that is, matter is enfolded into itself in its ongoing materialization. The iterative enfolding of specific materializing phenomena into practices of materialization matters to the specifics of the materialization it produces.<sup>83</sup> In short, the iterative enfolding of matter comes to matter. Matter is the sedimenting historicity of practices/agencies and an agentive force in the world's differential becoming. Becoming is not an unfolding in time but the inexhaustible dynamism of the enfolding of mattering.

Temporality is constituted through the world's iterative intra-activity. Matter's dynamism is implicated in its production. Temporality is produced through the iterative enfolding of phenomena marking the sedimenting historicity of differential patterns of mattering.<sup>84</sup> As the rings of trees mark the sedimented history of their intra-actions within and as part of the world, so matter carries within itself the sedimented historicities of the practices through which it is produced as part of its ongoing becoming—it is ingrained and enriched in its becoming.<sup>85</sup> Time has a history. Hence it doesn't make sense to construe time as a succession of evenly spaced moments or as an external parameter that tracks the motion of matter in some preexisting space. Intra-actions are temporal not in the sense that the values of particular properties change in time; rather, which property comes to matter is re(con)figured in the very making/marketing of time.

Similarly, space is not a collection of preexisting points set out in a fixed geometry, a container, as it were, for matter to inhabit. Matter isn't situated

in the world; matter is worlding in its materiality. What matters is marked off from that which is excluded from mattering but not once and for all. Intra-actions enact specific boundaries, marking the domains of interiority and exteriority, differentiating the intelligible from the unintelligible, the determinate from the indeterminate.<sup>86</sup> Constitutive exclusions open a space for the agential reconfiguring of boundaries. As boundaries are reconfigured, "interior" and "exterior" are reworked. That is, through the enfolding of phenomena, as part of the dynamics of iterative intra-activity, the domains of "interior" and "exterior" lose their previous designations. The boundaries that are enacted are not abstract delineations but specific material demarcations not in space but of space. Spatiality is intra-actively produced. It is an ongoing process of the material (re)configuring of boundaries—an iterative (re)structuring of spatial relations. Hence spatiality is defined not only in terms of boundaries but also in terms of exclusions.

Space, time, and matter are mutually constituted through the dynamics of iterative intra-activity. The spacetime manifold is iteratively (re)configured in terms of how material-discursive practices come to matter. The dynamics of enfolding involve the reconfiguring of the connectivity of the spacetime-matter manifold itself (a changing topology), rather than mere changes in the shape or the size of a bounded domain (geometrical shifts). It should not be presumed that either the manifold itself or changes to the manifold are continuous. Discontinuity plays an important role. Changes do not follow in continuous fashion from a given prior state or origin, nor do they follow some teleological trajectory—there are no trajectories.] ? mm

The question of the nature of change brings us back around to the metaphor of the tree rings. This metaphor is meant to be evocative of the sedimenting process of becoming. In particular, the point is that the making/marketing of time is a lively material process of enfolding. But the metaphor is also limited in several important ways. (In any case it is not to be taken literally as representation; rather, it is offered as an evocation and provocation to think-with:) First of all, the point is not that time leaves its mark as it were and marches on, leaving a trail of sedimentation to witness the effects of the external forces of change. Sedimenting is an ongoing process of differential mattering. The past matters and so does the future, but the past is never left behind, never finished once and for all, and the future is not what will come to be in an unfolding of the present moment; rather the past and the future are enfolded participants in matter's iterative becoming (see especially the discussion of the quantum eraser experiment in chapter 7).

Another important limitation is that this metaphor does nothing to inter-

rupt the persistent assumption that change is a continuous process through or in time. But as we have seen the disruption of continuity in the form of a “quantum discontinuity” (a very tiny one indeed) is the source of the disruption of many of the foundational notions of classical physics; indeed it disrupts no less than taken-for-granted notions of space, time, matter, causality, and agency, and epistemology, ontology, and ethics. (The double or paradoxical naming of this discontinuity suggests a disconcerting aporia—what is a discontinuous discontinuity?—should we understand this discontinuity to contain the trace of its own disruption/undoing? In a sense the troubled naming seems quite apt since a discontinuity that queers our presumptions of continuity cannot be the opposite of the continuous, nor continuous with it.) Quantum leaps aren’t jumps (large or small) through space and time. An electron that “leaps” from one orbital to another does not travel along some continuous trajectory from here-now to there-then. Indeed, at no time does the electron occupy any spatial point in between the two orbitals. But this is not what makes this event really queer. What makes a quantum leap unlike any other is that there is no determinate answer to the question of where and when they happen. The point is that it is the intra-play of continuity and discontinuity, determinacy and indeterminacy, possibility and impossibility that constitutes the differential spacetime-matterings of the world. Or to put it another way, if the indeterminate nature of existence by its nature teeters on the cusp of stability and instability, of determinacy and indeterminacy, 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.

