PRETEMPORAL ORIGINATION:

A PROCESS APPROACH TO UNDERSTANDING THE UNIFICATION OF THE HISTORY OF SCIENCE AND THE SCIENCE OF HISTORY

by

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ABSTRACT

Philosopher of science Wilfrid Sellars argues that there are two mutually exclusive images of human-in-the-world that philosophy ought to unify: the "manifest image" of common, shared experience and the "scientific image" of imperceptible objects. Process philosophy, as a metaphysical framework, is in a unique position to allow both images to sit together in dynamic tension, rather than allowing one image to collapse into the other. Not only do I maintain that process philosophy is logically robust, but I also argue that there are several instances of empirical verification of process as an ontology.

Taking a process ontology seriously, however, requires that we re-articulate an understanding of the two grand narratives that are utilized to explain our origins: the socio-cultural evolution of consciousness and the objective evolution of the universe. I call these the *history of science* and the *science of history,* respectively. In Western academia, the *science of history* is usually given ontological priority; but within a process metaphysic, neither can be said to be explanatorily primary. That which holds these two narratives together, and that

which produces spacetime itself, I refer to as “pretemporal origination.” The mode through which this process elicits evolution is through creative-discovery, wherein creation and discovery are not two separate modes of mind-universe interaction, but unified on a continuum of constraints.

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CHAPTER 1: INTRODUCTION

Historically and methodologically, the scientific enterprise is characterized as an attempt to understand the world objectively, or *as it really is* without any sort of subjective supervenience. By assuming that they could bracket their preconceptions and reduce their phenomenological experience to mathematical relations and Lockean primary qualities, Enlightenment scientists attempted to discover the underlying components of reality constitutive of given experience.[1] The implications of this project have coerced a scientifically-informed understanding of waking experience to take on a form of representationalism, wherein an ungraspable objective reality is veiled in direct experience by mental interpretations.[2] In this view, human subjective experience is composed of and produced by experience-less invisible entities (atoms and sub-atomic particles) and unseen causes (forces and fields). These entities and causes, having no experiential or subjective internality themselves, are utterly different in kind from the phenomenon of human consciousness. If a coherent understanding of the material universe and the human being's place within it is to be developed, a reconciliation between lived experience and scientific explanation must be made.

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1 John Locke makes the distinction between "primary qualities" and "secondary qualities" in his *Essay Concerning Human Understanding (book II, chapter viii)*. Primary qualities refer to solidity, extension, figure, and motion, whereas secondary qualities refer to subjective experiences like smell, taste, and color. Secondary qualities are produced by the interaction of our experience and primary qualities, and primary qualities are fundamental aspects of objects, themselves.

2 For a concise explanation of representationalism, see "Representative theory of perception" in *The Oxford Guide to Philosophy* (Honderich 2005, 813-814).

To this end, I argue that there is a shared ground of both phenomenal experience and the evolution of space-time which I will term *pretemporal origination*.

Interestingly, within the development of quantum physics, the scientific method of reducing the content of naïve experience to unseen "building blocks" has led to the breakdown of the subject-object divide – the very divide that has been necessary for the classical metaphysical outlook of the scientific enterprise to be maintained. The process of understanding macro-sized objects by analyzing their constitutive parts has, within the field of quantum mechanics, forced philosophically-oriented scientists to grapple with the assumption that the subjective observer is in some sense detached from the objects of observation. For example, in analyzing the findings of quantum measurement and quantum pioneer Niels Bohr's philosophical explications, physicist Karen Barad (2007) argues that "subject" and "object" do not pre-exist their interaction, rather they arise together in the process of *intra-action*. Philosophically and scientifically, the classical subject-object dichotomy is an erroneous ontological appropriation – a complete *division* that ought to be considered an abstract *distinction*.[3] While the ontological and epistemological implications of quantum theory serve as my scientific entry point for a departure from classical materialism, findings in biological self-organization and neuroscience are also pointing to the generation of a Kuhnian revolution away from the very possibility of maintaining a project of pure objectivity in the modern scientific paradigm.

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[3] For a full analysis of the difference between "division" and "distinction," see Barfield 1971, 18-21.

"The aim of philosophy," according to philosopher of science Wilfrid Sellars, "is to understand how things in the broadest possible sense of the term hang together in the broadest possible sense of the term" (1963, 1). It is up to the metaphysician of science, therefore, to utilize the ontological and epistemological implications of scientific discoveries for analysis of the greater milieu of human enterprises. The resulting analysis must then be brought back to bear on the implications of the sciences as human enterprises themselves. In this manner, a dialectic can be developed between the sciences and the humanities that illuminates both fields of inquiry, underpinning them with a shared metaphysic. This encompassing metaphysic would be the broadest possible Sellarsian framework in which things, in the broadest sense, could hang comfortably.

Process ontologies, as systems for understanding the fundamental nature of the world, are in a unique position to hold together findings from different disciplines of modern science. The argument that *dynamical process* and *change* are metaphysically, if not chronologically, prior to *objects* and *substances* coincides readily with modern science's discoveries and explanations. The implications of this philosophical project do not leave the concept of *subject* unchanged either. The subject is no longer an unobtrusive observer of the processual flow of reality, but is constituted by its concurrent intra-action with dynamic matter (Barad 2007, 342). Process philosophy not only fits the scientific findings, it also changes the way we must understand the scientific enterprise that has led to those findings. Process ontology, as articulated primarily by Alfred North Whitehead in *Process and Reality* ([1929] 1978) and Karen Barad in

Meeting the Universe Halfway (2007), starts from a position prior to the subject-object division assumed by classical science, and, therefore, reorients the historical understanding of scientific development itself.[4]

Evolutionary cosmology and human cultural history are the two grand narrative methods through which secular Western academics understand the developmental origins of our current state of affairs. Rather simply, science places human history within the scope of the evolution of the universe, whereas history places the development of science within the scope of cultural-consciousness evolution.[5] I refer to these modes of orientation as the *science of history* and the *history of science*, respectively. Broadly speaking, the former view treats the emergence of subjectivity out of the random interactions of axiologically-empty objects. The latter view, on the other hand, treats the emergence of scientific objectivity (including the very concept of "objects") and its discoveries as resulting from historical, subjective interactions.

Within academia, these two evolutionary views are usually treated within different domains, namely the sciences and the humanities. Both are granted certain levels of truth within their respective spheres of influence, but the scientific explanation is usually bestowed ontological priority given the assumed

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4 Barad (2007) does not directly refer to her philosophical system, *agential realism*, as a process philosophy proper. However, in Chapter 2, I argue, that *agential realism* is a scientifically-informed ontology of process.

5 For examples of authors who place human history within the narrative of the evolution of the universe, see Hawking (1988); Chaisson (2006); or Swimme and Berry (1992).
For examples of authors who place the development of science within the evolution of cultural consciousness, see Whitehead (1925); Barfield (1965); Tarnas (1991).

temporal recency of conscious subjectivity in the evolutionary model of the universe. However, provided the actual validity of the breakdown of the subject-object division, both within the physical sciences and within process philosophy, the *history of science* cannot be simply subsumed by the *science of history.* Their relationship must be more nuanced than the metaphysical understanding presented by materialist evolutionary cosmology. If the scientific explanation cannot be given primacy over the historical explanation, it also cannot be denied as illusory. I will attempt to articulate how these two methods for understanding the relationship between consciousness and universe can be held together in a sort of complementary tension, without one understanding collapsing into the other. The objective truths shall remain, but the notion of subjectivity and objectivity shall change. In other words, objective truth will be set in motion, preventing the understanding of ourselves and the world from achieving any semblance of static completion.

In order to articulate the subtle change in understanding that process philosophy imbues the relationship between the *history of science* and the *science of history*, I shall further utilize the terms *creation* and *discovery* to frame my conclusions. While both imaginative creativity and empirical discovery are used in both the humanities and in the sciences, creativity tends to be harnessed by the humanities whereas discovery tends to be claimed by the sciences. Commonly considered to be opposed modes of human action, within a process metaphysic they are both instantiations of a singular, underlying phenomenon. In this same manner, cognitive scientist Robert M. French has determined that our definitions

of these two notions arise out of their locations on a "continuum of constraints" (French, n.d.).

I argue that, based on a new understanding of the relationship between subject and object, the methods of science are not simply methods of discovering pre-existing truths. Rather, when a great scientific discovery is made, such as the discovery of the heliocentric model of the solar system, not only is an epistemological alteration introduced into human cultural-consciousness, but an ontological shift also takes place *in the universe itself*. It is important to reiterate here, after making a lofty claim, that I am not arguing that objective, empirically-validated truths are illusory, nor am I advocating a form of solipsism; rather, I am arguing that our very notion of objectivity needs to be reconstructed.

The importance of this reconstruction of the subject-object relationship at this point in human history cannot be overstated. Human beings, primarily in the Western world, but increasingly across the globe as the Western world view is transmitted with economic globalization, have found themselves in the throes of what Richard Tarnas (1991), utilizing the psychological research of Gregory Bateson (1972), refers to as "the double-bind of modern consciousness" (Tarnas 1991, 420). The world as experienced is imbued with human meaning and value, yet, simultaneously, scientific explanations of the universe treat meaning as somehow epiphenomenal.[6] The loss of meaning as a fundamental aspect of the universe in which we dwell displaces the human from her context and leads to

[6] For examples of authors who discuss the paradox inherent in the epiphenomenalist view of consciousness, see Tarnas (1991); Bortoft (1996); or Deacon (2012).

various forms of schizophrenic reaction (Tarnas 1991, 420). The results of this schizophrenia can be seen in mass consumerism and its resulting waste creation, global climate change produced by industry and transportation, economic and political inequalities, the industrialization and the genetic-alteration of food production, and religious fanaticism. I do not intend to say that some of these issues were not present prior to the Scientific Revolution, for such a statement would be patently false. However, the promise of science to release humanity from the grips of supernatural ignorance into a utopian world of objective truth has proven to do quite the opposite.

My analysis of the breakdown of the subject-object divide and its metaphysical implications for the human-cosmos interface may require a suspension of many basic assumptions, especially for reductive materialists. However, the fruits of this critical labor will result in a redefinition of both human consciousness and universe that fits contemporary evidence *and* logical argumentation. My hopes for this thesis mirror Owen Barfield's sentiments in his introduction to *Saving the Appearances: A Study in Idolatry* (1965) when he states:

> There may be times when what is needed most is not a new discovery or a new idea as a different "slant"; I mean a comparatively slight readjustment in our *way* of looking at the things and ideas on which attention is already fixed.
> (Barfield 1965, 11)

I hope to show that *our way of looking at things* is always already constitutive of the things themselves.

Note on context: This thesis is couched within the Western tradition, and I purposefully do not make reference to philosophical or scientific ideas offered by the great traditions of the region classically known as the East. When I make reference to grand projects such as “science,” “history,” or “philosophy,” it is with the understanding that I am referring only to these projects as they have developed within the Western tradition.

Note on language: The reader might notice a certain circularity in my discussion of process philosophy insofar as I reiterate certain ideas several times in different phrasing. This is not due to a desire to be wordy; rather, it is an inherent aspect of discussing the recursive nature of process ideas in English, which utilizes a decidedly linear progression in its subject-predicate structure. Those who have read the work of my two exemplars of process thought, Alfred North Whitehead and Karen Barad, will notice a similar iterative circularity in their own writing. This inability for the English sentence structure to express the fundamental shift in understanding required for a process metaphysics is due to a catachresis of sorts, wherein words are used incorrectly or inadequately to transmit the desired meaning. For this reason, I invoke constant reminders that the subject-predicate, linearly developing sentence structure of the English language precludes an ability to naturally discuss the implications of process metaphysics in a simpler manner.

CHAPTER 2: A BROKEN WORLD VIEW

The Images of Humanity

In his influential, albeit gender-dated, essay, “Philosophy and the Scientific Image of Man,” Wilfrid Sellars (1963) lays out his distinction between the “manifest image” of human-in-the-world and the “scientific image” of human-in-the-world. Sellars's two idealizations of the modes through which humanity relates to the greater milieu of existence are, within their own jurisdictions, considered to be explanatorily complete. He argues, due to the purported completeness of each image, the philosopher's pursuit in this area of research is, “after separate scrutiny, [to] fuse [them] into one vision” (Sellars 1963, 4). In order to begin unpacking Sellars's unificatory challenge to philosophy, I shall articulate what he means by the “manifest image” and the “scientific image.” Then, I shall argue that a Whiteheadian process philosophy is a powerful method for reconciling these opposed “images” or world views.

The “manifest image” of humanity is the common sense, everyday experience of being in a world of mid-sized objects and other persons. According to Sellars, the “manifest image” is “the framework in terms of which man came to be aware of himself as man-in-the-world” (Sellars 1963, 6). In this historical perspective, the “manifest image” took root in human consciousness when human beings began to critically analyze their world-situatedness. By way of explanatory contrast, Sellars makes quick reference to a pre-critical mode of being as the “original image,” which he characterizes as an animistic human-world relationship, wherein all objects are perceived as having human-like agency

(1963, 10).[7] The “original image” is similar to the world view of indigenous peoples both past and present, wherein the world is alive and humans are able to commune with and negotiate with the myriad beings and personalities that make up the cosmos. It is clear that Sellars's principal reason for employing the term is to provide a contrast with the “manifest image” because he spends very little effort extrapolating the concept of the “original image.” The “original image” ensures that he is not implying that the “manifest image” is somehow uncritical or unscientific, for it is both empirical and categorial (Sellars 1963, 7). Billiard-like causal interactions, categories of species, artistic works, public transportation, evening dinner – these all take place within the confines of the “manifest image.” In addition, much of the history of philosophy is concerned with the “manifest image,” including, but not limited to, ancient and medieval philosophical systems, Continental traditions, and Anglo-American systems concerned with “common sense” and “ordinary usage” (Sellars 1963, 8). Philosopher Jay Garfield refers to this “image” as the view of the human-world relationship “delivered by sophisticated common sense,” wherein human beings are persons who live in a world imbued with language-created normativity contextualized by a natural world composed of “purely descriptive natural laws” (Garfield 2012, 104). Importantly, the “manifest image” is not a function of the past that has been overcome; rather, it exists concurrently with the “scientific image,” and it is for this reason that the two images must be unified in some manner.

[7] It might be more appropriate to say that humans were partaking in the agency that was infused throughout the world around them, rather than attributing a human-like characteristic to the non-human.

The corpus of research, method of inquiry, and world view that Sellars refers to as the "scientific image" is "that which postulates imperceptible objects and events for the purpose of explaining correlations among perceptibles" (Sellars 1963, 19). The "scientific image" explains the phenomena of the world through posited entities like fields, atoms, and wave-packets. This view of the world is essentially mechanistic in character, insofar as its description of reality does not include teleological explanations, meaning, or value. Whereas Sellars refers to the objects of the "manifest image" as "truncated persons," meaning that events occur not because of volitional qualities intrinsic to objects, but because of habits and patterns of interaction (Sellars 1963, 13); he argues that:

> The distinctive trait of the scientific revolution was the conviction that all events are predictable from relevant information about the context in which they occur, not that they are all, in some ordinary sense, caused. (Sellars 1963, 14)

In other words, the "scientific image" of human-in-the-world is concerned with bracketing or confining events (such as in highly-organized scientific experiments like the CERN Large Hadron Collider) to determine what contextual information can be gleaned so that anticipatory conjectures can be made about events in future similar contexts. The method of science in the "scientific image" is predictive and descriptive, whereas the science of the "manifest image" is purely descriptive. This analysis of contextually-relevant information is the impetus for the powerful and popular reductionist campaign in the sciences because, in essence, reductionism provides finer-grained, higher-resolution perspectives of context.

