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Chaos, Indifference, and the Metaphysics of Absurdity: The Ethical Challenges Posed by Gare's Process Thought

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ABSTRACT: The ecological crisis demonstrates the inadequacy of current modes of thought to grasp the nature of reality and to act accordingly. A more sophisticated metaphysical system is necessary. Arran Gare, a prominent Australian philosopher, has produced such a system, which takes into account the postmodern sciences of non-linear thermodynamics, quantum mechanics, and complexity theory. The present article promotes a cosmology based on Gare's metaphysics. In contrast to modern science, the postmodern account offered here will come to terms with a world governed by indifference, which is the same indifference that Albert Camus describes as "absurd." Camus will be interpreted in light of Gare's metaphysics.

Introduction

The ecological crisis demonstrates the inadequacy of current modes of thought to not only grasp the nature of reality, but to act accordingly within the world. In order to overcome this, it is important for philosophers to elaborate and defend more sophisticated metaphysical positions and understandings. Arran Gare is a prominent Australian philosopher who has done just that.

This article promotes a cosmology that is centred on Gare's metaphysical categories. I will first discuss the importance of metaphysical thinking and the relationship between metaphysics and epistemology. I will then seek to describe how the dominant metaphysics of modernity

has been expressed as mechanistic materialism and how this metaphysics has as its result the current environmental crisis. Identifying the problematic assumptions inherent in the mechanistic materialist conception of the world, this article will contrast this mode of thought with Gare's metaphysical categories.

Outlining Gare's metaphysical categories as an alternative system of thought, I will show how these are consistent with the postmodern sciences of non-linear thermodynamics, quantum theory, and complexity theory. In contrast to modern science, which prizes clarity, linearity, and a problematic conception of absoluteness, it is argued that these fields imply a universe that is active, indeterminate, and chaotic. I maintain that thermodynamics stresses the active, irreversible nature of physical processes; quantum theory the unpredictable, indeterminate state of reality; and complexity theory the ways in which order can emerge from this chaos. When interpreted through hierarchy theory, it will be shown that these fields can account for the emergence of conscious life on earth. When placed within the context of process philosophy, it is argued that these scientific fields support the view of an active universe that is spontaneously self-organizing into a self-aware universe.

Finally, this paper looks to extend the implications of Gare's process-oriented views and postmodern science into an ethical interpretation of Albert Camus' absurdism. In addressing this, I argue that Camus is a dialectical thinker whose anti-reductionist position is consistent with process philosophy and can assist in overcoming the nihilistic implications of a meaningless universe. Furthermore, it will be shown how Camus' rejection of suicide stands in stark contrast to the analytical and reductionist mindset of modernity, which I argue represents an implicitly suicidal mode of thought (as evidenced in the environmental crisis). In conclusion, I maintain that in order to overcome any nihilistic implications arising from the chaotic nature of reality, we must interpret Camus in process terms and take up the challenge of existing in the face of apparent absurdity.

PART I: METAPHYSICS AND EPISTEMOLOGY

Understanding and confronting the environmental crisis will require addressing our most basic assumptions about the world. Just as when building a house it is important to lay adequate foundations, when dealing with any system of thought it is important that the underlying assumptions

are structurally sound, coherent, and, most importantly, accurately reflect the reality that they seek to describe. It is for this reason that metaphysical discussions are vital when considering a problem as vast as climate destabilization.

Metaphysical systems are "speculative theories about the nature of being or existence" (Gare, *Nihilism* 283) that inform our common sense view of reality and dictate how we approach and interact with the world. All systems of thought rely upon metaphysical assumptions in order to be coherent and validate themselves. In turn, to defend a metaphysical view of the world is to defend a claim to knowledge, which relies upon a theory of knowledge or epistemology (Gare, *Postmodernism* 111).

There is a dialectical co-reliance between metaphysics and epistemology, with neither being able to exist without the other. Hierarchically, however, metaphysical schemes are more fundamental than epistemologies. Metaphysical schemes are so fundamental that we often take them for granted, accepting them subconsciously without necessarily acknowledging their presence in our thinking. According to Gare, epistemologies are "evaluated in terms of criteria based on the dominant metaphysics" and "the problem with most theories of knowledge is that they presuppose and assume the validity of a particular metaphysical theory" (*Nihilism* 285). In this sense, a shift in epistemological theory is more achievable than a complete metaphysical revolution. To re-conceive a metaphysical scheme is to tear away at the very foundation of thought. A change in epistemology will merely tinker with the modes of expressing that underlying metaphysical system. As a result, epistemologies tend to be constrained by their metaphysical foundations. Since epistemologies need to be explained by the metaphysical systems that legitimate them (Gare, *Nihilism* 285), it is important to recognize the naturalized assumptions that are being made at a metaphysical level.