As discussed earlier, agency is the space of possibilities opened up by the indeterminacies entailed in exclusions. And agency, in this account, is a much larger space of possibilities than that generally considered. The reworking of exclusions entails possibilities for (discontinuous) changes in the topology of the world’s becoming. But not everything is possible at every moment. Interior and exterior, past, present, and future, are iteratively enfolded and reworked, but never eliminated (and never fixed). Intra-actions reconfigure the possibilities for change. In fact, intra-actions not only reconfigure spacetime-matter but reconfigure what is possible. Ethicality is part of the fabric of the world; the call to respond and be responsible is part of what is. There is no spatial-temporal domain that is excluded from the ethicality of what matters. Questions of responsibility and accountability present themselves with every possibility; each moment is alive with different possibilities for the world’s becoming and different reconfigurings of what may yet be possible.<sup>87</sup>

## CONCLUSIONS

Scholars in feminist studies, science studies, cultural studies, and critical social theory are among those who struggle with the difficulty of coming to terms with the “weightiness” of the world. On the one hand, there is an expressed desire to recognize and reclaim matter and its kindred spirits (e.g., the body) exiled from (or swallowed up by) the familiar and comforting domains of culture, mind, and history, not simply to altruistically advocate on behalf of the subaltern but in the hopes of finding a way to account for our own finitude. Can we identify the limits and constraints, if not the grounds, of discourse-knowledge in its productivity? But despite its substance, in the end, according to many contemporary attempts at its salvation, it is not matter that reels in the unruliness of infinite possibilities; rather, it is the very existence of finitude that gets defined as matter. Caught once again looking at mirrors, it is either the face of transcendence or our own image. It is as if there are no alternative ways to conceptualize matter: the only options seem to be the naïveté of empiricism or the same old narcissistic bedtime stories.

I have proposed a posthumanist account of performativity that challenges the positioning of materiality as either a given or a mere effect of human agency. In an agential realist account, materiality is an active factor in processes of materialization. Nature is neither a passive surface awaiting the mark of culture nor the end product of cultural performances. The belief that nature is mute and immutable and that all prospects for significance and change reside in culture merely reinscribes the nature-culture dualism that feminists have actively contested. Nor, similarly, can a human-nonhuman distinction be hard-wired into any theory that claims to take account of matter in the fullness of its historicity. To presume a given distinction between humans and nonhumans is to cement and recirculate the nature-culture dualism into the foundations of feminist theory, foreclosing a genealogy of how nature and culture, human and nonhuman, are formed. Hence any performative account worth its salt would be ill advised to incorporate such anthropocentric values in its foundations.

A crucial part of the performative account that I have proposed is a rethinking of the notions of discursive practices and material phenomena and the relationship between them. In an agential realist account, discursive practices are not human-based activities but specific material (re)configurings of the world through which boundaries, properties, and meanings are differentially enacted. And matter is not a fixed essence; rather, matter is substance in its intra-active becoming—not a thing but a doing, a congeal-

ing of agency. Apparatuses are material (re)configurings or discursive practices that produce (and are part of) material phenomena in their becoming. Discursive practices and material phenomena do not stand in a relationship of externality to each other; the material and the discursive are mutually implicated in the dynamics of intra-activity. In an agential realist account, performativity is understood not as iterative citationality (Butler) but as iterative intra-activity. Intra-actions are agentive, and changes in the apparatuses of bodily production matter for ontological as well as epistemological and ethical reasons: different material-discursive practices produce different material configurings of the world, different difference/diffraction patterns; they do not merely produce different descriptions. Objectivity and agency are bound up with issues of responsibility and accountability. Accountability must be thought of in terms of what matters and what is excluded from mattering.

In an agential realist account of technoscientific practices, the knower does not stand in a relation of absolute externality to the natural world—there is no such exterior observational point.<sup>88</sup> The condition of possibility for objectivity is therefore not absolute exteriority but agential separability—exteriority within phenomena.<sup>89</sup> We are not outside observers of the world. Neither are we simply located at particular places in the world; rather, we are part of the world in its ongoing intra-activity. This is a point Niels Bohr tried to get at in his insistence that our epistemology must take account of the fact that we are a part of that nature we seek to understand. Unfortunately, however, Bohr cut short important posthumanist implications of this insight in his ultimately humanist understanding of the “we.” Vicki Kirby eloquently articulates this important posthumanist point: “I’m trying to complicate the locatability of human identity as a here and now, an enclosed and finished product, a causal force upon Nature. Or even . . . as something within Nature. I don’t want the human to be in Nature, as if Nature is a container. Identity is inherently unstable, differentiated, dispersed, and yet strangely coherent. If I say ‘this is Nature itself,’ an expression that usually denotes a prescriptive essentialism and that’s why we avoid it, I’ve actually animated this ‘itself’ and even suggested that ‘thinking’ isn’t the other of nature. Nature performs itself differently.”<sup>90</sup>

The particular configuration that an apparatus takes is not an arbitrary construction of our choosing; nor is it the result of causally deterministic power structures. Humans do not simply assemble different apparatuses for satisfying particular knowledge projects but are themselves specific parts of the world’s ongoing reconfiguring. To the degree that laboratory manipula-

tions, observational interventions, concepts, and other human practices have a role to play, it is as part of the material configuration of the world in its intra-active becoming. Humans are part of the world-body space in its dynamic structuration.

*(Body w/out organs)*

There is an important sense in which practices of knowing cannot fully be claimed as human practices, not simply because we use nonhuman elements in our practices but because knowing is a matter of part of the world making itself intelligible to another part. Practices of knowing and being are not isolable; they are mutually implicated. We don’t obtain knowledge by standing outside the world; we know because we are of the world. We are part of the world in its differential becoming. The separation of epistemology from ontology is a reverberation of a metaphysics that assumes an inherent difference between human and nonhuman, subject and object, mind and body, matter and discourse. Onto-epistemology—the study of practices of knowing in being—is probably a better way to think about the kind of understandings that we need to come to terms with how specific intra-actions matter. Or, for that matter, what we need is something like an ethico-onto-epistemology—an appreciation of the intertwining of ethics, knowing, and being—since each intra-action matters, since the possibilities for what the world may become call out in the pause that precedes each breath before a moment comes into being and the world is remade again, because the becoming of the world is a deeply ethical matter.

*OUT PUT*

*research notes*