The contrast between Sellars's two images of human-in-the-world has been articulated more recently by both the biologist Steven Rose and the anthropologist Terence Deacon (although neither directly engages Sellars's arguments or terminology). Each asks a simple question by means of introducing the dichotomy: Rose asks, “What causes a frog to jump?” (Rose 1997, 10) and Deacon asks, “What causes a beach stone to move?” (Deacon 2012, 18). Each provides multiple answers to the same question, most of the answers being scientific. Both scientists argue that the “manifest” explanations complicate the purely scientific explanations because they represent a top-down sort of causation and end-directedness (Deacon 2012, 20-21; Rose 1997, 11).

In Rose's account, five biologists attempt to answer the question of the hopping frog. The first provides a neurophysiological explanation involving brain impulses and muscle contraction, the second describes the flight response caused by a nearby snake, the third offers an ontogenetic explanation concerning the development of the frog's leg muscles as an embryo, the fourth provides an adaptive-evolutionary explanation concerning the natural selection of the jumping trait in frogs, and the fifth describes the biochemical properties of the actin and myosin in the frog's muscles (Rose 1997, 10-13).

Deacon's scenario pictures a young boy skipping a stone on the surface of the ocean. He asks how this event could be understood. Choosing to focus entirely on the internal muscle movements, one can consider oxidative metabolism, the digestion of carbohydrates, the sunlight used in photosynthesis by the plants the boy previously consumed, the energy of the ATP molecules in the boy's muscles,

neuronal firings in the cerebral cortex, or the evolutionary history that led to the morphology of the boy's arms and hands (Deacon 2012, 18-19). Any of these explanations could be deemed scientifically correct. However, Deacon provides another explanation:

> "[There is also the boy's] *mental conception* of what this stone might look like skipped over the waves, his knowledge of how one should hold and throw it to achieve the intriguing result, or his fascination with the sight of a stone resisting its natural tendency to sink in water." (Deacon 2012, 19; italics in original)

In these examples, each scenario presented by Rose and Deacon falls under the world view of the "scientific image," except for those of Rose's second biologist and Deacon's description of the boy's mental conception. All of the other scenarios are based on imperceptible, context-dependent entities or events (such as ATP, myosin, or the inherent evolutionary past incorporated in the present physiology). By contrast, the second biologist's scenario is based on a flight response involving a teleonomic explanation. As Rose explains,

> [I]t is not causal in the sense of describing a temporal chain of events in which first one thing, the nerve firing, then another, the muscle contraction, happen one after another in time. The jump inevitably precedes achieving the goal toward which it is directed. (Rose 1997, 11-12)

This explanation involves the habits of a frog as "truncated person," and its patterns of interaction with its environment is the analytical explanation for the frogs jump, not the underlying imperceptibles. Similarly, Deacon's presentation of the mental constructions of the boy's intention to throw the stone across the water involve both the boy's experience of his own "manifest image," as well as our "manifest image" view as the observer of the scenario. The boy throws the stone

because of his *desire* to see the water and the stone interact in an entertaining manner. He is *hoping* to experience the habit of a flat stone, when thrown correctly, to skip across the calm surface of a body of water (rather than, for example, hoping to experience the electrons on the stone's outer surface repel the electrons of the water's surface). For the observer of the event, the explanation of the boy's mental state is a "manifest image" explanation because the boy's habits and patterns of interaction are the causal explanations, as opposed to the reductive biological or physical explanations of his internal construction.

These examples of the two Sellarsian "images" not only help to elucidate their differences, but also show that the harmonizing of the two is still not considered settled fifty years after Sellars (1963) first articulated the problem. Tarnas's "double-bind of modern consciousness" (1991, 420) is a living conundrum. I argue that the main reason Sellars's articulation of these two "images" of humanity have not been satisfactorily fused into a coherent world view is because he does not acknowledge the *active* role of the subjective observer in each "image," including his own. While the "images" themselves are idealized world views that logically entail the subjectivity of a world-viewer, his analysis does not acknowledge the inherent necessity of the subject in the determination of the objects, whether "manifest" or "scientific." This disregard for the experience of a subject is readily apparent in the "scientific" image, which utilizes depersonalized imperceptible objects as explanatorily fundamental. The categorial and empirical nature of the "manifest image," which entails that it is a specific kind of world view based on repeated verifiability of the nature of the

objects that inhabit it, rather than being the unique subjective experience of any given individual, ensures that it is an "image" implicitly informed by a subject-object dualism. In this "image," objects are not ontologically affected by or interactive with subjectivity.

Imaging the Images of Humanity

The subjectivity of the observer is the factor that unites both "images," for it is an inherent aspect in both. An "image" *requires* an onlooker, and by focusing analysis on the role of the onlooker in the determination of the "image," philosophy can begin to hang the two images together in a single metaphysic. The fact that intentional subjectivity is not passive in its interaction with the world is attested to by John Archibald Wheeler (1977), the acclaimed theoretical physicist. He illustratively states:

> [I]t was long natural to regard the observer as in effect looking at and protected from contact with existence by a 10cm slab of plate glass. In contrast, quantum mechanics teaches the direct opposite. It is impossible to observe even so miniscule an object as an electron without in effect smashing that slab and reaching in with the appropriate measuring equipment. (Wheeler 1977, 5)

This understanding of the dynamic inter-relationship between observing subject and observed object, which has been discovered in modern physics and creatively articulated in the process philosophies of Alfred North Whitehead ([1929] 1978) and Karen Barad (2007), is a useful starting point for understanding how the "manifest image" and the "scientific image," due to their shared constitution as "images" observed by a subject, might be systematically conjoined. For the

purposes of this discussion, I will focus on the process philosophy of Whitehead, although I do find Karen Barad's *agential realism* to be directly in concert with Whitehead's ontology, as I will show in the next chapter.

Whitehead's project of articulating a coherent and adequate process philosophy begins with his analysis of the "bifurcation of nature" (1920). Whereas Sellars presents his two "images" as always already present in the mind of the educated modern Western human, Whitehead argues that this division is an abstraction, misleading at best and detrimental at worst. Sellars desires a unification of two distinct modes of understanding the world, but Whitehead thinks that one must start from a place of understanding *prior to* the division.

In *The Concept of Nature* (1920), Whitehead asserts:

> For natural philosophy everything perceived is in nature. We may not pick and choose. For us the red glow of the sunset should be as much part of nature as are the molecules and electric waves by which men of science would explain the phenomena. (Whitehead 1920, 29)

Much like John Archibald Wheeler's (1977) depiction of shattering the slab of plate glass that separates the observer from the observed, Whitehead argues that both of Sellars's "images" are always already aspects encompassed within a perceiving subject, and unification occurs by taking perception as the starting point. The observer is not a passive onlooker as was once thought; rather she is an active actualizer of the real, and Whitehead's metaphysical project is to take this idea seriously. Philosopher of science Isabelle Stengers portrays Whitehead's challenge to the "scientific image" thus:

> There is the simple fact that the scientists' questions do not enable them to formulate the problem of the "mind" because these questions and their answers presuppose it... Everything to which scientists could refer, insofar as they are aware of it in perception, including the electromagnetic radiations witnessed by "that which" their specialized instruments give them to perceive, is indeed a part of nature; that is, like the concept of nature itself, it designates the mind *qua* presupposed and bracketed. (Stengers 2011, 35)

The observing and experiencing subjectivity of the scientist, the artist, or the civilian is that which unites all models of explanation, and, insofar as this unification is prior to the distinctions made within either the "manifest image" or the "scientific image," Whitehead argues that it should be the foundation for natural philosophy.

A final presentation of Whitehead's insight will be helpful here. He states:

> What I am essentially protesting against is the bifurcation of nature into two systems of reality, which, in so far as they are real, are real in different senses. One reality would be the entities such as electrons which are the study of speculative physics. This would be the reality for which there is knowledge; although on this theory it is never known. For what is known is the other sort of reality, which is the byplay of the mind. Thus, there would be two natures, one is the conjecture and the other is the dream. (1920, 30)

Here, Whitehead portrays the "scientific image" as conjecture and the "manifest image" as a dream. Neither has any concrete reality except in the experience of a subject. From this basis, Whitehead develops his process philosophy in *Science and the Modern World* (1925)and *Process and Reality* ([1929] 1978), wherein he seeks to understand the world of experiencing subjects and experienced objects as always already unified by the metaphysical primacy of processual interaction.

In *Science and the Modern World* (1925), Whitehead takes on the intricately complicated task of unpacking his conceptualization of the primacy of

process by breaking apart the idea of physical "simple location." "Simple location" is a concept that is shared by the formulations of both Newtonian mechanics and Einsteinian relativity. Whitehead states:

> To say that a bit of matter has *simple location* means that, in expressing its spatio-temporal relations, it is adequate to state that it is where it is, in a definite finite region of space, and throughout a definite finite duration of time, apart from any essential reference of the relations of that bit of matter to other regions of space or other durations of time. (Whitehead 1925, 58; italics in original)

This notion of simple location is readily apparent in the Newtonian view of the universe, which incorporates a container-view of space and an independently existing flow of time. Objects, like billiard balls or atoms, simply occupy their given location in space and either move or stay stationary as time progresses. In Einsteinian relativity, however, the notion of simple location is harder to pick out since motion is relational and space and time are unified. However, philosopher of science Filmer S. C. Northrop (1941) argues, Einstein redefined absolute space as relational space, but carried with it a pre-relativistic understanding of physical objects as simply located in relation to other physical objects. In redefining space as relative, Einstein missed the point that physical "objects" - and, therefore, objectivity, itself - must also be redefined, since in the Newtonian system, physical objects are *defined by* their location in absolute space (Northrop 1941).

Nevertheless, Whitehead does not mean to argue that the notion of simple location is inherently false, merely that taking the abstract notion of simple location to be a definitive, ontological aspect of reality is an example of his notion of the *fallacy of misplaced concreteness* (Whitehead 1925, 58). Rather than

understanding the doctrine of simple location as an abstract conception always already coupled to the concrete immediate experience of the scientist, the abstraction has been assumed to be the concrete reality and the experience to be an epiphenomenon. It is from this critical analysis of the doctrine of simple location that Whitehead tackles the daunting task of formulating his entire metaphysical system based on the fundamental notion of "process."

Whitehead argues that immediate experience is the given, concrete fact from which all analysis of reality must begin. From this starting point, a proper understanding of space-time can be garnered. By analyzing what occurs in phenomenological experience, Whitehead determines that "primarily space-time is the locus of the modal ingression of sense-objects" (Whitehead 1925, 71). "Modal ingression" here is the universalization of the means by which humans experience a distant "object" *here*, while also acknowledging that the "object" is actually a distance away. This internal relatedness as concrete experience, since it precedes the abstract notion of an external relatedness based on the doctrine of simple location, is the metaphysical state of affairs for all entities. Just as the experiencing subject is entailed by the objects of phenomenological experience, so the objects within experience (or the constituents of those objects), in some sense, also internally experience the subject as an object.

Whitehead does not mean to anthropomorphize the basic constituents of reality; rather, his intention is to argue that human experience is a uniquely anthropomorphic formulation of the overall state-of-affairs. Rather than lapsing into solipsism, Whitehead follows his logic *through* solipsism, wherein everything

is a product of one's own experience, into his philosophy of organism, wherein every "thing" is produced through the interaction of experiencing entities. He uses the term "prehension" to universalize the notion of human perception. He states:

> The difficulties of philosophy in respect to space and time are founded on the error of considering them as primarily the loci of simple locations. Perception is simply the cognition of prehensive unification; or more shortly, perception is cognition of prehension. The actual world is a manifold of prehensions; and a "prehension" is a "prehensive occasion"; and a prehensive occasion is the most concrete finite entity, conceived as what it is in itself and for itself, and not as from its aspect in the essence of another such occasion. (Whitehead 1925, 71)

What Whitehead is essentially stating here is that the world, both as understood in the "manifest image" and in the "scientific image," is really composed of internally related occasions of prehension. Another way in which to understand prehensions is to conceptualize them as "uncognitive apprehensions" (Whitehead 1925, 69). This view is sometimes referred to as *panpsychist* or *panexperientialist*. Whitehead would probably prefer the term *panprehensive*.

From his standpoint that space-time, as understood by physics, is an abstract model of the internally inter-related manifold of occasions of prehensive unification, Whitehead comes to the determination the "processes" are metaphysically prior to the abstract notion of simply-located physical objects. He states:

> A prehension is a process of unifying... Thus nature is a structure of evolving processes. The reality is the process... The realities of nature are the prehensions in nature, that is to say, the events in nature. (Whitehead 1925, 72)

Whitehead performs a figure-ground reversal. He displaces the common conception that processes are a function of the interaction of simply-located objects with the notion that simply-located objects arise out of interacting processes.

In this way, Whitehead develops his philosophical system from a standpoint that precedes the “manifest” and “scientific” distinction. If the objects of analysis for either the “manifest” viewpoint or the “scientific” viewpoint are actually abstract understandings of prehensive unification, then neither viewpoint can be said to explanatorily consume the other. In fact, it is something more like the “original image,” to which Sellars (1963) only briefly refers, that chronologically precedes the other two. In the same way that the “manifest image” chronologically precedes the “scientific image” and yet is concurrently maintained along with it, something like the “original image” underlies the two main images of Sellars's analysis in a Whiteheadian system.

In Sellars's brief explanation of the “original image,” he states that it is an image of man-in-the-world wherein one ought “to characterize it as a framework in which *all* the 'objects' are persons” (Sellars 1963, 10). He goes on to say that primitive peoples did not relate to objects as persons from a standpoint of *belief*, as if they saw a tree first then added the belief of personhood. Rather, the relationship between primitive person and “object as person” automatically involved an interpersonal mode of interaction prior to any formulation of belief (Sellars 1963, 10). Just as within a Whiteheadian metaphysic, the world view of the “original image” is that all objects have an interior interrelationship to all

other objects. Whitehead's ([1929] 1978) metaphysics, however, makes the interior interrelatedness *metaphysically prior to and constitutive of* objects, and this determination is based on his understanding of phenomenological investigation (Sellars' "manifest image"), and the implications of Einsteinian relativity and advances in quantum theory (Sellars' "scientific image"). Whitehead retrieves and enhances the "original image" as the logical unifier of the "manifest" and the "scientific."

Sellars (1963) argues that the chronological development through the three "images" is a process of continual depersonalization. It follows a movement of human-world relatedness that develops from a world populated with "persons," to a world populated with "truncated persons," to a world populated with "imperceptible objects and events" (Sellars 1963). Whitehead agrees that this progression has, indeed, taken place; however, in order to have a cohesive view of the world that unifies the "manifest image" and "scientific image," which Sellars calls upon philosophy to develop, it is important to acknowledge that the "original image" is the underlying state of affairs. Although, in order to take the "manifest image" and the "scientific image" seriously, as Whitehead certainly does, the "original image" must be reformulated to include the reality of immediate experience and the findings of the sciences. This requires an "original image" construed within the figure-ground reversal of a process metaphysics.

CHAPTER 3: PROCESS ONTOLOGY

Alfred North Whitehead is the seminal process philosopher of the twentieth century, having articulated a nuanced metaphysical latticework of processual interaction in his book *Process and Reality* ([1929] 1978). Supportively, process philosophy has a history that reaches back to Heraclitus, through Leibniz, Bergson, C. S. Peirce, and William James (Rescher 2000, 3). More recently, elementary particle physicist and feminist Karen Barad (2007) has articulated an ontology, which she calls *agential realism,* that can be placed directly into this genealogy of process thinkers, although she does not claim it for herself. This chapter will be a summary of the basic principles of both Whitehead's and Barad's ontologies for the purpose of understanding process as a whole, since both approach the subject from different vantage points, areas of expertise, and historical periods. Whitehead's starting point is the *logical* necessity of explaining the co-existence of both scientific facts and subjective experience, whereas Barad's starting point is the *empirical results* of quantum experiment. I not only intend to summarize their respective ontologies, but, following the recommendation of Barad (2007) and philosopher Donna Haraway (1992), I also intend to read them diffractively, or to look at how they minutely differ from and reinforce one another to better articulate the underlying phenomena of process that both attempt to describe in their unique ways and with their own unique sets of tools.