Substance Metaphysics

The dominant metaphysical scheme of modernity is rooted in substance metaphysics, specifically in terms of mechanistic materialism, a mode of thought that came into focus with the Enlightenment philosophies of Bacon, Descartes, and Newton (Best 190). However, the metaphysical roots of mechanistic materialism are found in the ancient Greek philosophies of Parmenides and Plato.

In the Parmenidean concept of reality, process and change are subordinate to substantial things (Rescher 7). The "Parmenidean One" is that which is "ungenerated, imperishable, indivisible, perfect, and motionless" (Blackburn 278). Reality is understood as permanent and changeless, exhibiting a binary of existence and non-existence—something must be, or it must not be, but it cannot be both or in between. Plato elaborated on this mode of thought by dividing reality into the two separate realms of Being and Becoming. Being is composed of the perfect, timeless, and unchangeable realm of Forms or Ideas. Becoming is the imperfect, changing, and perceptible world of everyday occurrences. Privileging the first of these as a higher order of existence, the world of Becoming is viewed as a derivative and lesser imitation of the world of Being. Truth is considered "that which is unchanging and essential," while "the world of change and transformation is the realm of illusion and mere appearance," on this widely held interpretation of Plato (Best 193).

The emphasis of these philosophies rests in the changeless nature of true reality; that which is not eternal is, by default, either false or illusory. By providing the starting points for substantialistic metaphysics, these philosophies have provided the metaphysical basis for the emergence of mechanistic materialism as the dominant worldview of modernity, even if neither Parmenides nor Plato themselves were mechanistic materialists.

Mechanistic Materialism

Building on the metaphysics inherited from Parmenides and Plato, the mainstream of Enlightenment thinking understood the world in purely mechanical terms as a vast machine governed by universal and unchanging laws (Best 190). According to McLaren, this mode of thought "is based on [the] belief in the primary reality of material components over composite entities," and has become "the core pattern of thought . . . [that] dominate[s] the modern world" (43).

In mechanistic materialism there is a distinction made between humans—and their capacity to reason—and nature. Beginning with Francis Bacon, who saw reason not as the means to contemplate nature, but to control it (Best 191), this perspective places human beings outside of nature, with knowledge seen as an unchanging, thing-like tool that could be used to control the natural world (Kirkpatrick 28).

Following Bacon, Descartes' philosophy saw the world as "a neutral

physical body extended in space," with *a priori* mathematical knowledge the means by which one could effectively decode nature (Best 191). By decoding nature, one could come to understand the timeless laws that lay behind it, and therefore be in a position to exert greater control over it. Arguing that animals were no more than complex machines, Descartes extended this to the human body, which he saw as a no more than a mechanical system (Bowler 93). Conceiving of minds as "thinking substances . . . disjoined from the extended matter of the physical universe" (Gare, *Postmodernism* 37), Descartes separated the world of rational human experience from the world of mechanical natural phenomena (Toulmin 107). This dualism provided a modern interpretation of being and becoming, with being connected to that which is eternal and perfect, while the natural world of becoming was subordinate to this reason. This "laid the foundation for modern epistemology . . . [by] creating the binary chains between mind and body, subject and object, [and] human beings and nature" (Best 191-192).

This view of the world was vindicated by Newton, who discovered the universal laws of gravity and motion and the mathematical laws that described them (Best 191-192). By providing an empirically testable framework through which predictions could be made, Newton revealed nature "to be law-abiding, orderly and predictable" (Best 191-192), effectively reducing the world to a passive mechanical system consisting of matter in motion.