Alfred North Whitehead presented the Gifford Lectures, which would eventually be published as *Process and Reality*, in 1927 (Whitehead [1929] 1978),

and Karen Barad published *Meeting the Universe Halfway* in 2007, allowing for a full 80 years of development in the theoretical and experimental understandings of quantum mechanics between them. Many writers have attempted to bring Whitehead's ontology into concert with the myriad interpretations of quantum theory, but my reading of Barad's work has illuminated Whitehead's philosophy, and vice versa, more so than any of these other attempts at correlation.[8] Although Barad never mentions Whitehead directly in her work, she develops an epistemo-ontology very much in line with Whitehead. Whitehead develops his philosophical undertaking with a sense of process firmly in mind since he is heavily indebted to the French process-thinker Henri Bergson ([1911] 1998), whereas Barad realizes the necessity of adhering to an ontology of process through her scientific experimentation.

Whitehead's Process Philosophy of Experience

Whitehead's ([1929] 1978) project to conceptually unite the objective world of science with the subjective world of human experience is formulated around process, rather than substance, as metaphysically foundational. Whitehead's conceptual understanding of process and temporal change is heavily influenced by French philosopher Henri Bergson's notion of *duration*, which Bergson defined as "the continuous progression of the past which gnaws into the future and which swells as it advances. And as the past grows without ceasing, so

[8] For examples of authors who have compared Whiteheadian philosophy to certain interpretations of quantum physics, see Epperson 2004; Shimony 1965; Stapp 2007.

there is no limit to its preservation" (Bergson [1911] 1998, 4). This notion of duration as a constant upswelling of the past into the immediate present proves invaluable for Whitehead's thought. The idea that time, as experienced, is a process of constant morphic change provides the foundation for one of Whitehead's unique philosophical concepts, that of *concrescence*, or the continual coming-to-be of any actual entity as it involves other actual entities. This concept will be explicated further as this chapter unfurls.

What is equally invaluable for Whitehead's thought, however, is the place where he parts ways with Bergson. One major contention that Whitehead has with Bergson's philosophy is Bergson's disparagement of the scientific enterprise's spatialization of time, such as thinking of time as a series of successive events on a timeline.[9] According to Filmer S. C. Northrop,

> Whitehead found himself unable to understand how the use of spatial concepts in scientific procedure could enable scientists to predict with the precision they achieve, were spatialization the falsification of fact which Bergson maintained. (Northrop 1941, 169).

In not only accepting the primacy of duration as a non-spatial experience, but also acknowledging the importance of spatializing the idea of time for scientific inquiry, Whitehead formulates a metaphysical scheme that allows for subjective experience and scientific objectivity to coexist without falling into a bifurcated nature.

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[9] For Bergson's analysis of spatialized time, see Bergson, "The Idea of Duration," in *Bergson: Key Writings* 2002, 55-57.
For Whitehead's contention with Bergson's disregard for abstractions, see Whitehead 1925.

In addition to the explication of Whitehead's notion of "the bifurcation of nature" already given in Chapter 1, he also describes this bifurcation through the supposed dual realities of "nature apprehended in awareness and the nature which is the cause of awareness" (Whitehead 1920, 31). Philosopher Thomas Nagel very recently articulated a similar dissatisfaction with this dichotomizing of the natural order into two parallel realities utilizing the concept of "intelligibility." He states:

> The intelligibility of the world is no accident. Mind, in this view, is doubly related to the natural order. Nature is such as to give rise to conscious beings with minds; and it is such as to be comprehensible to such beings. Ultimately, therefore, such beings should be comprehensible to themselves. And these are fundamental features of the universe, not byproducts of contingent developments whose true explanation is given in terms that do not make reference to mind. (Nagel 2012, 17)

Human experience or "mind," therefore, must be assumed as a metaphysical reality rather than built up from the entities of the "scientific image." Much like David Chalmers's explication of the "hard problem of consciousness," subjective experience can not be explained from the external interactions of physical entities because experience is utterly different *in kind* if these entities are assumed to be completely free of any sort of world-oriented standpoint (Chalmers 2010, 5). Whitehead's solution to this problem is to argue that experience is metaphysically fundamental. Experience does not need to be explained, rather it ought to be the explanatory principle from which all other concepts should be derived.

Whitehead atomizes and universalizes experience in his concept of actual entities or actual occasions, which he describes as:

> [T]he final real things of which the world is made up. There is no going behind actual entities to find anything more real... [they are]

> drops of experience, complex and interdependent. (Whitehead [1929] 1978, 18)

The coming-to-be of an actual occasion is the process of *concrescence*, or the mode of becoming concrete. Actual occasions appear and perish in a wink, never to do so again. Once an actual occasion perishes it ceases to be a locus of experience and becomes a datum to be experienced by other actual occasions. The experience of coming-to-be is the process of concrescence, which is the subjective pole of an actual occasion; whereas the fulfillment of concrescence gives way to an objective determination, which becomes the *superject* of that actual occasion that, in turn, becomes a possible ingredient for the experiential content of other actual occasions (Whitehead [1929] 1978, 28-29, 44-45). In this sense, an actual occasion is a present, momentary awareness that is composed of past actual occasions as superjects, both the superjects of its own trajectorial lineage and the superjects of *all* past actual occasions, which are, in a sense, radially oriented to it.

My moment-to-moment experience is a personally-ordered progression of actual occasions; and, as my immediate experience continually falls away to bring forth new experiences, so do all actual occasions. The constituents of my experience are the superjects of past actual occasions, including the superjects of the actual occasions that composed my own classically-understood linear history. Now, the direct experience of superjects, or the transmission of the internal constitution or latent subjective pole of past actual occasions, Whitehead terms *prehensions*. He states:

> Each actual entity is 'divisible' in an indefinite number of ways, and each way of 'division' yields its definite quota of prehensions. A

> prehension reproduces in itself the general characteristics of an actual entity: it is referent to an external world, and in this sense will be said to have a 'vector character'; it involves emotion, and purpose, and valuation, and causation. In fact, any characteristic of an actual entity is reproduced in a prehension. (Whitehead [1929] 1978, 19)

It should be remembered from Chapter 1 that Whitehead referred to perception as "cognition of prehension" (Whitehead 1925, 71).

So, an actual occasion prehends past actual occasions as superjects. For a human being, this means that in any immediate moment of experience, she is prehending the superjects of her own past experiences in addition to the superjects of the past actual occasions in her specious present or momentary phenomenological horizon, where "specious present" is defined as "the finite interval of time embracing experiences of which the mind is conscious of happening 'now', and constitutes the remembered past from the anticipated future" (Honderich 2005, 888). However, there is still one important ingredient in Whitehead's metaphysical scheme that needs to be articulated in order to get a full picture of how Whitehead unifies subjectivity and objectivity. If actual occasions are continually concrescing and giving themselves to new actual occasions as superjects in a continual process of change and flux, how is it that familiarity or consistency is an aspect of one's own direct experience? This aspect of experience needs to be accounted for, and Whitehead does so with his concept of *eternal objects*.

Eternal objects serve as the formative means by which an actual occasion prehends past actual occasions. They are the *manner* in which constituents of an actual occasion's subjective pole are experienced. Whitehead states:

> [Eternal objects] are here in the perceiver; but, as perceived by him, they convey for him something of the total flux which is beyond himself. The subject-object relation takes its origin in the double rôle of these eternal objects. (Whitehead 1925, 151,)

In other words, when I experience the red of an apple, I am experiencing the eternal object, redness, that resides both in me *and* in the apple. In the same way, I experience the eternal object of roundness. These simple eternal objects, when conjoined, form the complex eternal object of the apple as a whole (Whitehead 1925, 166-170). While I prehend the actual occasions that compose the apple as prehensions, i.e. the vectorial transfers of the subjective poles of the past actual occasions as superjects, I perceive or sense the eternal objects as the forms in which these prehensions are conveyed. Isabelle Stengers explains:

> As far as color is concerned, it is no longer there "again" but "once again," always the same but always new, for it is not worn out, does not live, does not endure. Eternal because it is always there – it would never be anything but an indefinite endurance – but because experience testifies to color in the sense that it is what it is, without reference to a process within time. Color is eternal in the precise sense that it requires that endurance and change do not define in an exhaustive way what is required in the order of nature. (Stengers 2011, 155)

Whitehead considers change and flux to be fundamental to reality; but he must account for what seems to remain the same. In order to do so, eternal objects are offered as the *means through which* actual occasions experience their world. They are always abstract. Whitehead states, "If we abstracted the form from the feeling,

we are left with an eternal object as the remnant of the subjective form" (Whitehead [1929] 1978, 232). The term "subjective form" is a technical term that means the qualitative mode through which an actual occasion concresces.

So far, I have introduced several Whiteheadian terms that are necessary for the development of this thesis. "Actual occasions" are the basic drops of experience of which the world is fundamentally composed. "Concrescence" is the process in which these occasions come to be, perish away, and pass their experiential determination on to other actual occasions. "Superjects" are the objective side of the subjective pole of actual occasions as they terminate and are experienced by other actual occasions. "Prehensions" are the subjective, vectorial *feeling*, experienced by actual occasions in concrescence, of past actual occasions as superjects. "Eternal objects" are the formative manner through which actual occasions subjectively experience the world (as composed of other actual occasions) around them.

One final important point needs to be made here. Although Whitehead necessarily needs to present the process of concrescence in a temporally-ordered fashion given the nature of linear language and sentence structure, he is careful to state that concrescence, itself, is not temporally extensive; but the superject of the process is extended in time (Whitehead [1929] 1978, 69). His reason for stating this important aspect of the process of becoming is to avoid falling into a Zeno-like trap of infinite regress. Hypothetically, if an act of becoming takes two seconds, it would first have to go through an act of becoming which takes one second, which would have to go through an act of becoming which takes half of

one second, ad infinitum. However, the whole process must *definitively* take two seconds. In this regard, the subjective pole of concrescence does not take place in time, but its consequent satisfaction, or superject, is extended in time (Whitehead [1929] 1978, 69, 283-294). So, while the process of becoming is not *within* spacetime, it is *productive of* spacetime.

Barad's Process Philosophy of the Quantum

The majority of working physicists do not trouble themselves with the philosophical ramifications of their field of study. However, physicist Karen Barad does not shy away from philosophy, and her unique interpretation of quantum theory, which she terms *agential realism*, holds much in common with Whitehead's experiential process thought. She succinctly makes the correlation clear in this simple statement: “Space, time, and matter are mutually constituted through the *dynamics of iterative intra-activity*” (Barad 2007, 181; italics added). “Intra-activity” is a technical term introduced by Barad that refers to the fact that “things” do not precede their interaction, but emerge out of the interactive process. This technical term will be revisited shortly.

As means of entry into the strange nature of quantum physics, Barad describes what is meant by a measuring apparatus and offers her theory of how one might understand what takes place while maintaining a coherent ontology. When a characteristic of a particle, like an electron, is to be measured, the apparatus that the experimenter uses is a determinant of what *can* be measured. For example, an experimenter can test for an electron's position, but will be

unable to test for its momentum simultaneously. The apparatuses needed to measure both characteristics are mutually exclusive (one requires a fixed apparatus and one requires a moveable apparatus). In order to measure either the position or the momentum of the electron, a photon is scattered off of the electron. If the photon hits a fixed platform, the position of the electron can be determined in much the same manner as taking a picture. If it hits a moveable platform, the displacement of the platform will be used to determine the momentum of the electron. However, these are two entirely different modes by which the photon is active in the observation. In the measurement of position, the photon is considered part of the *agencies of operation*, and in the measurement of momentum, the photon is considered part of the *object* being measured (Barad 2007, 111-114).

Central to Barad's thesis is the definition of an apparatus. Is the apparatus the measuring platform? Is the photon part of the apparatus? Is the computer that records the results part of the apparatus? Is the scientist, herself, part of the apparatus? Niels Bohr, one of the founders of quantum theory and a key articulator of the orthodox interpretation of the theory, understood that the determination of what an apparatus *is* is consequential for the very notion of what science is, and, ultimately, what objectivity is (Barad 2007, 143). According to Barad, Bohr ascertained that a measuring apparatus is a classical, stable object that is chosen by a researcher. What is deemed objective truth, then, are the outcomes produced by a classical apparatus that can then be shared and communicated between scientists. Ultimately, Bohr rested on an epistemological answer to the question of defining objectivity. What is objectively “real” is what a

classical apparatus measures. This epistemological answer to the ontological question led to the notion that the "classical" world of experience and the "quantum" world of statistical uncertainty are inherently separate, with objective truth residing firmly in the realm of the classical world of the results of measurement (Barad 2007, 143-144).

Karen Barad argues that this anthropomorphic conception of objective reality relies on a view of a liberal humanist subject that chooses an apparatus, but ultimately stands apart from the world that he or she is measuring. Whereas Niels Bohr and other founders of the Copenhagen interpretation of quantum theory articulate quantum mechanics primarily as an epistemological tool, Barad's view considers ontology and epistemology to be unified in the same way that subject and object are unified.[10] She states:

> *No inherent/Cartesian subject-object distinction exists... The boundary between the "object of observation" and the "agencies of observation" is indeterminate in the absence of a specific physical arrangement of the apparatus.* What constitutes the agencies of observation are determinable only on the condition that the measurement apparatus is specified. *The apparatus enacts a cut delineating the object from the agencies of observation.* Clearly, then,... *observations do not refer to properties of observation-independent objects (since they don't preexist as such).* (Barad 2007, 114; italics in original)

Here, a measuring apparatus makes the delineation between agency of observation and object, or, more simply, subject and object. However, for Barad, a measuring apparatus is *not* a classical everyday object. Rather, measuring apparatuses are "not preexisting or fixed entities;

[10] For further discussions on Niels Bohr and the epistemological Copenhagen interpretation of quantum theory, see Herbert 1987, 143-145; Stapp 2011, 2.

> they are themselves constituted through particular practices that are perpetually open to rearrangements, rearticulations, and other reworkings... The materialization of an apparatus is an open (but nonarbitrary) temporal process: apparatuses do not simply change in time; they materialize (through) time. *Apparatuses are themselves material-discursive phenomena, materializing in intra-action with other material-discursive apparatuses.* (Barad 2007, 202; italics in original)

"Intra-action" here refers to Barad's notion that agencies and objects do not pre-exist their interaction, rather, they are mutually constitutive of each other. It is through the process of intra-action that agencies and objects are determined. In her ontological interpretation of quantum measurement, she uses the term "phenomena" to ontologically unite the classical notions of subject and object into a single concept. She states:

> Phenomena are constitutive of reality. Reality is composed not of things-in-themselves or things-behind-phenomena but of things-in-phenomena. The world is a dynamic process of intra-activity and materialization in the enactment of determinate causal structures with determinate boundaries, properties, meanings, and patterns of marks on bodies. The ongoing flow of agency through which part of the world makes itself differentially intelligible to another part of the world and through which causal structures are stabilized and destabilized does not take place in space and time but happens in the making of spacetime itself.... That is, it is through specific intra-actions that phenomena come to matter – in both senses of the word. (Barad 2007, 140)

In other words, what is real is determined by the interface of agency and object, but the agency and object are, themselves, determined within the interface. This is the "material-discursive" process that Barad refers to when she uses the term "intra-action." Based on her understanding of quantum physics, Barad argues that reality is not something we inhabit, but something that we are active in

actualizing. Also, reality is not determined by *human* consciousness, but by all intra-action. She states:

> These causal intra-actions need not involve humans. Indeed, it is through such practices that the differential boundaries between humans and nonhumans, culture and nature, science and the social, are constituted. (Barad 2007, 140)

Agency, for Barad, is not the liberal humanist understanding of a Kantian transcendental ego that sits apart from and observes the world without affecting it. The separability of the agency and the object, rather, is "a matter of *exteriority within phenomena*" (Barad 2007, 177; italics in original). In other words, agency and object are always united by their intra-action within phenomena, however they are separable by the determination of that which enacts (agency) and that which is enacted (object). This determination, however, is not an ultimate, fixed, unchanging determination. Rather, the determination of the agency and the object is enacted by the "cut" of the measuring apparatus, whatever that apparatus might be. For example, I have a mug of coffee on my desk as I am writing. Currently, I am observing the mug as an agency viewing an object. However, when I pick up the mug it becomes a part of the agency and the coffee that I swish around inside becomes the object. Likewise, during this whole process, my cat sits behind me and observes the whole process, wherein the mug and I are both objects of observation. This nesting of agencies and objects is occurring throughout the physical hierarchy from atoms to the extent of the universe, and the intra-action of agency and objects is ultimately unified by the notion of phenomena, which is ontologically primary to the delineation of either.

Whiteheadian Baradism

Alfred North Whitehead ([1929] 19780 and Karen Barad (2007) both seek to unite the concepts of subject and object into a coherent metaphysical framework while also universalizing the notion of the liberal humanist subject to be a uniquely human iteration of the "subjective pole" or "agency" of all matter. While Whitehead was not privy to all of the developments of quantum theory, his intuitive and mathematical mind was able to articulate a cosmological understanding of the world that is semantically entirely different from Barad's, but conceptually amazingly similar. In order to fully articulate the implications of the process ontology underlying Whitehead's *philosophy of organism* and Barad's *agential realism*, I will attempt to read them through each other.

The fundamental ontological building blocks of the world are "actual occasions" or "phenomena." While Whitehead ([1929] 1978) seems to emphasize the subjective or experiential pole of an actual occasion as ultimately real, or as the determiner of what is real, he is keen to point out that an actual occasion does not exist except as a concrescence of prehensions. In the same way, Barad (2007) argues that a "phenomenon" is the unification of an agency and an object, wherein agency and object are determined within the phenomenal intra-action. For both, the world is composed of the dynamical production of subject-objects, which are continually taken up and transformed by other subject-objects in the bubbling cacophony of the evolution of the universe. Rather than simply stating that everything has a mentality akin to the conscious experience of a human being,

both Whitehead and Barad argue that human experience is a unique mode of the intra-active or concrescent processes that are taking place omnipresently.

Whitehead ([1929] 1978) states that every subjective experience of an actual occasion is vectorially transmitted to future actual occasions as the determined, or objective, superject of the occasion as a prehension within the subsequent concrescent occasion. This explanation of concrescence gives the false impression that concrescence has a temporal ordering. However, as was stated earlier, concrescence does not take place *in time*, rather, it is productive *of time*. The subject and the superject of an actual occasion cannot be divided, for they are always-already unified within the atemporal subjective pole of an actual occasion. In the same way, Karen Barad (2007) argues that agency and object do not exist independently and sovereignly, rather they are constantly being reinterpreted through each other based on the cuts that are enacted by the measuring apparatus that unites them. Also similar to Whitehead, Barad argues that intra-actions do not take place within a spacetime matrix, rather they are productive of the spacetimematter matrix itself. She states:

> [I]terative 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 the constitutive exclusions. (Barad 2007, 179)

For both Whitehead and Barad, space-time and atemporality require each other in a complementary fashion.[11] Both are necessary for the manifold of the universe to be logically and materially enacted.

So far, I have explained Whitehead's ([1929] 1978) and Barad's (2007) versions of process ontology more-or-less within the present-tense, or what takes place in a momentary intra-action. However, history must be taken into account, both because this paper relies on the historical development of their respective ideas *and* because history is the developmental mode through which humans understand the world. For Whitehead, following Bergson, history has a reality insofar as it is a function of an experiential actual occasion, rather than as the entirety of past events on a time line. An actual occasion is composed of both positive prehensions and negative prehensions, wherein a positive prehension is that which an actual occasion feels as an aspect of concrescence and makes a part of its subjective form. A negative prehension is that which is excluded from, and through such exclusion is still a formative aspect of, a concrescence. In this manner, *all* past occasions are present within an actual occasion as either a positive prehension or a negative prehension – nothing is left out. This is the way in which history's reality is effected. History is not something set in stone, never

[11] "Complementary" is a technical term introduced by Niels Bohr to formulate a cohesive scientific theory produced by quantum formalism. In essence, complementarity refers to the fact that mutually exclusive measuring arrangements will produce different types of observations, i.e. particle or wave characteristics. While neither can be observed simultaneously, both are needed for a coherent understanding of the overall situation. In this sense, the characteristics are said to be complementary. See Rosenblum and Kuttner 2006, 108 for a more detailed discussion.

to be changed; rather, history is taken up by each actual occasion through the process of its concrescence to be uniquely interpreted and then transmitted.

Similarly, Karen Barad (2007) argues that history is not an unchanging past but an ever-evolving aspect of production of space-time in the process of intra-action. Logically, since space-time is *not* an absolute framework wherein intra-actions take place, but that which is produced by intra-actions, history itself must be a product of phenomenal intra-actions. She states:

> [T]he historiality of phenomena is written into their materialization, their bodily materiality holds the memories of the traces of its enfoldings..., Neither the past nor the future is ever closed. (Barad 2007, 383)

The past and the future are a function of intra-active phenomena, continually being taken up and refigured. To say that there is a definite linear progression of history, according to both Whitehead and Barad, is to commit the fallacy of misplaced concreteness, for the concept of a linear progression of history is, itself, a function of concrescent or intra-active processes.

Finally, both Whitehead ([1929] 1978) and Barad (2007) take on the notion of quantum nonlocality, wherein nonlocality refers to the results of experimentation that violate physicist John Stuart Bell's inequality theorem, ultimately showing that entangled particles interact “without crossing space, without decay, and without delay” (Herbert 1987, 214). This nonlocality is a characteristic of any two particles that have ever interacted, *and* particles that have ever interacted with those particles, thus extending nonlocal influences

amongst *all* particles in the universe according to the current inflationary model of the universe (Rosenblum and Kuttner 2006, 149-152).

Although Whitehead was not aware of the experimental verification of nonlocality, not to mention the debates between Niels Bohr and Albert Einstein following the publication of the EPR paper in 1935, he came to a philosophical understanding of the necessity of nonlocality for his metaphysical framework to logically hold. In his discussion of positive and negative prehensions, Whitehead states that "an actual entity has a perfectly definite bond with each item in the universe" (Whitehead [1929] 1978, 41).[12] He also states, regarding the process of concrescence, that "the initial fact is macrocosmic, in the sense of having equal relevance to all occasions; the final fact is microcosmic, in the sense of being peculiar to all occasions" (Whitehead [1929] 1978, 47-48). In this sense, the instantiation of concrescence involves every occasion in the universe, whereas the final determination (or superject) of concrescence is localized – only to be taken up nonlocally by other actual occasions as a prehension.

Barad (2007), in her analysis of quantum nonlocality, argues that locality is not the issue at stake; rather, separability is. Locality is determined within the cut delineated in an intra-action, so it has reality within phenomena. However, separability is not an inherent aspect of the universe, but something that is produced through intra-actions. This separability, however, does not remain as an autonomous separation, but is then taken up again in the material-discursive

[12] For another discussion of Whiteheadian nonlocality, cf. Michael Epperson 2004, 202-208.

process of intra-action. For, ultimately, the universe is not composed of separate entities; it is composed of intra-active processes that produce agents and objects within phenomena.

The idea that the universe is a grand process of becoming, rather than a conglomeration of interacting, independent objects, is capable of elucidating many anomalies in the materialist interpretation of scientific findings. The conceptual tools that Barad and Whitehead have produced, and that I have attempted to weave together, allow us to better understand not only the relationship between the Cartesian subject and object or the Sellarsian "manifest image" and "scientific image," but also elucidate the intra-active nature of science, history, and consciousness.

CHAPTER 4: PROCESS ACTUALIZED

Because I am advocating that a process metaphysics, principally as construed by Alfred North Whitehead ([1929] 1978) and Karen Barad (2007), be taken seriously as a method for providing a framework robust enough to comfortably unify the two principle "images-of-man" proposed by Sellars (1965), it is important to provide evidence to substantiate my reasons for doing so. I have already provided Whitehead's reasoning for developing an argument against simple location from Einsteinian relativity and Barad's reasoning for intra-action based on the unusual implications of quantum measurement. In this chapter, I will provide further support from quantum physics, biology, and neuroscience. My reasoning for utilizing these three areas of science is to present the scientific suitability of process ontology in the classically-demarcated realms of world, life, and mind. This section is meant to be somewhat tangential to the main argument of this thesis, but I feel that it is necessary to make that argument more robust. Also, I must acknowledge that the empirical support for process philosophy that I provide is in no way conclusive; it is, rather, meant to be a survey of process in the sciences for the purpose of developing an intimational understanding Whitehead's and Barad's figure-ground shift.

Quantum Physics

The strangeness of quantum physics is an area of contention concerning both epistemology and ontology.[13] There are almost as many interpretations for

[13] Because we have already ventured into the quantum realm with Karen Barad, this section will serve as a reminder of some basic concepts and offer some suggestions

what occurs when a quantum measurement is taken as there are philosophically-inclined physicists and scientifically-minded philosophers. However, there is one certainty involved in all of the mystery surrounding the meaning of quantum theory: the Newtonian universe of externally related objects interacting in an absolute space in an independent, uni-directional flow of time can no longer function as the scientifically-accepted, base view of the world.

In *Process Metaphysics*, philosopher Nicholas Rescher makes the relationship between quantum physics and process philosophy explicit:

> Instead of very small things (atoms) combining to produce standard processes (windstorms and such), modern physics envisions very small processes (quantum phenomena) combining in their modus operandi to produce standard things (ordinary macro-objects). (Rescher 1996, 98)

Along these same lines, acclaimed physicist David Bohm writes, "...*what is* is the process of becoming itself, while all objects, events, entities, conditions, structures, etc., are forms that can be abstracted from this process" (Bohm [1980] 1995, 48). The deterministic wave-like nature of matter that quantum theory describes is the aspect of Sellars's (1965) "scientific image" that corroborates a process ontology at the ground-floor level of reality.

Processual intra-action is at the root of Barad's (2007) unique take on quantum ontology. However, she is certainly not the only thinker to view the implications of quantum physics through a process ontology. Others have done so quite explicitly. Henry Stapp, physicist at Lawrence Berkeley National Laboratory, has proposed a Whiteheadian ontology based on the quantum

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for further investigation.

interpretation of mathematician John von Neumann and the relativistic quantum field theory of Tomonaga and Schwinger (Stapp 2007, 85-98). Philosopher Michael Epperson draws a direct parallel between the theory of quantum decoherence and Whitehead's notion of concrescence, which is the process of the coming-to-be of fundamental actual occasions of experience (Epperson 2004). Further reading includes Abner Shimony's "Quantum Physics and the Philosophy of Whitehead" (Shimony 1965) and George Lucas' chapter on "Philosophy of Science and Philosophy of Nature" in *The Rehabilitation of Whitehead: An Analytic and Historical Assessment of Process Philosophy* (Lucas 1989, 180-199).

The weirdness of the quantum has filled library shelves with pages of analysis and speculation, and it is far from the scope of this paper to enter into a complete discussion of the metaphysics of quantum theory. I have touched on some of the main reasons why I think quantum phenomena point to an ontology of process in the unification of observer and observed and in the notion that particles and atoms are not classically-conceived objects. I now venture out of the strange microscopic world of quantum processes to look at the more familiar, yet still amazingly mysterious, world of macroscopic living organisms.

Biology

If the physical sciences are beginning to point in the direction of an ontology of process, is there evidence for a similar change-of-perspective taking place in the sciences of life? Interestingly, Whitehead refers to his metaphysics as the *philosophy of organism* (Whitehead [1929] 1978, 18), which alludes to the

notion that the metaphysically fundamental events, which he calls actual occasions, are instances of self-produced moments of organized togetherness of prehensions. This mode of self-becoming is beginning to gain traction in evolutionary biology. Similar principles are also being used to explain the self-sustaining nature of living organisms as pertains to the simultaneity of their independence from, yet utter subsumption within, a contextual environment.

In *Lifelines: Biology, Freedom, Determinism*, biologist Steven Rose (1997) presents a non-reductive view of biology that incorporates an argument for necessarily understanding life-processes in a four-dimensional context, while also maintaining the always-already embedded nature of the organism-in-environment. In chapter 6 of his book, Rose argues that the classic nature-nurture debate in genetics creates a dualism that distracts from the proper analysis of living organisms. He states:

> Dichotomously genetical thinking wishes always to partition – first splitting 'nature' from 'nurture', and then adding them together again. So both being and becoming are regarded as the products of the additive effects of genes – nature – and 'environment' – nurture. (Rose 1997, 142)

He goes on to argue that this dichotomy is misleading, and proposes that the terms "specificity" and "plasticity" are more appropriate terms for understanding the relationship between the organism, its internal constituents, and the environment in which it is embedded – all mutually informing each other. Here, "specificity" refers to the inertia inherent in an individual living entity to maintain its internal dynamics and the external boundary that separates it from the environment, whereas "plasticity" refers to the ability of the external environment to impose

change on the internal workings of the organism through constant constraint (Rose 1997, 142-143). He further specifies:

> But both specificity and plasticity are embedded properties of the organism; both, if you like, are completely made possible by the genes, and completely made possible by the environment. They cannot be partitioned. (Rose 1997, 143)

Rose's (1997) argument that organism, environment, and genes are in constant dynamical interaction *prior to* the nature-nurture distinction aligns with Whitehead's (1920) argument against "bifurcation." Rose's explanatory holism for understanding the nature of life regards living processes as operative within a continuum of interactions (or *intra-actions*, following Karen Barad [2007]) from the smallest interior genes to the overarching surrounding environment. This constant dialectic that occurs between living processes and environment is an autopoietic process, wherein life has the "capacity and necessity to build, maintain, and preserve itself" (Rose 1997, 18; see also 306).[14]

Philosopher Evan Thompson (2007), a student and colleague of Francisco Varella (one of the biologists who introduced the term "autopoiesis"), describes the self-organization of living organisms as if it were a constant dialectic between organism and environment, utilizing a living cell as a paradigmatic example. In his description, a cell is determined as an individual within a chemical surrounding because of its delineating membrane. However, the internal process required to maintain the membrane requires the delineation produced by the membrane (Thompson 2007, 99). He broadly summarizes the concept thus:

[14] "Autopoiesis" is a term for the self-productive nature of living systems. It was introduced by Humberto Maturana and Francisco Varela. See Maturana, Humberto and Francisco Varela 1980.

> The form or pattern of the autopoietic organization is that of a peculiar circular interdependency between an interconnected web of self-regenerating processes and the self-production of a boundary, such that the whole system persists in continuous self-production as a spatially distinct individual. (Thompson 2007, 101)

Note how the "spatially distinct individual" is the outcome of "self-regenerating processes" and continual "self-production." In this view of fundamental biology, individuals result from underlying processes of interaction and constant flux.

The relationship between autopoietic processes and the biological theory of evolution is intimate. The interrelationship between genes, organism, and environment *and* the changes that are produced in that relationship are the driving force behind biological evolution. As Steven Rose states: "Evolutionary change occurs as a result of lifeline trajectories with changing environments. Such change occurs at many levels from the molecular to the species" (Rose 1997, 307-308). Much like the interplay of subject and object that is productive of material objects in Karen Barad's (2007) interpretation of quantum theory, Rose points out that the interplay of the four-dimensional individual (which is a component of the four-dimensional species) with the environment is productive of the resultant species. Finally, process philosopher Nicholas Rescher explicitly argues:

> Evolution is....an emblematic and paradigmatic process for process philosophy. For not only is evolution a process that makes philosopher and philosophy possible, but it provides a clear model for how processual novelty and innovation comes into operation in nature's self-engendering and self-perpetuating scheme of things. (Rescher 1996, 99)

The temporal process of environmental effects coupled with genetic variation on the development of species is inherent in Darwinian evolution. The change and

flux produced by the passage of time is absolutely necessary within the evolutionary framework.