According to Dix, "this first phase of modern science . . . assumed that causation was simple, linear, deterministic, mechanical and unidirectional" (13). Under this dominant metaphysics, time is considered a parameter in which the past and future are equivalent (Prigogine and Stengers 9). The world is seen as simple and governed by atemporal, reversible laws (Prigogine and Stengers 7). From this reversibility of time it is implied that "one . . . [can] go forwards or backwards at any point and the same essential laws . . . [will still] be in operation" (Best 192). Since all future events will be similar to present events, all future events can effectively be predicted (Best 192). As such, events can be plotted objectively and chronologically as parts of a reversible linear sequence. Combined with the cause and effect of the Newtonian paradigm, reality appears to be fatalistically imbued with a predetermined, teleological, and tautological trajectory. There is a preordained, underlying direction, or *meaning*, to reality, and the timeless laws of nature are what prescribe this

meaning. The Enlightenment metaphor of a clockwork universe encapsulates the perceived timeless nature of reality: the world is no more than the sum of its parts, and these parts can be broken down, reassembled, and rearranged through the application of universal reason.

I have argued elsewhere that the project of modernity has been manifested into logics of domination, accumulation, and individualism and that these logics have put us on a trend toward ecocide (26-33). It is this project of modernity, expressed through mechanistic materialism, which legitimates neoliberal economics and the ongoing conversion of the earth into a source of economic profit. This has culminated in an environmental crisis that we are unable to avoid while these ideas still dominate (38-50). If we are to confront climate destabilization, an alternative conception of the world is required.

Process Metaphysics

In order to develop a more adequate conception of the world it is necessary to first challenge prevailing metaphysical assumptions. Process philosophy provides this alternative metaphysical tradition to substance-based ontology.

The basic premise of process philosophy is that "we live in a world where nothing stands still and change is the very essence of reality" (Rescher 25). Unlike in mechanistic materialism, entities "are not inert substances in a state of being, but processes of becoming" (McLaren 87). Gare describes the process view of the world in the following terms:

> The world is in flux, a process of becoming in which whatever is, is an enduring pattern of activity . . . [that] can only maintain itself through constant interaction with the background flux and other patterns of activity. (*Nihilism* 310)

This tradition of philosophy is recognized to have begun in ancient times with theories of this underlying flux derived from Heraclitus (McLaren 47). In contrast to the static system of Parmenides (Rescher 9), Heraclitus argued that 'all things are passing' and 'nothing abides' (Gare, *Nihilism* 310). Whereas Parmenides placed his faith in everything that is, Heraclitus argued that 'nothing is' and that everything is becoming (Gare, *Nihilism* 310). Recognized as a founding figure of the process approach to reality, Heraclitus "depicted the world as a manifold of opposed forces joined in mutual rivalry, interlocked in . . . constant strife and conflict" (Rescher

9). In this view, reality is not seen as a collection of *things*, but a collection of *processes*. A "river is not an *object* but an ever changing flow; the sun is not a *thing*, but a flaming fire" (Rescher 10).

Rescher provides a synoptic overview of the history of process thought and identifies a strong tradition of philosophers who have contributed to the development of process philosophy (9-24). Most significantly, this tradition of thought has culminated in the metaphysics of Whitehead. In Whitehead's metaphysics, "the building blocks of reality . . . are not substances at all, but 'actual occasions'—processual units rather than 'things'" (Rescher 20). Rather than viewing the primary nature of reality as eternal, Whitehead insists that temporality and change are basic (Rescher 21). Whitehead's thought insists there is "a dialectical tension between individual[s] and [the] world" (Rescher 21), in which both "microcosm and macrocosm are coordinated, [and] linked to one another in [a] seamless web of process" (Rescher 21).

Gare's Categories

Gare maintains that in order to develop process philosophy as an alternative to mechanistic materialism, it is necessary to first elaborate and defend a categorical scheme that opposes the dominant categories present in people's thinking (*Nihilism* 311). Since such categories are "the most fundamental concepts for understanding the world," they provide the means through which all other subsequent concepts can be understood (*Nihilism* 311-312).

According to Gare, the most important concepts to displace are space, time, matter, and motion (*Nihilism* 313). The categories he proposes to replace these are the categories of the ultimate, of existence, of explanation, and of ultimate potentiality. Through these categories, Gare provides a view of the world that sees the nature of the cosmos as:

> A process of creative becoming constituted of a multiplicity of emergent processes . . . in a complex relation to other co-existing processes . . . [which have] some degree of autonomy from all others. (*Nihilism* 313)

Unlike the dominant metaphysical categories of mechanistic materialism, which are constituted by fixed and eternal laws, these categories are dynamic, open, and subject to ongoing development. They exist "in a dialectical process of constant re-formulation" (McLaren 45), and are

thereby able to account for themselves as being consistent *within* this framework.