Furthermore, Thompson (2007) argues that autopoiesis is directly connected to cognition. He defines cognition broadly as "behavior or conduct in relation to meaning and norms that the system itself enacts or brings forth on the basis of its autonomy" (Thompson 2007, 126). Thompson argues that autopoiesis is the defining characteristic of living systems *and* that autopoiesis and cognition are mutually inclusive. Life and experience entail each other by the very nature of the individual-environment interrelationship. In this view, the relationship between experiential subjectivity and experienced objectivity arise within the autopoietic process, wherein the organism and environment *determine one another*. The organism is not a simply-located object within an absolute environment; but a temporal process that determines the environment by being a part of it *while* the environment determines the organism by being a part of its cognitive experience.

Neuroscience

The brain is commonly considered to be the organ of consciousness, a physical object that produces our experiences out of the interactions of billions of neurons that respond to external stimuli received through the nervous system. According to philosopher Alva Noë:

> Empirical research on consciousness and human nature takes for granted that the problem for science is to understand how

> consciousness arises in the brain. That consciousness arises in the brain goes unquestioned. (Noë 2009, 24)

Certainly, a brain of some sort is *necessary* for the type of consciousness experienced by humans and other animals, but there have been several philosophers and scientists who have recently argued that the brain is not *sufficient* for consciousness in the sense that it produces consciousness in a bottom-up manner (Noë 2009; Shields 2009; Stapp 1993). The breakdown of the subject-object divide that I have been unpacking thus far necessarily requires that the brain-object is not metaphysically prior to the conscious-subject, but that both arise together. The purpose of this section is to explore this concept.

In his essay entitled "Panexperientialism, Quantum Theory, and Neuroplasticity," process philosopher George W. Shields (2009) argues that the experimentally-verified occurrence of neuroplasticity is evidence for the veracity of a process metaphysic. Relying on the work of neuroscientist Jeffrey Schwartz and science journalist Sharon Begley in their book *The Mind and the Brain* (2003), he states:

> The basic thesis of neuroplasticity....is that sufficiently repeated acts of mental attention at the macro-level of conscious experiences can cause alterations at the micro-physical level of the brain, resulting in significant experiential and behavioral alterations. (Shields 2009, 252)

In other words, repeated acts of subjective attention to different environmental, emotional, or therapeutic stimuli actually change the neuronal pathways and physical structure of the brain, leading to new modes of behavior. From a purely Sellarsian (1965) "scientific image" point of view, wherein the experience of the

human person is removed from the explanatory equation, this verified neurobiological process is an impossibility because the personal experiences of the human do not carry causal weight for the underlying mechanistic entities, such as neurons. However, under the explanatory aegis of a process metaphysic, wherein the becoming of a subject and the being of an object are co-productive, neuroplasticity is not an anomaly.

Shields also argues that the psychophysical *modus operandi* for neuroplasticity is quantum. He states:

> When neurotransmitters are released, calcium ions must pass through the extremely narrow, microscopic ion channels in a neuron. The narrowness is at such a microscopic level that quantum mechanical rules and Heisenberg's Uncertainty Principle can be applied to it. (Shields 2009, 252)

He goes on to explain that this means the release of a neurotransmitter by a calcium ion is a result of quantum probability, rather than mechanistic determinism. The wave function for "releasing a neurotransmitter" and the wave function for "not releasing a neurotransmitter" exist in a superposition, wherein the probability of either result is between 0 and 1. Strong habits and obsessive compulsive tendencies result from an increased probability for wave function collapse on one side (e.g., "releasing a neurotransmitter") over the other ("not releasing a neurotransmitter"). However, by consciously training one's mind to alter one's habits in favor of, say, a more productive habit, the probability for wave function collapse changes, resulting in a new brain circuit (Shields 2009, 252-253). In other words, the mind changes the physical structure of the brain, which in turn changes the subjective actions of the mind, which in turn changes

the physical structure of the brain, and so on. Neither consciousness nor the physical brain is given priority, but neither are they separated from each other. They produce each other simultaneously.

I will now turn from neuroplasticity to hemispherical neuroscience. Psychiatrist Iain McGilchrist's (2009) book *The Master and His Emissary* is a work that describes the neurophysiological make-up of the brain (both human and nonhuman) and makes the argument that the interaction between the two hemispheres of the divided brain, as evidenced both in neuroscience and cognitive science, can inform our understanding of the trajectory of human history. I will be showing how McGilchrist's description of how the right hemisphere and the left hemisphere interact in relation to conscious awareness corresponds directly to Whitehead's description of *concrescence,* or the process of coming-to-be of prehensive unification. First, I would like to quote McGilchrist on what it means to study the brain:

> We cannot look at the world coming into being within the brain, without that qualifying the world in which the brain itself exists; our understanding of the brain's ways of understanding alters our understanding of the brain itself – the process is not unidirectional, but reciprocal. If it turns out that the hemispheres have different ways of construing the world, this is not just an interesting fact about an efficient information-processing system; it tells us something about the nature of reality, about the nature of our experience of the world, and needs to be allowed to qualify our understanding of the brain as well. (McGilchrist 2009, 30)

In much the same way as the organism and the environment are mutually determining of each other at their cognitive interface in Evan Thompson's (2007) biological scheme discussed in the previous section, mind and world are mutually

determining of each other at the interface of neurological understanding in McGilchrist's scheme. The world, or at the very least our understanding of it, is not left unaltered as our understanding of the brain changes. This statement is meant to be more suggestive than definitive, as the main purpose of this section is to analyze McGilchrist's empirically-informed neurological findings.

Here, it might help a reader unfamiliar with Whitehead's philosophy to refer to Chapter 2 for a reminder of his basic concepts. Now I will be focusing on the notion embodied by his term *concrescence*. In concrescence, an actual occasion physically (or affectively) prehends the superjects of past actual occasions, then conceptually prehends these superjects through the forms of (abstract) eternal objects, then concrescence ends in its satisfaction.[15] In other words, concrescence moves from given affective feeling, to unique abstract interpretation, to a final transference of this unique interpretation to be affectively felt by other future actual occasions.

McGilchrist extensively describes the relationship between the hemispheres of the human brain as a conspicuously similar operation, both physically and historico-socially. McGilchrist states that the right hemisphere alone tends to novelty, whereas the left hemisphere only attends to what is known (this is true also for complex animals, such as horses) (McGilchrist 2009, 40). When presented with a unique problem, the right hemisphere can contemplate possible solutions, whereas the left hemisphere focuses on predictable solutions that have already been considered in the past (McGilchrist 2009, 40-41). The left

[15] For a concise definition of "concrescence", see Cobb 2008, 60-62.

hemisphere is involved in more divisive thinking, taking a “local, short-term view” to analyze aspects of experience. The right hemisphere, by contrast, is involved in integrative thinking, seeing “the bigger picture” and incorporating seemingly disparate ideas and perceptual objects into a cohesive whole (McGilchrist 2009, 42-43). Finally, and perhaps most telling, McGilchrist states:

> The left hemisphere can only re-present; but the right hemisphere, for its part, can only give again what it 'presences'... Abstraction is necessary if the left hemisphere is to re-present the world. The left hemisphere operates an abstract visual-formal system, storing information that remains relatively invariant across specific instances, produces abstracted types or classes of things; whereas the right hemisphere is aware of and remembers what it is that distinguishes specific instances of a type, one from another. The right hemisphere deals preferentially with actually existing things, as they are encountered in the real world. (McGilchrist 2009, 50)

So, the right hemisphere is involved in novelty, possibility, integration, and immediacy; the left hemisphere is involved in what is already known, predictability, division, and abstraction. These concepts are all involved in the process of concrescence, and, amazingly, the serial sequence of concrescence mirrors the serial sequence of hemispherical interaction. It is important to note, here, that “serial” does not mean “temporal.” This distinction will be revisited.

According to McGilchrist (2009), the right hemisphere of the brain takes in the overall situation in its novelty, and this novelty is then offered to the left brain for dissection and analysis. He states:

> Global attention, courtesy of the right hemisphere, comes first, not just in time, but takes precedence in our sense of what it is we are attending to; it therefore guides the left hemisphere's local attention, rather than the other way around. (McGilchrist 2009, 43)

Whitehead's famous phrase, “the many become one, and are increased by one” (Whitehead [1929] 1978, 21), might appear to be the inverse of McGilchrist's hemispherical interaction, but it must be remembered that the left hemisphere deals with a divided multiplicity *in abstraction*. Rather, in human experience, the right hemisphere integrates novel multiplicity (and, interestingly, is also involved in emotional affection) (McGilchrist 2009, 58-61); then, the left hemisphere analyzes the novel experiences utilizing abstractions (much like the conceptual prehension utilizing abstract eternal objects); then these abstract interpretations are *re-integrated* into the worldview of the right hemisphere (much like the transfer of the unique subjectivity of an actual occasion's satisfaction into other actual occasions) (McGilchrist 2009, 46). Utilizing this model of the motion of neural processes associated with consciousness, Whitehead's *fallacy of misplaced concreteness* (1925) could be understood as the failure to re-integrate left brain's abstractions into the right brain's openness to the world of novel experience.

Although McGilchrist (2009) states that the right hemisphere's global awareness precedes the left hemisphere's concentrated awareness *in time,* and Whitehead ([1929] 1978) explains that *concrescence* is not temporally extensive (see Chapter 2), I think this is a false disagreement. Serially-ordered time is a uniquely analytical left-hemisphere concept. McGilchrist states:

> [T]he apparent sequence of things causing one another in time is an artifact of the left-hemisphere way of viewing the world. In creation we are not actively putting together something we already know, but finding something which is coming into being through our knowing, at the same time that our knowing depends on its coming into being. (McGilchrist 2009, 231)

When McGilchrist says that the right-hemisphere's view of the world temporally precedes the left-hemisphere's analysis, he is employing his own left-hemisphere mode of analysis to understand the process of interhemispherical interaction. He states that the human experience of time as a duration or an undivided flow is dependent upon right-hemisphere functioning, and that

> The left hemisphere's tendency to break [time] up into units and make machines to measure it may succeed in deceiving us that it is a sequence of static points, but such a sequence never approaches the nature of time, no matter how close it gets" (McGilchrist 2009, 76).

So, when McGilchrist says that the right-hemisphere world view precedes the left-hemisphere world view *in time*, he is not arguing that it takes place in linear time; but rather that the right hemisphere's holistic view is fundamentally necessary prior to the left hemisphere's scrutiny in durational time, which then results in left-hemisphere linear time as the analytical outcome.

The processual interaction of the brain hemispheres, from right to left to right, mirrors the process of concrescence for an actual occasion (at least for the personally-ordered actual occasions of a human being's experience). One might speculate that the brain morphologically evolved the way it did so that human beings could experience the process of concrescence at a higher order. If Whitehead is correct in the assumption that experiential processes metaphysically precede physical structure, this speculation would indeed follow.

Conclusion: Process Behind the Findings

I hope to have shown that recent findings in physics, biology, and brain science corroborate some of the basic assumptions of process philosophy. The fusion of observer and observed in quantum theory, the continual flow of information and material between organism and environment discovered in biology, and the reciprocal relationship between the classically-demarcated notions of "mind" and "brain," in addition to the similarity between Whiteheadian concrescence and the inter-hemispheric relationship, all point to an empirical validation of process philosophy's most basic arguments. There is, however, an inherent impossibility of empirically studying process itself, and this impossibility arises out of the nature of how we have historically defined empirical facts.

In quantum measurement, we can never directly observe the wave-nature of reality, for whenever a measurement is taken a particle is found to be either here or there. The wave-nature is discovered when multiple measurements are taken, such as firing multiple electrons or photons through two slits in a barrier. When all of the measurements are taken in concert with each other, the underlying wave-nature is apparent within the diffraction of the resultant measurements, but never actually observed. In the same way, we can not scientifically "observe" the process that metaphysically underlies the phenomena on all the tiers of the great pyramid of reductionist science (from physics, through chemistry, biology, and psychology), but the process can be discovered by comparing observations within the tiers and across the tiers. A film run on a projector is an imperfect approximation of the sensuous and rich experience of a conscious human being,

and the film is composed of still frames that are rapidly shown on the screen in succession. In the same way, our scientific observations are a collection of snapshots of the grand processual intra-actions of the world-in-experience and can never actually reproduce *process* for scientific analysis. However, the clues are there for the inspection.

CHAPTER 5: EXPANDING THE SCOPE

I have argued that a process ontology is the best metaphysical option for understanding ourselves, the world that we live in, and the intra-active relationship between them that is simultaneously productive of both. I have utilized this argument for logical necessity and based on empirical findings from contemporary sciences. However, if we are to really understand what the relationship between the conscious, experiencing mind and the objective world truly is, we must take the argument to its fullest implications regarding Mind and Universe in the most general possible way in the particular instance of scientific investigation. Some of our greatest insights into the nature of the universe have been brought forth by the sciences, but the overall ontological picture expressed by synthesizing the basic principles introduced by unique scientific disciplines must be brought to bear on our understanding of science, itself.

In the processual ontology that I have been explicating, science is not the method of uncovering pre-existing facts about the world through empirical observation and the construction of theories that we once thought. Historically, this "detached" mode through which humans understand the scientific project was actualized insofar as it introduced the materialistic and mechanistic world view of the Newtonian cosmology – which is still dominant in the Western world view. Considering the fact that this world view has informed the modern techno-scientific mode of being-in-the-world for Western human beings, the truth of the materialist mechanical orientation could be said to hold because the detached world view constructed a world utilizing the blueprint of its metaphysical

assumptions. However, from a process understanding, “truth is a changing thing” is a true statement. Given new insights from quantum mechanics, biological self-organization, and neuroscience, the mechanistic world-view is no longer sufficient and must be overtaken, yet included, in the new ontology. From the new evidence, we must acknowledge that our scientific mode of inquiry is more active than we once thought, and we must also reinterpret the activity of the projects in which scientists of the past were involved. However, in doing so, we must also acknowledge that the dualistic assumptions of Enlightenment and post-Enlightenment scientists, as an aspect of their subjectivity, contributed to the creative discovery of the world they were researching and in which we live.

Given our vantage point as human beings living in the 21st century, we can look back at our scientific forebears and understand them as doing something other than what they thought they were doing. Whereas scientists during the Enlightenment and beyond thought that they were discovering pre-existing facts about the world, we can now understand that they were, in fact, partaking in the process of bringing those facts into being through their unique modes if intra-action – utilizing their own state-of-the-art measuring apparatuses, their own conceptions of how the world operates, and their own understanding of themselves as passive observers. For example, while Isaac Newton is commonly acclaimed as the first modern scientist, he was also heavily involved in alchemy and searching for God by attempting to understand the Bible and the natural world concurrently (Fara 2009, 139). His religious world view played into his scientific discoveries and inventions as much as his scientific method did, which

can be seen in his “God's eye view” model of absolute space and time. While science is hailed as the great objective mode through which the human mind understands the world as it truly is, we cannot truthfully separate the role that the scientist's subjectivity plays, not to mention the myriad social, regional, gendered, and historical factors that play into all of the great and minor discoveries that have taken place in the unwritten history book of scientific achievement, which has molded the physical world by being a formative aspect of past actual occasions or material-discursive processes.

As philosopher of science Thomas Kuhn articulates in his seminal work *The Structure of Scientific Revolutions* (1962), “Scientific development becomes the piecemeal process by which [facts, theories, and methods] have been added, singly and in combination, to the overgrowing stockpile that constitutes scientific technique and knowledge” (Kuhn 1962, 1-2). He goes on to say that scientific truths of the past that have been “debunked” by further investigation, such as Aristotelian dynamics and phlogistic chemistry, are considered to be scientific myths of an ancient past that contributed to the overall corpus, but were eventually reinterpreted in light of new data. Past scientific beliefs become a unique mixture of myth and science (Kuhn 1962, 2). Science, in a process reading of Kuhn, becomes not a continual accumulation of objective facts, but a continual reinterpretation of the human mind's relationship to the world around it, as that world is constantly being reworked by its intra-action with the human mind.