The Categories of the Ultimate

Gare's first categories are those of the ultimate, which include activity, order, and duration. As the name implies, these categories are required in order to define all subsequent categories (*Nihilism* 314).

Gare's concept of activity can be understood as "energy" (*Nihilism* 314). This activity resembles the Heraclitean flux and can be understood as the unordered energy that was released at the moment of the Big Bang (McLaren 85). Given that it is "our most coherent theory of the origin of the universe so far," the Big Bang is taken as the ultimate reference point for existence (McLaren 85). In relation to this activity, order "emerges as enduring patterns of activity" (McLaren 86). For Gare, "order is . . . the most difficult category to define," since whenever we think about anything, we are already assuming a degree of order (*Nihilism* 315). Therefore, to understand the concept of order, one must first imagine the complete absence of it. This absence of order can be defined as flux (*Nihilism* 315). Therefore, "any order in this flux can … be seen as some sort of limit or constraint" that differentiates it from sheer activity (*Nihilism* 315). By imagining the Big Bang as that which produced initial activity, the emergence of order from this background flux can be understood as the constraining of that initial activity (McLaren 11). From this ordering of activity, higher levels of order become possible, with the ordering of activity implying "a movement from what has existed to that which now exists . . . to that which could exist" (*Nihilism* 315).

From this comes the category of potentiality, which is the general term for the indeterminacy experienced in the world (McLaren 87). Potentiality provides temporal duration with a "kind of proto-memory" in "anticipation of . . . unrealized future possibilities" (*Nihilism* 315). It also provides the creative potential of the universe in which there are infinite potentialities, some of which are realized, some of which are not realized, and some of which are only partially realized. Unlike the Parmenidean system in which there can be only absolute being or absolute non-being, this view sees the nature of existence as particularly vague. Through potentiality, we can understand that there are spaces in between—and quite possibly beyond—being and not being.

The Categories of Existence

Gare's second group of categories are the categories of existence: process, structure, and event. Gare defines "process" as the ordering of activity which is "an immanent cause of its own becoming" (*Nihilism* 316). This self-ordering activity limits and constrains itself while simultaneously reproducing these constraints. Since it is the constraining of activity that constitutes order in the universe, this ordering needs to be understood in terms of durational processes (McLaren 88).

Gare identifies "primary beings" as composite processes of becoming (*Nihilism* 317). Gare stresses that these processes of becoming are durational and that there is high degree of interdependence between primary beings (*Nihilism* 316). The relationship between these different processes is what leads to the emergence of new composite processes and primary beings (*Nihilism* 317). In this conception of being, "there is no static, passive, inert matter as in mechanistic materialism" (McLaren 88). "To be" is to be a process and a process is that which has its own source of movement (*Nihilism* 316). According to McLaren:

> Processes of ordering are both partial causes of their own order, meaning that they exist only in relationship to a hierarchy of other processes in which they are either constituent processes, or supervening processes. (88)

Higher-level complex processes cannot be formed independently of one another. They emerge spontaneously over time, through the durational constraining of activity. This indicates how hierarchical structures can emerge and how higher levels of order can be generated from initial states of flux and disorder.

"Structures" are the ordering potentialities produced and maintained by processes (*Nihilism* 317). Gare states that "most of what people identify in the world as 'things' are 'structures', but not all structures are necessarily 'things'" (*Nihilism* 318). A thunderstorm is not a "thing" in the same way that a rock is a thing, however, there is a certain structure to a thunderstorm that differentiates it from other forms of weather patterns.

For Gare, structures are not completed matter, but entities continually in the process of actively maintaining their integrity and actuality (McLaren 88). They are "derivative from processes" as things that are produced, but need to be understood "in relation to [the] processes that … actualize these potentialities ... through their own becoming" (*Nihilism* 317). As an example, Gare argues that rather than a "thing," a tree must

be understood as "a process of becoming which is durational" (*Nihilism* 318). A tree is a structure that is in a constant process of recreating itself and maintaining its integrity through a confluence of processes, such as the intake of nutrients, photosynthesis, and so on.

Gare describes "events" as the coming into and out of being of processes and structures (*Nihilism* 318). When structures or processes emerge, this is an event. Likewise, when a process or structure decays, this is also an event. As concepts of potentiality exist "in the relationship between … supervening and constituent processes rather than in . . . atemporal objects," the idea of structures in Gare's metaphysics places the emphasis on *becoming* rather than on the realization of predetermined ends (McLaren 89).