Science textbooks are not classical objects that store unchanging knowledge, rather they are unique material configurations that change each and

every time they intra-act with a human consciousness given the unique formative structure of the consciousness. For example, if I read Copernicus's *On the Revolutions of the Heavenly Spheres* ([1543] 2002) from my vantage point as a scientifically-conscious philosopher, my unique intra-action with the information in the text would be quite different from that of a sculptor, as well as quite different from that of an astrophysicist. Also, if I read the work on a Tuesday I would glean different information that if I were to read it on a Saturday. If I read it a second time after reading it once, the information I would receive would be different than when I read it the first time. The same goes for any foray into the world of science, be it reading a text book or taking part in scientific experiment. While quantitative results from scientific experiment might be able to be repeated, the qualitative experience and insights of working scientists (which, I hope has been shown, can not be ontologically separated from the quantitative abstractions) will be different each time as the scientific corpus of knowledge is increased.

The human mind is unique insofar as it is the agency produced by and productive of the intra-actions that take place in the world in the special relationship between the organisms that we designate as *Homo sapiens* and the universe. However, it is not unique insofar as it holds a monopoly on agency. Agency and objectivity, or subject and superject, are co-creative of each other. The human mind is not an accidental epiphenomenon produced by the coincidental arrangement of experience-less particles or "unobservables," rather mind and matter realize each other and necessitate each other in a complementary fashion. "Complementary," here, is a technical term introduced by Niels Bohr

(1935) in his development of a new logic informed by quantum theory. Rosenblum and Kuttner define the logic of complementarity as:

> The two aspects of a microscopic object, its particle aspect and its wave aspect, are 'complementary,' and a complete description requires both contradictory aspects, *but we must consider only one aspect at a time.* (Rosenblum and Kuttner 2006, 108; italics in original)

Karen Barad (2007) describes this logic of complementarity as an effect of where the cut is made between the agency and the object within a phenomenon. Physicists Menas Kafatos and Robert Nadeau (1990) have extended this notion of complementarity to include the concepts of part and whole, thought and feeling, the content of consciousness and the content-less "background" of consciousness, the dynamic interplay between the left and right hemispheres of the brain, the biological situation concerning organic and inorganic matter, entropy and temporally reversible processes, and order and disorder (Kafatos and Nadeau 1990, 127-146). On a grand metaphysical scale, I would add Baradian agency and object and Whiteheadian subject and superject to this list of complementary concepts. Both concepts are required for an understanding of reality, but only one can be understood in a given moment of observation or contemplation. In this logical progression, I argue that atemporal Mind and temporal Universe are the overall complementary constructs that the unique human mode of consciousness partakes in at our scale of observation. Both are required for the mental-physical universe to hold together in any sense.

In the next chapter, I will unpack this seemingly abstract metaphysical scheme by looking at what I have termed the *history of science* and the *science of*

history as a path to understanding the uniquely human experience of and human-scale construction of a complementary universe. Before I move on, however, I would like to return to an important point about the complementary constructs elucidated by Whitehead ([1929] 1978) and Barad (2007). Both go at pains to develop a processual metaphysics wherein attributing subjectivity or agency to all of matter is not simply an anthropomorphic extension of human consciousness to everything in the universe. Their intention is to do quite the opposite. The complementary intra-action of agency and object are universalized to such an extent that human consciousness is merely, albeit also wondrously, a distinct instantiation of the meta-physical state of affairs required by both logic and scientific experimentation. This understanding can be succinctly expressed in the famous Hermetic expression, "as above, so below." This expression adheres no matter where you draw the cut in the continuum from universe to sub-atomic particle; human experience is merely one potential place where the cut can be drawn. However, the cut between human experience and universe experienced is the unique cut shared by the intra-actions that communicate through the written word, which is the community of intra-actions that produces scientific knowledge. It is to these intra-active products that this thesis is directed. To this end, the rest of this paper shall focus on understanding the unique relationship between the human and the universe, as the human has come to understand it.

CHAPTER 6: UNDERSTANDING OUR STORIES

In the 1970s, quantum cosmologist John Archibald Wheeler, in furious contemplation over the co-dependent relationship between observer and object necessitated by quantum mechanics, sketched the image of a "U" on a piece of paper. Affixed to the top of the left arm of the "U" was an eyeball gazing at the top of the right arm of the "U." This image was meant to represent consciousness observing the big bang (Rosenblum and Kuttner 2006, 206). The implications of this sketch, drawn by one of the twentieth century's pre-eminent physicists, thrusts the inherent paradox of the complementary relationship between agency and object into focus. If an observant agency is required for an objective reality to exist in any real sense of the term, then in some sense consciousness must have given rise to the very physical, evolutionary processes that modern cosmology tells us existed billions of years prior to the introduction of life, let alone human awareness. Quantum cosmology appears to be trapped in a paradoxical ouroboros of ultimate proportions.

From a process ontological standpoint, this circular relationship between the universe giving rise to consciousness and consciousness giving rise to the universe need not be a self-referential loop that provides no true understanding of the universe and ourselves. Rather, by universalizing the concept of agency, process ontology provides us with a robust understanding of time, space, matter, and observer that can hold the entire scheme together. I will elucidate this notion through our two great concepts of evolution: the evolution of consciousness and the evolution of the universe.

The point I hope to make in this chapter is similar to the argument put forth by Owen Barfield in *Saving the Appearance: A Study in Idolatry* (1965) wherein he argues that "the evolution of nature is correlative to the evolution of consciousness" (Barfield 1965, 142). Utilizing the concepts I have already put forward, I might exchange Barfield's term "correlative" with "complementary." One of the main premises of his argument rests on the interesting manner in which the scientific Western mind understands pre-history. According to Barfield, we understand pre-history as if

> The unrepresented [material configurations separate from human experience] was behaving in such a way that, *if* human beings with the collective representations characteristic of the last few centuries of western civilization had been there, the things described would also have been there. (Barfield 1965, 37)

"Collective representation" here is akin to Sellars's (1965) "manifest image," wherein the phenomena of the world are experienced through a mode of collective conditioning. Barfield is arguing that we cannot attribute the kind of reality to the pre-historic past, whether geologic or cosmic, that we can attribute to the reality as experienced here and now. Scientific description of the evolution of the universe and the evolution of life on Earth present a narrative that includes characters, environments, and temporal sequences that are similar to the world that we live in. For example, when we envision the early Earth, we envision a spherical, molten rock similar in shape and size to the planet that we currently call home. While Barfield does not want to disparage the findings of the sciences of geology, archaeology, and cosmology, he simultaneously does not want to give them more ontological credit than they are due. The models of pre-history that are

offered to us by the Western science are simply that, *models*. We would not be remiss to replace them with other models articulated by other peoples who do not adhere to the Western mode of thought (Barfield 1965, 37-39).

Arguing against this premise of Barfield's, I think that Western science has the profound advantage of being a grand project of systemic, collective explorations of the world that continually builds upon and updates past findings. However, as our foray in the ontology of process has articulated, the "past" is not something that has taken place never to be changed; rather, the past is a function of the present insofar as present measurement rearticulates and reconfigures the objects that are deemed to be uncovered from an objective, linearly-temporal past. The marriage of technology and science has allowed us to extend ourselves as agents of observation far beyond the realm of our immediate bodily senses, and these advances have informed our collective representations of the world around us. That being said, Barfield is quite right when he argues that, although we think our instruments of measurement take us into an understanding of the past as it was, this view of the past is always already interpreted through our modes of consciousness in the present. This fact cannot be overstated.

Turning now to the main thrust of this chapter, I will outline my views of the *history of science* and the *science of history*, utilizing two thinkers whose works epitomize each. For my understanding of the *history of science*, I will rely on Richard Tarnas's *Passion of the Western Mind* (1991). For my understanding of the *science of history*, I will rely on *The Universe Story* written by Brian Swimme and Thomas Berry (1992). I have chosen these two works to exemplify our stories

for a few reasons. Firstly, I have received direct instruction from both Tarnas and Swimme, and they have directly influenced my personal understanding of these subjects. Also, their works are examples of narratives that attempt to move beyond the purely objective or purely materialist conceptions of the subject matter within their respective disciplines. Since they have done so much ground work already, I am attempting to push their projects further by connecting them within a metaphysics of process.

History of Science

In *The Passion of the Western Mind*, philosopher and cultural historian Richard Tarnas (1991) relates the sweeping story of the evolution of Western human consciousness from ancient Greek civilization through the current double-bind of modern post-Copernican consciousness. In his analysis, Tarnas presents the story of the development of the modern mind as a process of learning and imagining, wherein Western humans beginning with the Greeks have continually posed questions to the world, developed answers to those questions, and posed new questions based on the determined answers. Science, in this understanding, is not a neutral mode of looking at the world, but a particular way of doing things that has a history of its own.

The *history of* s*cience* in the West somewhat arbitrarily begins with the ancient Greeks. I use the word "arbitrarily" because the Greek philosophers have their forebears who, in turn, have their forebears that recede into a somewhat amorphous fog of the past, particularly as we enter a realm of history prior to the

advent of the written word. However, analysis must have a starting point, and the ancient Greeks tend to be the starting point for the study of the modern world view because we have written records of their philosophical grapplings, they represent the emergence of the West's reverential reliance on reason, and because, as Alfred North Whitehead famously stated, “The safest generalization of the European philosophical tradition is that it consists of a series of footnotes to Plato” (Whitehead [1929] 1978, 39).

In his analysis of the Hellenic era, Tarnas extrapolates some of the main offerings that the Greeks presented to the historical development of and current foundations of the Western mind. He presents the Greek contribution to modern thought as having a dual legacy: simultaneously idealist and realist, transcendent and immanent, rational and empirical. Plato and Aristotle are the great figures of this period, each emblematic of one side of the dualism. According to Tarnas, “for Plato, the particular was less real, a derivative of the universal; for Aristotle, the universal was less real, a derivative of the particular” (Tarnas 1991, 57). In either case, the world is rendered understandable by the human mind through analysis rather than naively participated in through direct immersion – the emergence of the “manifest image” out of the “original image” (Sellars 1965). However, the mind is still granted a place in the cosmos by these two thinkers insofar as it is able to understand the world as it is because the cosmos has a divine intelligence of its own, albeit Plato considered this intelligence to be unchanging and universal and Aristotle considered this intelligence to be constantly in a process of development and open to revision. However, the beginnings of the split between

mind and cosmos can be seen in the demarcation between subjective mind and objective world.

One of the most pervasive and powerful legacies of the Greek world view is Aristotelian-Ptolemaic cosmology, wherein the earth sits at the center of the universe and the perfectly-ordered heavens move around the earth in perfect, circular motions. This world view cohered readily with the subsequent rise of Christianity in Europe, for it placed the earth (not yet considered to be a "wandering" planet) at the center of God's creation and the human between the perfection of God and the imperfection of the material world. This Great Chain of Being, wherein everything was created by God as a hierarchy of increasing perfection from the lowliest material objects through plants, animals, humans, angels, and ultimately God, himself, was given empirical validity in the *fact* that the cosmos followed the same logico-empirical structure.

Following the Classical Greek era, the stream of philosophical development entered into the Medieval Period dominated by the Christian world view that incorporated the rationalism and empiricism of the Greeks, but placed these human methods within a larger context of monotheism and linear time. Through the travels of Alexander the Great, who was tutored by Aristotle, the Hellenic cosmology was transmitted to Alexandria where it was married to the Hebrew theological narrative. According to Tarnas, the Christian revelation transformed the Hellenic world view in several ways: by imposing the hierarchical Great Chain of Being and eliminating the polytheism of the Greeks; by crystallizing the Platonic mind-matter dualism through the concept of Original

Sin, rendering the material world fallen from the perfection of God; by introducing a linear, historical narrative to cosmology, represented by the Fall, Christ's redemption of humanity, and his eventual return; and by de-emphasizing the autonomy of the independent human intellect under the subordination of the spiritual guidance of the Church (Tarnas 1991, 165-166).

The rigid dogmatism of the Church's hierarchical cosmology eventually began to crack under the strain of many cultural, intellectual, and technological forces. Among these were: the development of agricultural technologies, such as the windmill, water wheel, horse collar, and heavy plow, that allowed humans to harness the power of the natural world for their own purposes while also subverting the power of the Medieval social hierarchy (Tarnas 1991, 173-174); the retrieval of ancient Greek texts through the interaction with Arabic societies during the period of the Crusades; the development of perspective and appreciation for the human body developed by early-fifteenth-century Italian painters; the widespread dispersal of books made possible by Gutenberg's printing press; and Martin Luther's challenge to the supreme authority of the Catholic Church (Primack and Abrams 2006, 72). All of these factors, including many others not mentioned, led to a reinvigorated interest in the study of the natural world that culminated in the scientific revolution known as the Enlightenment in the sixteenth and seventeenth centuries.

The development of the modern scientific world view, and its break from the ancient and medieval world views, was founded on the cosmological insights of Copernicus, who proposed a heliocentric model of the universe to fix the

inherent discrepancies discovered in the Ptolemaic structure that relied on continually adding epicycles to the movements of the heavenly bodies so the theory would match observation. Based on Copernicus's calculations, a sun-centered universe would make regular planetary orbits around the sun appear to follow the confusing retrograde observations made from a moving Earth considered to be one of the many sun-orbiting bodies (Tarnas 1991, 250). Building upon this theory, Kepler suggested elliptical orbits to further match theory with observation, Galileo utilized the telescope to show that the heavenly bodies were not the perfect objects assumed in the Ptolemaic system, and Descartes concluded that there must be a force that continually pulled the planets toward the sun that prevented them from continuing on a straight inertial path (Tarnas 1991, 248-271).

Building on the work of these great thinkers, Isaac Newton unified the physics of the earth with the physics of the cosmos into a concise and elegant theory of universal gravitation. Tarnas summarizes Newton's grand synthesis of physics and cosmology as:

> Every particle of matter in the universe attracted every other particle with a force proportional to the product of their masses and inversely proportional to the square of the distance between them....Descartes's vision of nature as a perfectly ordered machine governed by mathematical laws and comprehensible by human science was fulfilled. (Tarnas 1991, 270)

The scientific revolution, as completed in the Newtonian conception of a mechanical universe that moved within an absolute space though an independent, linear time, succeeded in showing that the human mind is a detached observer that

was capable of understanding the cosmos and putting the natural world to work for the benefit of the human.

The Newtonian view of the cosmos has since been replaced by Einstein's relativity, quantum mechanics, and the empirical observation that the universe is expanding. Our current evolutionary understanding of the cosmos tells us that the universe is 13.8 billion years old, that the universe is expanding in all directions, that space and time are not independent but fused together in a 4-dimensional matrix called space-time, that the elementary parts of the universe do not follow classical laws, and that the universe is amazingly fine-tuned for life to have arisen. The seemingly simple view of the universe proposed by Newton has been immensely complexified in the more than 300+ years since it was developed, yet our understanding of mind and nature has not kept up with the empirical sciences.

Objectivity has a history. Modern science has a history. Our current understanding of the mind-boggling immensity of the cosmos is the product of two thousand years of conceptual development. In the *history of science*, the inquisitive nature of the mind is *prior to* the current theories of the universe; in other words, the current view of the universe arises out of the evolution and development of the human mind in its attempt to relate to the cosmos in which it finds itself. Our model of the universe has a history that has its Western origins in the philosophical nature of the ancient Greeks, who lived in a world enclosed by the divine spheres of the heavens. As the inquiring minds of our ancestors continually probed the world around them with their senses and their logical faculties, the universe exploded outward into an amazingly complex environment

for the mind to explore. Our universe has a cultural history, embedded in the social-scientific history of the human mind. According to the *history of science,* the universe as we know it is a product of consciousness evolution.