The Categories of Explanation

The third set of categories are the categories of explanation. These include "the explanation of all that has existed, does exist and could exist" (*Nihilism* 314). Gare states that "to explain something is to identify its causes" (*Nihilism* 314). McLaren sees this notion of causation as similar to Aristotle's four causes. These are:

i. The material cause, which refers to the matter involved.
ii. The efficient cause, or the exercise of power.
iii. The formal cause, or the form aimed at.
iv. The final cause, which refers to the aim for this form.

McLaren explains this in terms of creating a clay pot. Clay would be the material used, with the exercise of power (or energy) the means by which one transforms clay into a pot for the purpose of containing a plant. This is in contrast to the "incoherent" mechanistic and deterministic view, which should assume that formal, *a priori* mathematical principles and laws determine that clay, by nature, becomes pots. Whereas the deterministic, mechanistic view should see pots as the inevitable outcome of clay, process philosophy introduces the agency of efficient and final causes into processes (91).

In Gare's metaphysics, there is no "linear notion of cause and effect as a fixed universal law" (McLaren 91). Gare's notion of causation is complex and dynamic, involving a multiplicity of mutually informing processes.

Gare describes "conditional causation" as "the conditions which generate a new process or allow an existing process to maintain itself" (*Nihilism* 319). This conditional causation is informed by "environmental causation," which serves as the environmental conditions for a process, ultimately extending back to the origins of the universe (*Nihilism* 319).

Gare argues that structures and events should be understood "as causes and effects only insofar as these are understood in relation to processes and their immanent and conditional causation" (*Nihilism* 319). Therefore, "a causal relation between events must be seen as . . . processes which produce and utilize these structures in their becoming" (*Nihilism* 319). Gare notes that "this complex notion of causation reintroduces and extends the notion of causation as activity realizing potentials," while emphasizing "that the very existence of anything must be self-creating activity" (*Nihilism* 320).

While potentialities may not always be realized, the possibility for their emergence must exist in the initial conditions of colliding processes. Causes do have effects, but these are not wholly deterministic or products of a single chain of action. There are multiple causes, with multiple possible effects, all of which are irreducible to simple causes alone; there is also the agency of processes involved. McLaren notes that in Gare's process terms, "the very notion of effect . . . is seen . . . as [the] active response, or appropriation by a process" (91). Cause is the durational realizing of potentialities—or final causes—that are already present in the beginning of action and which serve as the initial conditions for existence. From this, a "dialogue of emergence" occurs between the immanent causation of emergent processes and environmental and conditional causation (McLaren 91). Unlike in mechanistic materialism, these final causes are not unitary, but multiple, with many potentialities capable of being realized, partially realized, or not realized at all.

The Categories of Ultimate Potentiality

The final category is the ultimate potentiality and spatio-temporal position. In this conception, space and time are shown to be not only inseparable from each other, but to be ontologically derivative (*Nihilism* 314).

This category rejects the conception of space and time as "the self-subsistent, continuous receptacles within which things are located" (*Nihilism* 321). Rather, space-time is conceived of in relational terms as a particular kind of structure or process (*Nihilism* 321). Whereas Newtonian

metaphysics reduced time to a mere dimension of space, Gare's metaphysics views time as more complex than this. In Gare's process terms, space-time is "an order of potentialities for independence (space) and interaction (time)" (*Nihilism* 321). Space and time thus actively become through the interaction and "emergence of semi-autonomous sub-processes (*Nihilism* 321).

McLaren notes that space-time emerges from the initial case of order, which is "a differentiation from the background of unordered activity" (92). This emergence of order in turn creates a spatio-temporal relationship based on the speed and scale of its own existence as a process of becoming. The past becomes that which "a process, structure or event … can be causally influenced by," while the future is considered that which "it can causally affect" (*Nihilism* 321). In regard to space, distance is defined "in terms of the duration required for there to be an interaction" (*Nihilism* 321). This duration only becomes comprehensible through the emergence of space-time, which must be recognized as the condition for this initial emergence (*Nihilism* 321).

Gare's category of ultimate potentiality "opens up the possibility of there evolving a number of space-time orders" (*Nihilism* 321), making coherent "the emergence of a multiplicity of spatio-temporal orders" (McLaren 93). However, these need to be understood as existing under the supervening spatio-termporal order of the universe at large. Gare notes that "since all processes, and the space-time orders they generate, are locatable within the space-time produced by the universe as a whole, it is necessary to acknowledge this as the most basic space-time" (*Nihilism* 321). McLaren argues that:

> There is no Absolute space-time . . . but multiple spatio-temporal orders that are both . . . constituents of the supervening spatio-temporal order of the universe and themselves . . . constituents and supervening spatio-temporal orders relative to other spatio-temproal orders. (McLaren 93)

Space-time is relational and hierarchical; we create time and space relational to our experience. This process also occurs at other levels of existence. For instance, space-time at a cellular level is small and fast, relational to the metabolic reactions taking place. These same cells help constitute humans, with our space-time larger and slower relational to *our* experience. As organisms, we help constitute the biosphere, which has its

own space-time parameters, which helps constitute the solar system, which has its own space-time parameters, and so on. However, this all exists within the overarching space-time generated by the universe, which is bigger and slower than the space-times that help constitute it.

We can understand Gare's cosmology as follows: prior to order, there is only disorder. As activity is spontaneously constrained, structures are created, and in relation to these structures, space-times emerge. Inherent in all activity are unrealized potentialities dependent upon initial conditions in order to become. Unlike Platonic Forms, these potentialities are not static and eternal, but subject to change based on the initial conditions. These are in turn dependent upon supervening and mutually informing processes. Everything that exists is a process of becoming and is maintained through a multiplicity of causative processes. As processes and structures develop agency, they exist in dialectical tension with not only their subordinate processes, but also with their supervening processes. While we can trace all activity back to the Big Bang and the emergence of order that followed, all causes since cannot be conceived of as unidirectional. Smaller, emergent processes can influence the supervening processes that they themselves help constitute. That is to say, they can also influence the initial conditions for their own existence.

PART II: POSTMODERN SCIENCE

Advances in post-mechanistic science are consistent with Gare's metaphysical categories. In what Best and Kellner describe as "the postmodern turn," science has shifted away from the mechanistic, reductionistic, and deterministic worldview of Newtonian physics (195). This "new science" overturns the static view of the world and reinterprets it as being "constituted by forces of diversity, evolution and instability … [through] a complex dialectic of order and disorder" (Best and Kellner 203). The three main branches of influence in postmodern science include thermodynamics, quantum mechanics, and chaos theory (Best 189).

Thermodynamics and Dissipative Structures

Thermodynamics is a scientific field that emphasizes activity and irreversibility. It is the dynamics of heat property that describes the processes by which "heat propagation gradually leads to homogenization and equilibrium of thermal properties" (Best and Kellner 204). Thermodynamics

emerged at the beginning of the nineteenth century in Fourier's descriptions of heat flows (Gare, *Nihilism* 335). Carnot elaborated on these, formulating the principle of irreversibility: that once fuel is used, it disappears as fuel forever (*Nihilism* 336). Coining the term "entropy," Clausius described how energy is conserved and established the first two laws of thermodynamics (the conservation of energy and the increase in entropy) (*Nihilism* 336). The four laws of thermodynamics are:

i. Zeroth Law: The Concept of Temperature
ii. First Law: The Conservation of Energy
iii. Second Law: The Increase in Entropy
iv. Third Law: The Unattainability of Zero

The Zeroth law (so named due to its later inclusion after the other three laws) addresses the concept of temperature. Temperature is the "parameter that summarizes the relative populations of energy levels in a system at equilibrium" (Atkins 11). A "system" is that which is at the center of attention in thermodynamics, with everything outside the system referred to as the "surroundings" (Atkins 1). Systems can be open or closed, with a system considered "open" if it is in interaction with, and influenced by, its surroundings. In contrast, a closed system is isolated from its surroundings.

Temperature is the property that reveals whether closed systems will be in thermal equilibrium, or whether there will be a consequent state of change that will continue until temperatures have equalized (Atkins 15). Open systems will experience transfers of heat until the temperature of all systems have equalized, achieving thermodynamic equilibrium. Systems are considered to be in equilibrium if there is no activity—that is, no transfers of heat—occurring. If system A is in thermal equilibrium with system B, and system B is in thermal equilibrium with system C, then system C will also be in thermal equilibrium with system A (Atkins 5).