Science of History

Another view of the origin of the universe as we know it is presented by modern cosmology, the fruit of the inquisitive labors of the scientific community; and the human mind is but a miniscule actor located at the very end of the immensely long timeline of cosmic evolution. Rather than being the source of universe as we know it, the human mind turns out to be the culmination of the universe as we know it. In *The Universe Story*, cosmologist Brian Swimme and cultural historian Thomas Berry (1992) relate the scientific understanding of the universe from what Swimme refers to as the Flaring Forth through billions of years of development to our current industrial civilization on the brink of environmental collapse. Human beings and human consciousness arise very late in the game of the evolution of the universe and, therefore, our conceptual theory of the universe arises from our seeming ability to look back on what has already taken place.

In the *science of history*, particles, space, time, light – everything of the physical universe - emerged out of an unfathomably intense explosion of energy from a primal singularity. According to NASA, our current estimations tell us that this eruption occurred 13.77 billion years ago ± 0.059 billion years (NASA/WMAP Science Team 2012). Of course, this number has also changed

over the course of the past century. In 1919, less than one hundred years ago, scientists still thought the universe was infinitely old (National Aeronautics and Space Agency [NASA] 2010). Since then, however, we have developed more and more powerful measuring devices, and, as far as we know, our calculations have become more accurate. The working model of the universe that we currently utilize begins with a powerful eruption 13.8 billion years ago followed by several iterations of universal transformation that have ultimately led to the current state of affairs (NASA 2010).

According to Swimme and Berry, the universe began as a burst of cosmic energy that expanded at a seemingly perfect and elegant rate.[16] Had it expanded slightly slower, it would have collapsed in on itself. Had it expanded slightly faster, it would have dissipated outward without allowing any structures to form. This initial epoch of universal development also had a perfect symmetry insofar as the particles and forces of our current standard model of physics had not yet developed their identities. Once these identities were locked into place, however, the limits in which the universe would continue to unfurl were essentially set in place (Swimme and Berry 1992, 17-19). After this phase transition when the symmetry of the earliest universe broke, particles were continually emerging from the void, interacting with each other, and annihilating each other. Nothing was

[16] It is important to note that Swimme and Berry published this work in 1992, and it is the nature of a scientific work that, once published, it has already started to become somewhat inaccurate as scientific advances take place. For example, Swimme and Berry state that the Flaring Forth took place 15 billion years ago, a fairly accurate estimate in 1992, but about 1.23 billion years off by today's standards. However, the story presented by the authors is still more or less an accurate portrayal of the standard model of cosmic evolution, and I am utilizing it for its conciseness and its incorporation of humanity in the evolutionary arc.

permanent. Swimme and Berry state that this constantly swirling and swelling sea of particles that emerged out of nothingness billions of years ago is at the foundation of everything we experience today. They state:

> The nature of the universe today and of every being in existence is integrally related to the nature of this primordial Flaring Forth. The universe is a single multiform development in which each event is woven together with all others in the fabric of the space-time continuum. (Swimme and Berry, 1992, 21)

The mysterious initiatory moment of the universe has the unique characteristic of being temporally distant from our vantage point, yet effectively present in every object of scientific scrutiny.

Very quickly, the universe entered another phase of its development – less than a single second after it emerged. At this juncture, the universe expanded out to a point where the energy of photons no longer elicited new particles when particles encountered their antiparticles – the total number of elementary particles began to decrease. There was now the capability for enduring particles, and enduring relationships between particles, in the expanding universe. (Swimme and Berry, 1992, 21-22). Then, for several hundred thousand years, the universe expanded and cooled before protons and electrons entered into the relational structure we now know as atoms, particularly the atoms of hydrogen and helium. Hydrogen and helium could now form vast galactic clouds with black holes at their centers which spun the clouds around faster than a thousand times each second creating density waves. These density waves initiated the condensation of hydrogen and helium clouds into the formation of stars (Swimme and Berry, 1992, 34).

After a billion years, the universe had dynamically multiplied its internal structure into trillions of self-organizing galaxies, which then gave birth to trillions of stars as the attraction of hydrogen and helium atoms was accelerated by the density waves that produced the spiral arms of spinning galaxies. As the atoms collide, friction creates heat that eventually overrides the endurance capacity of the atoms and they are destroyed in the implosion. In the raging fire at the center of the stars, hydrogen is turned into helium, and helium is transformed into carbon and other higher-order nuclei so that the star can continue to burn its fuel (Swimme and Berry, 1992, 48). After a star has used up all of its own fuel, the remaining materials condense under their gravitational attraction, forming a super-dense mass of neutrons called a pulsar, a singularity called a black hole, or a supernova. If the star supernovas, the star's neutrinos escape the collapse and, insodoing, erupt through the outer layer of the star, scattering the outer elements, including carbon, oxygen, and nitrogen. As these elements are released, they enter into new relationships of attraction that form new stars and planets (Swimme and Berry 1992, 48-49).

Galaxies produced by these supernovas are rich in heavier elements. In the Milky Way galaxy, 4.5 billion years ago, the sun of our home solar system was born. Spinning around this sun were the remnants of the original sub-cloud composed of heavier elements. This spinning disc of gas eventually collapsed into the planets of our solar system. (Swimme and Berry 1992, 64-65). In their early stages, all of the planets were actively surging bodies of molten liquid or gas. Mercury, Venus, and Mars eventually cooled to become rocky planets, whereas

Jupiter, Saturn, Neptune, and Uranus continue to be the swirling and active planets that they were during their earliest inception. Earth, on the other hand, happened to have the right size and happened to be such a cozy distance from the sun that the amazing diversity of life could develop under its protection. Four billion years ago, the first living cell mysteriously emerged in the cauldron of the early Earth (Swimme and Berry 1992, 82-86).

The early prokaryotic cells that survived reproduced, and they saved the characteristics that enabled survival in genetic information. They differentiated through genetic mutation. They grappled with a decreasing supply of life-sustaining chemical compounds by mutating to consume parts of deceased prokaryotes or compounds produced by other prokaryotes. Some prokaryotes even developed the ability to photosynthesize their own food. Prokaryotes produced oxygen as a byproduct of their digestive functions, and oxygen's incessant need for electrons actually destroyed the enzymes of the very cells that produced them. In this chaotic environment two billion years ago, a new form of life appeared: the eukaryote. The eukaryotic cell could respire, utilizing oxygen to power its internal dynamics (Swimme and Berry 1992, 85-98).

Life continued to evolve on the planet, producing singular entities that developed from the symbiotic relationship of previously separate entities, carnivorous cells that consume other living cells, and cells that produce through sexual combination (Swimme and Berry 1992, 101-109). Multicellular organisms appeared roughly 700 million years ago. These multicellular organisms evolved over the course of hundreds of millions of years through countless iterations of

forms and functions, from jellyfish to insects to reptiles to mammals to birds (Swimme and Berry 1992, 109-140). Out of this evolutionary developmental past of trial and error for features that allow a species to survive in constantly changing environments, humans emerged roughly 2.6 million years ago (Swimme and Berry 1992, 146).

Homo habilis utilized stone tools to interact with their surroundings differently than their predecessors. *Homo erectus* carried out the first great migration from Africa, through Asia, and on into Europe, utilizing animal skins for clothing and controlling fire for warmth. *Homo sapiens* continued to refine these earlier technologies, and developed their arts through cave painting and sculpture. Symbolic consciousness was born. Eventually, humans would move out of their traditional hunter-gatherer lifestyle into communal villages supplied by the domestication of plants and animals. From these villages arose larger empires that ultimately transformed into the nation-states that we live in today (Swimme and Berry 1992, 147-220).

In modern evolutionary cosmology, the Flaring Forth precedes the human discovery of it by 13.8 billion years (NASA 2010). It makes no sense to say that the universe is a product of consciousness because consciousness is such a relatively recent emergent player in the cosmic drama. Although scientists acknowledge that our model of the universe is subject to revision as new discoveries emerge and new information is incorporated into the current theory, it tends to be accepted as scientific fact that the human mind is a late product of the universe.

The Two Stories

I hope the juxtaposition of the grossly simplified versions of what I am referring to as the *history of science* and the *science of history,* as developed by Tarnas and Swimme, respectively, elicit a sense of cognitive dissonance in the reader. In the first presentation of our understanding of ourselves and the cosmos in which we live, the rational Western mind was born as it created a beautifully ordered and contained world based on the logical analysis of simple observation. Over the course of a couple thousand years, during which time our methods of observation became more powerful, this neatly contained world burst outward into the immensely huge, multibillion-year-old, and continually expanding universe that we acknowledge as scientific fact today. The *history of science* considers our current model of the universe to be a product of an evolving human consciousness as it interacts with a world that it awoke to just a few thousand years ago.

The second presentation, on the other hand, takes our fairly recent discoveries and extends them billions of years before life and human consciousness arose to discover the great, pre-existing truths of the immense universe wherein the human is a seemingly insignificant speck. I want to acknowledge that Brian Swimme and Thomas Berry present the human as anything but cosmically insignificant, as evidenced by their statement that "mathematical formulations of the scientists are the way in which the multiform universe deepens its self-understanding" (Swimme and Berry 1992, 40). However, although they attribute amazing agency to the cosmos and acknowledge

that the human has a unique role to play as a self-conscious aspect of its unfolding, Swimme and Berry present human consciousness as being the outcome of the evolution of the universe and modern cosmology as the discovery of pre-existing facts.

Depending on one's personal affinity for either the fundamentality of consciousness or the fundamentality of the universe, one might be very comfortable taking either story as basic. However, in regards to the process philosopher and the logical and epistemological arguments for the unity of subject and object, these two narratives ought to be able to sit in dynamic tension without one collapsing into the other. In some sense, the evolution of human consciousness that developed the technologies that extend our senses and the mathematics that extend our logic gives rise to the very universe that we are investigating *and* the universe that we have discovered to have a current age somewhere around 13.8 billion years (NASA 2010) has culminated in a vastly large space-time matrix wherein conscious human beings have emerged in one immensely small neighborhood. This is the koan-like conundrum that infected John Archibald Wheeler (1977) when he doodled his ouroboros-like U.

In what sense can we hold these seemingly opposed stories in a dynamic tension that acknowledges the validity of each? At this point, I would like to return to Wilfrid Sellars (1965). In my formulation, the *history of science* is the emergence of the "scientific image" out of the development and refinement of the "manifest image." The *science of history*, on the other hand, is the emergence of the "manifest image" out of the developmental narrative of the primal

imperceptibles of the “scientific image.” I argue that the *history of science* is actually a Sellarsian “manifest image” with a developmental temporal extension, whereas the *science of history* is a Sellarsian “scientific image” with developmental temporal extension. Both the *history of science* and the *science of history* are concurrent stories of origin of the human-universe relationship, just as the “manifest image” and the “scientific image” are concurrent world views of the human-universe relationship.

Now that I have nested Sellars's (1965) original challenge to philosophy within these two seemingly divided evolutionary schemes, I will offer a solution to the problem in the same vein that I offered a solution to Sellars's more-or-less static dichotomy. If the *history of science* and the *science of history* are the dynamic instantiations of the “manifest image” and the “scientific image”, respectively, then there must be some sort of dynamic original-image that can unite the two narratives, ontologically.

CHAPTER 7: PRETEMPORAL ORIGINATION

How might we develop a concept of the Sellarsian original image that is developmental and dynamic? In other words, what is the ground that can unite the two discrepant Western understandings of the past – the discrepancy being that the *history of science* reveals that the universe arose out of the evolution of human consciousness and the *science of history* reveals that human consciousness arose out of the evolution of the universe. I have argued that the "original image" of primal participation undergirds the categorial and empirical "manifest image" and the theoretical "scientific image." Along the same lines of logic, I now maintain that an analog concept can unite the *history of science* and the *science of history*. This analogous notion is a pre-temporal participation that gives rise to the sequential evolution of the two stories, wherein both stories produce each other by reciprocally informing each other in this ground concept. I will refer to this grounding principle as "pretemporal origination."

This "pretemporal origination" does not take place *within* the developmental framework of either the *history of science* or the *science of history*, rather it is the experiential component that gives rise to each. It is unanalyzable insofar as it is that which analyzes. We can attempt to describe pretemporal origination with abstract concepts or intuit certain characteristics based on personal experience, but any attempt to define the experiential ground of the *history of science* or the *science of history* will result in Whitehead's *fallacy of misplaced concreteness* ([1929] 1978), for we would be attributing ontological fundamentality to secondary attributes of the primal reality. In other words, once

it is described, it has already advanced beyond description. Keeping this warning in mind, however, there are certain suggestive offerings that can be said about "pretemporal origination." Much like the wave-like nature of matter, which can only be observed indirectly through the patterns of point particles on a photosensitive plate, the time-originating nature of "pretemporal origination" can be discovered through the diffractive analysis of history and science.

As was discussed in Chapter 2, both Alfred North Whitehead ([1927] 1978) and Karen Barad (2007) refer to their basic metaphysical processes of becoming as the originators of space-time. Physicists David Bohm ([1980] 1995) and Julian Barbour (1999) have come to similar conclusions about the ground of mind and cosmos, as has medical doctor Robert Lanza (2009) in his theory of biocentrism. To begin my indirect analysis of the unanalyzable, I will juxtapose some telling statements of these thinkers so that we might taste the flavor of "pretemporal origination."

Consider these statements:

A.N. Whitehead:

> The conclusion is that in every act of becoming there is the becoming of something with temporal extensions; but that the act itself is not extensive, in the sense that it is divisible into earlier and later acts of becoming which correspond to the extensive divisibility of what has become. ([1929] 1978, 69)

Karen Barad:

> Space and time are phenomenal, that is, they are intra-actively produced in the making of phenomena; neither space nor time exist as determinate givens outside of phenomena. (2007, 315)

David Bohm:

> Relativity theory has already led us to expect many different systems of time and space, as these are abstracted from different contexts of process. Quantum theory has led us further to the notion that one system of time and space may be enfolded in relationship to another and that all our common systems are enfolded in the vacuum state. Now we go further to contemplate much greater systems that enfold even the vacuum state with its oscillation and evolution. In all these relationships, any one system has its "timeless" enfoldment in another (or in others). But each system has to be seen in both aspects, i.e. of time and of a relatively "timeless" enfolded state. ([1980] 1995, 196)

Julian Barbour:

> The structure of making a Now self-aware is eternal and timeless. Structure is all that counts. Self-awareness does not happen at a certain time and last for some fraction of a second. Yesterday seems to come before today because today contains records (memories) of yesterday. Nothing in the known facts is changed by imagining them hung on a 'line of time' – or even reversing their positions on that line. The instant is not in time, time is in the instant (1999, 53)

Robert Lanza:

> Space, like time, is not an object or a thing. Space is another form of our animal understanding and does not have an independent reality. We carry space and time around with us like turtles with shells. Thus, there is no absolute self-existing matrix in which physical events occur independent of life. (2009, 127)

All of these thinkers acknowledge that consciousness is ontologically part and parcel of the universe, and that this point alone must fundamentally alter the classically dualistic assumption that allowed the modern scientific project to study the universe as a pure object. Taking into account the findings of the most up-to-date sciences, these working scientists have determined that the ground of space and time is also the ground of experience. Also, rather than being a characteristic

of time or a constituent within time, this ground is the originator of time, in any linear or circular sense of the term.

In other words, the conception that I am a conscious human being living on a planet revolving around the sun 13.8 billion years after a mysterious eruption of cosmic energy is true, but it is only true insofar as this conception is determined by what I am calling "pretemporal origination." In the same way, an ancient Greek citizen contemplating the cosmos as an infinite and ordered perfection circling the central earth was true, but only insofar as it was determined by the "pretemporal origination" that grounded his or her consciousness. But, the reality of my conception of this past person's conception is only grounded in the "pretemporal origination" of my experience, because that hypothetical Greek is a function of the past, which is a function of my "pretemporal origination." In other words, we can not help but live in the universe that we do in our current time, because this is the universe that has evolved complementary to our probing minds, and the same can be said for our forebears and the universe that they occupied. The universe is expanding, this is an empirical fact. The expanding universe as we know it now, however, is *also* an iteration of the evolution of the human mind's conception of it. Both require each other, yet only one is given full credence at any given time.

The story that evolutionary cosmology presents to modern consciousness and the history of the coming-to-understanding of evolutionary cosmology are presented to modern scholars as related, however this relationship is usually characterized by one story being ontologically dominant over the other.

Classically understood, the universe that scientists uncover is unrelated to the process of its discovery, i.e. from our modern standpoint we project that the evolving universe was actively present in the background, waiting to be discovered, prior to our emergence from the Aristotelian-Ptolemaic cosmology of our predecessors. It is my fundamental argument that this is not a positive statement that we can make. The objective universe is coeval with our subjective determination of it, and these two poles are united in the "pretemporal origination" that underlies conscious experience, space, and time.

This "pretemporal origination," as I have called it, is not equivalent to the content of consciousness, for it is the dual stories produced by the content of our conscious attention that it unites. Rather, it is the experiential ground that acknowledges the complementary constructs. Just as the wave and particle nature of a quantum entity are mutually exclusive in regard to simultaneous measurement, yet are required for a complete picture of the overall state of affairs, it is the "pretemporal origination" of the scientist, as she takes part in the "pretemporal origination" underlying mind and universe, that allows for both to be considered together. The mutual exclusion of the two types of characteristics is made mutually inclusive by the always already unifying nature of "pretemporal origination." Analogously, the *history of science* and the *science of history* are held in complementary tension by the "pretemporal origination" of those who maintain our developmental knowledge of each and extend this knowledge into the greater cultural milieu.

In *Science, Faith, and Society* (1946), philosopher and scientist Michael Polanyi analyzes the nature of the scientific practice. He argues that the process of scientific discovery is very different from the view of science as the piecemeal process of examining evidence and drawing conclusions from a neutral perspective. Rather, he thinks that scientific discovery involves a holistic or gestalt understanding of the world that guides one's research toward productive outcomes. He states:

> The process resembles the creation of a work of art which is firmly grounded by a fundamental vision of the final whole, even though that whole can be definitely conceived only in terms of its yet undiscovered particulars – with the remarkable difference, however, that in natural science the fundamental whole lies not within the powers of our shaping, but must give a true picture of a hidden pattern of the outer world. (Polanyi 1946, 32)

In other words, the scientist is actively seeking out a world that he has already conceived or intuited. This gestalt or holistic vision of the whole is built upon past scientific discoveries and an education in the underlying methods and conceits of the scientific enterprise, yet it is also a vision of the whole that can morphically change as new evidence is introduced. The gestalt leads the scientist to evidence, and the evidence leads the scientist to an altered gestalt. Polanyi states, “Potential discovery may be thought to attract the mind which will reveal it – inflaming the scientist with a creative desire and imparting to him a foreknowledge of itself” (Polanyi 1946, 33). “Pretemporal origination” is the ground of our two evolutionary stories, and it is also the ground of the individual's relationship to the universe. It is this kinship between the mind of the human and the universe that she explores that allows for the holistic understanding that powers scientific

discovery. The coeval relationship between the *history of science* and the *science of history* is the dynamic creation of new gestalts, and it is "pretemporal origination" that changes with each new iteration.

This argument might be charged as a form of anthropocentrism, wherein it seems to be stating that the universe is a product of the uniquely human mode of sensible and conceptual intra-action with the universe. While this charge is not taken lightly, I would like to argue that this notion of "pretemporal origination" universalizes the human, while also humanizing the universal. The evolutionary narrative that we use to scientifically explain the origins of all that we see utilizes uniquely human constructions of time and space scales. As we extend our measuring capabilities utilizing new technologies, we create newer iterations of space and time within the discoveries. The *history of science* is the history of the creation of the universe by "pretemporal origination," and the *science of history* is the science of the discovery of ourselves as ultimately experiential components of "pretemporal origination." In this manner, epistemology and ontology are essentially united – not as static conditions, but as mutually implicative of each other in the continual processual development of mind and universe. According to Karen Barad:

> 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-epistem-ology* – 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. (Barad 2007, 185)

Although the ground of the *history of science* and the *science of history* is pretemporal in nature, it must also act in such a way as to allow for changing epistemo-ontological intra-actions. In order to understand the way in which pretemporal origination is productive of the *history of science* and the *science of history*, I now turn to the idea that creation and discovery are not separable modes of being, but unified by their location on a continuum of constraints.

CHAPTER 8: CREATION AND DISCOVERY

Time is not an absolute, independently existing entity that lords over human experience or the universe itself. In fact, time has a rather extensive history itself, beginning with the early Paleolithic union of cosmic and human cyclical time, evolving through the creation of Renaissance era clock towers that represented the mechanical view of the cosmos, through our current disjunction between the digital time of human society and the grand time scales of cosmology.[17] Our notions of time have changed as much as our notions of the universe itself. Processual change is productive of time itself, as Whitehead ([1929] 1978) and Barad (2007) have both argued. It is the process of intra-action that brings about the material world and our iterative historical understanding of its development, and it is "pretemporal origination" that provides the base for the complementary development of both the *history of science* and the *science of history*. If it is the processual change of "pretemporal origination" that is productive of space-time as we currently know it, how is this process effected, epistemo-ontologically, in the world? Maintaining the theme of unifying supposed opposites, I will utilize the notions of "creation" and "discovery" to discuss the mode of processual change that is "pretemporal origination."

The common understanding of creation is that it is the production of something new that did not necessarily pre-exist the creator's actions, be it a human work of art or the Christian God's seven-day molding of the world. Discovery, on the other hand, is the "un-covering" of that which is already

[17] For a full treatment of this history of our understanding of time, see Frank 2011.

present. According to Robert M. French, a cognitive scientist who has written philosophically about these two notions, “the main difference between them seems to depend on the ineluctable nature of discovery compared to the unique character of creation” (French n.d., 1). However, in the same way that process ontology has unified epistemology and ontology, creation and discovery must be unified in the same manner. Since the term “pre-existing” no longer applies to unmeasured quantum particles or a concrete space and time non-relative to an observer, referring to scientific developments as pure discoveries no longer holds. There is something more fundamental than these two disparate concepts.

Robert M. French (n.d.) unifies creation and discovery by placing them on a continuum of constraints, wherein novel developments that take place within more numerous and more rigid constraints are considered discovery and those that take place in looser and fewer constraints are deemed creations. This “continuum of constraints” runs from the hard sciences (with mathematics, composed of structures of extremely rigid axioms and principles, being the “hardest” of the sciences) to the arts.

In order to differentiate between the types of constraints that determine an act of creation from an act of discovery, French states that discovery is determined by “external” constraints whereas creation is determined by “internal” constraints. By way of example, he states that physicists cannot alter the speed of light or Planck's constant, for these are constraints imposed by empirical observation. On the other hand, artists must work within cultural, or genre-imposed, constraints (French n.d.). How should we understand this interest from

the standpoint of process philosophy's pre-dualistic standpoint? From this point of view, the “external” constraints imposed on the hard sciences are simply the current limits of our observational abilities. For example, beyond the speed of light and below the physical limit of Planck's constant, our logico-classical understanding of the world of distinct entities interacting in a continuous space-time breaks down. In order for science to follow its classical project, it must remain within these constraints, by definition. On the other hand, the seemingly arbitrary and change-able cultural constraints that determine acts of creativity, such as man-made rules of poetics or the aesthetics of perspective, are in fact the limits imposed by the greater milieu of a culture, or the limits of our sensible conception of the world, that is determined by its world view or cosmology. Surgeon Leonard Shlain has actually argued that perceptions produced by visionary artists precede the physical explanations of the world produced by science (Shlain 1991). In Shlain's (1991) view, our overall vision of the world needs to change before we can work out the scientific details, much like Polanyi's (1946) argument that a scientist's gestalt (perhaps informed by the visionary artists of her day) guides her experimentation. There is no cut between “external” constraints and “internal” constraints, there are simply different rigidities. But, even the rigidness of constraints are not unchanging or constant, the constraints themselves can change – and it is in this changing of constraints the our terms “creation” and “discovery” are shown to be unified.

French (n.d.) parallels his notion of constraints to that of Thomas Kuhn's (1962) notion of paradigms. To French, Kuhn's distinction between “normal”

science and "revolutionary" science is related to whether scientists are working within currently accepted scientific constraints or whether they are in the process of tweaking the accepted constraints (or parameters) to seek out new, far-reaching constraint networks that can expand, yet include, past constraint networks. For example, he argues that a scientist working on pollution levels in rivers is partaking in normal science, whereas the Copernican revolution in cosmology is a case of revolutionary science (French n.d., 2). One works within accepted constraints, and one creates new constraints for scientific research to venture within. Within the realm of the sciences, revolutionary science is when the distinction between creation and discovery blurs. When the revolutionary scientist begins loosening the constraints of her given paradigm, she has the freedom to choose what parameters to alter and what parameters to leave the same. In this sense, her actions become more creative. According to French, the creative act in the sciences is "*selecting the right path*, from among all the possible paths defined by the constraints" (French n.d., 3). The shorter the path, the more we believe someone else would be able to "discover" the conclusion; the longer the path, the more we acknowledge the inherent "creativity" of the scientist. Fundamentally, novelty is determined by a loosening of constraints, whether in the sciences, the humanities, or the arts.

Constraint is not only a term through which we determine whether a human project is deemed a creative act or an act of discovery. Anthropologist Terence Deacon makes broad use of the concept in *Incomplete Nature* (2012), his work on the dynamics by which mind might have emerged from a materially

evolving universe. He states that the term constraint “denotes the property of being restricted or being less variable than possible, all other things being equal, and irrespective of why it is constricted” (Deacon 2012, 193). From this general concept of constraint, he states that it can take two forms. It can be extrinsic, or imposed on a system from outside, and thus can be deemed a positive constraint. Constraint can also be intrinsic, or determined negatively wherein a constraint between two systems is determined by what is left out by their shared commonality (Deacon 2012, 93)

Another way to understand constraint is through the notions of “emic” and “etic” modes of study. Originally utilized within the field of anthropology, “emic” refers to the study of a culture from within its norms and values, and “etic” is the study of those norms and values from without. Emic carries a sense of subjective understanding, whereas etic carries a sense of objective study. Utilizing Deacon's understanding, the etic perspective is an extrinsic determiner of constraints on an emic system, whereas intrinsic constraint is determined negatively from within the emic without an etic perspective on the situation.

Understanding creation and discovery, then, is an understanding of the dynamics of constraints and their modes of change. Working within constraints, and thus working emically within a given system, an act is considered a discovery when something new is developed within a given system due to the inevitability of its development within the given constraints. An act is considered creative when it allows us to view our emic situation by alluding to the potential of an etic perspective, since it loosens the constraints imposed on it by its emic location.

Creative-discovery, for lack of a better term, is the act of moving far enough away from one's emic location by sufficiently loosening the constraints, and viewing one's original location etically, effectively developing the beginning of a new emic situation. The *history of science*, in this sense, is an attempt at understanding the creative-discovery of our current emic situation by etically viewing the developments that sufficiently loosened past constraints. The *science of history*, on the other hand, is the attempt to etically view the universe from our emic position within it, or the position from which we attempt to understand the constraints we live within to develop the best possible approximation at an etic view of the universe itself.

From a process philosophy standpoint, the emic viewpoint of mind and universe as related by intrinsic constraints is the true state of affairs, and the assumption that we can take an etic view is an abstraction. However, this abstraction has a reality by being part of what determines the intrinsic constraints between mind and universe. My term "pretemporal origination," akin to a cosmic Sellarsian (1965) "original image," is the standpoint from which the *history of science* and the *science of history* emanate. The *history of science* is the evolutionary expansion of the universe emically, as experienced from within the evolution of consciousness. The *science of history* is the current model of a possible etic understanding of the emic state of affairs. "Pretemporal origination" is that which underlies both insofar as it is the ground of consciousness and, to borrow Barad's term, spacetimemattering (2007, 179).

One way to visualize this concept of "pretemporal origination" is to utilize our current understanding of the expanding universe. Two discoveries are important here: (1) when we look out into the universe, we are looking backward in time (Primack and Abrams 2006, 134), and (2) the universe is expanding away from every single point within it (Swimme 1996, 85-87). Now, visualize how the time and space are being created by every actual occasion or every intra-action that takes place within our model of an evolving and expanding cosmos. The material universe is being created in these intra-actions, and these intra-actions are the source of the potential future's actualization into the past. In other words, the universe is expanding outward into the past from myriad instantiations of "pretemporal origination." In this sense, our universe is produced by the human form of intra-action in the *history of science*, and the model of this universe becomes an object for the agentive intra-action of "pretemporal origination" to incorporate into its future instantiation. Mind and universe arise simultaneously from these iterative intra-active processes.

Space, "the final frontier," is simultaneously a vision of the future and the material presence of the past. The present becoming of past and future, as experienced and produced by "pretemporal origination," finds its current iterational embodiment in the combined fact that the omnicentric universe expands outward from every (classically-understood) point within it *and* the past and future are determined by their respective distance from each point. In the processual metaphysics that we have been exploring, these "points" are no longer purely physical locations in a purely physical universe, but psycho-physical

becomings that intra-act both externally and internally. One might even speculate that, perhaps, the expansion of our universe, a characteristic discovered in the 1920s, is a physical effect produced by the continual introduction of novelty by the creative-discovery of “pretemporal origination” at work in the universe.

CONCLUSION

In this thesis, I have articulated the classical mind-body problem in the contemporary context of modern science and its historical development. In order to do so, I presented Wilfrid Sellars's (1965) concepts of the "manifest image" and the "scientific image" as mutually exclusive models of the world utilized by human consciousness. In order to unify these mutually exclusive, because explanatorily complete, concepts, I offered Alfred North Whitehead's ([1929] 1978) process metaphysics as a method of understanding the world *prior to* the bifurcation of the "manifest image" and the "scientific image." I then argued that Sellars's concept of the "original image" as mode of being wherein humans were immersed in a world of "persons" is aligned with the view of the world offered by Whitehead.

In order to understand Whitehead's metaphysics more robustly, I summarized some of his major concepts and articulated how they fit together. I then introduced the *agential realism* of physicist Karen Barad (2007) as a contemporary and scientifically-informed version of Whitehead's metaphysics. I attempted a diffractive reading of the two authors through each other in order to better understand the nature of the processes that both articulate from their unique vantage points. In a slight tangent, I then offered certain ideas from modern science that corroborate the philosophical ontology of process.

Returning to the main thrust of my argument, I turned from the more-or-less static Sellarsian "images of man," and offered the *history of science* and the *science of history* as developmental and evolutionary versions of the same

concepts. In this offering, I summarized the two stories and argued that they are mutually incompatible, much like the Sellarsian images. In order to unite them, I argued that something along the lines of a dynamic original image is needed, and I termed this concept "pretemporal origination," since time and space emerge out of its intra-active nature.

I provided a mode through which this pretemporal origination produces spacetime and the contents of consciousness through the concepts of creation and discovery. These seemingly distinct concepts are connected on a continuum of constraints, and great changes in constraint networks are emblematic of how these two concepts are actually unified. I then offered a visualization of the empirico-ontological production of the universe by looking at the notion of cosmic omnicentrism.

The purpose of this essay is to be an offering of how we might frame an understanding of the universe and consciousness that is consistent with scientific findings as well as compatible with unique experiential feeling of human subjectivity. This offering is anything but a completed project, but its inherent incompletion is meant to mirror and to take seriously the constantly changing intra-active relationship of mind and matter itself. Any project that claims completeness, insofar as it is closed to further inquiry or interpretation, is no longer a living philosophy.

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