Increases in temperature lead to increases in activity. As the temperature of a system increases, populations of molecules reach higher energy states. As it is lowered, these populations relax back into lowered states of energy. In this sense, "temperature and turmoil go hand in hand" (Atkins 15). If an increase of heat is introduced into system C, which is an open system and not insulated from systems A and B, activity will occur and these systems will be prompted towards equilibrium. Upon reaching equilibrium, all transfers of heat will cease.

The first law of thermodynamics is the conservation of energy, which dictates that energy can never be created or destroyed (Atkins 16). There will always be the same amount of energy in the universe, and although it is impossible to create or destroy it, it is possible to *transform* it from one state to another (Best 205).

The second law refers to the increase in entropy. Entropy comes from the Greek word meaning "transformation" (Best and Kellner 205) and is used to measure the quality of energy in a system (Atkins 38). Low entropy means high quality energy while high entropy refers to low quality energy (Atkins 38). Entropy can be understood as a measure of disorder: "If energy is stored in an ordered manner . . . then the entropy is low," whereas "if matter and energy are distributed in a disordered way . . . then the entropy is high" (Atkins 48).

Heat can be used to drive "work," which can be defined as "motion against an opposing force" (Atkins 17). In mechanical terms, this could be illustrated as using steam to move a locomotive. However, it is impossible to convert heat entirely into work—nature exerts a tax on all conversions of heat into work, and a portion of energy is always lost to the surroundings (Atkins 41). Therefore, there will always be an overall increase of entropy in the universe when any energy is used or work takes place.

Energy can only transition from concentrated and useable (low entropy) forms of energy into dispersed and unusable (high entropy) forms of energy. A piece of coal can be understood as a portion of stored energy derived from the sun that has been transformed into plant and animal matter and compressed through a process of fossilization into a lump of ordered, combustible energy with low entropy. Once burned, the energy becomes disordered and dispersed, released as heat with high entropy into the atmosphere. This energy is therefore not lost, but *transformed* and scattered into unusable forms.

The second law of thermodynamics is vitally important to understanding all life process on earth. It is through the second law that we are able to move, to act, to think, to develop understanding, and to create works of art and literature. However, as we do all of these things, we spread an overall increase of disorder into our surroundings (Atkins 62).

The third law of thermodynamics refers to the unattainability of zero. As there will always be a net increase in entropy, it is impossible to ever achieve absolute zero temperature: "no finite sequence of cyclic processes

can succeed in cooling a body to absolute zero" (Atkins 82). A "zero" on both Centigrade and Fahrenheit temperature scales does not reflect an *absolute* zero in thermodynamic terms.

From thermodynamics we can understand that the energy in the universe is "increasingly passing from useful to useless states" (Best and Kellner 205). Entropy, which is the measure of disorder and unavailability of energy, documents the irreversible nature of energy transformations in the universe. According to the laws of thermodynamics, "no event or natural state in the present moment is exactly similar to any other event or state in the past or future" (Best 195). This implies "an asymmetry in the relationship between the present, the future and the past," with the universe "seen to be running down to a 'heat death' in which all energy would be uniformly distributed throughout the universe," according to Gare (*Nihilism* 336).

If process metaphysics describes an increase in order from disorder through the constraining of energy, then thermodynamics and the law of entropy represent the opposite, a tending towards increases in disorder arising from once ordered states. While thermodynamics invalidates the atemporal aspect of the Newtonian cosmology through its demonstration of irreversibility in the universe, it also appears to undermine Gare's process view of the world through its description of the linear increase in *disorder* as opposed to order. How can these be reconciled epistemologically?

Non-equilibrium thermodynamics recaptures a sense of order from an otherwise deterministic trend towards complete disorder. Non-equilibrium thermodynamics is a branch of thermodynamics "centered on the study of the generation of new order in thermodynamically far from equilibrium systems" (Gare, *Postmodernism* 127). Whereas linear thermodynamics "describes the stable, predictable behavior of systems" that "remain basically the same at equilibrium" (Prigogine and Stengers 139), non-equilibrium thermodynamics describes the self-organizing nature of living processes. In this sense, a purely mechanical system such as a steam engine can be seen to work according to linear, tending towards equilibrium thermodynamics. By contrast, organic systems work according to non-equilibrium, non-linear thermodynamics. Whereas equilibrium structures are wholly determined by their external parameters (*Nihilism* 337), non-equilibrium (organic) structures maintain a dialogue with their surroundings, spontaneously generating order out of random movement (Best 201). According to White:

> [Non-equilibrium] thermodynamics has revealed that the evolution of a physical system is only partially destined to follow a particular course of development. Under certain "far-from-equilibrium" conditions, random "fluctuations" have the potential to propel a system towards a "bifurcation point" at which the direction of change becomes unpredictable (263).

This "active conception of matter" introduces the notion of "self-organization" or "autopoiesis" as a concept that defines life processes from mechanistic operations (Best and Kellner 206). Life systems are thus not viewed as "machines concerned with the uniform manufacture of a product," whether this is a specific task or work to carry out, but rather as "living systems that spontaneously and autonomously create their own conditions of self-renewal through evolving complexity" (Best and Kellner 206). As Dix argues, "living systems are not in equilibrium; they function far from equilibrium at the 'edge of chaos' . . . [in] the realm of complexity and emergence" (14).

Through non-linear thermodynamics, new forms of order emerge from outside fluctuations that "have a dynamics of their own beyond the conditions of their emergence" (*Postmodernism* 127). Non-equilibrium structures are irreversible *dissipative structures*, which are "self-organizing" and have "abrupt, unexpected . . . changes in behavior," leading to new and spontaneous forms of order (Best and Kellner 206). Porush argues that these dissipative structures "seem to have a mind of their own," as "self-organizing systems that locally contradict the second law of thermodynamics" (57).

Unlike deterministic, mechanical systems, which consume energy and spew forth disorder, dissipative structures store and transform entropy in non-linear ways, creating higher forms of order out of disorder. From this comes the concept of *negative entropy* or "negentropy." By "contradicting the general drift toward entropic degradation," dissipative structures spontaneously develop "pockets of negentropy" (White 264).

Such non-equilibrium systems are the conditions for life. Whereas at equilibrium "molecules behave as . . . independent entities" that ignore one another, introducing non-equilibrium "wakes them up," generating "a coherence quite foreign to equilibrium" (Prigogine and Stengers 180-181). This is a similar process to osmosis, in which the difference in salinity between fluids motivates movement between semi-permeable membranes. When disequilibrium is introduced, migration is initiated and

activity occurs. Life processes depend upon such states of disequilibrium in order to be active and to maintain their structure. Taking the external fluctuations of difference, far from equilibrium systems are able to feed upon this flux to "establish their own boundaries and to undergo transition autonomously" (*Postmodernism* 127).

Prigogine and Stengers stress that a system far from equilibrium may be described as "organized" not because it realizes a plan strictly alien to itself or outside itself, but because the amplification of fluctuations occurring at the "right moment" result in favoring one reaction path over a number of "equally possible" paths (176). This is coherent with Gare's category of potentiality, in which unrealized potentialities exist within the initial boundary conditions. As dissipative structures we require nutrition through food as the energy that fuels us; we eat and drink to maintain non-equilibrium energy flows. This flows down hierarchically and enables the cells that constitute us to metabolize and to stimulate the chemical reactions that help maintain our structure. As conscious processes, we need to exercise autonomy to interact with this food. If nutrition is scarce, we lose our capacity to maintain ourselves. Likewise, the degree and quality of food available will impact upon our ability to act, think, thrive, or die. Thus, there is only a degree of relative autonomy in dissipative structures, as they depend upon external, initial conditions in order to *have the potential* to maintain their structure and to achieve autonomy. Organelles can be understood as the semi-autonomous dissipative structures that make up cells, which are the semi-autonomous dissipative structures that make up organs, which are the semi-autonomous dissipative structures that make up human beings, and so on. At each level, these dissipative structures rely upon the conditions afforded to them by their supervening processes, which they in turn constitute, in order to maintain themselves. At a larger scale, the earth can be understood as a complex of dissipative structures that we help constitute and which provides us with the conditions to be able to live and act within it.

According to Gare, "life forms can be conceived of as complexes of dissipative structures emerging from indeterminate physical and chemical processes" (*Postmodernism* 127). These in turn generate indeterminate biological processes (*Postmodernism* 127). Deacon contends that in this context, "being alive does not merely consist in being composed in a particular way . . . [but] in *changing* a particular way. If this process of change stops, life stops" (175). We are never completely stable entities, but rather

exist in a constant state of maintaining flux.

According to Prigogine and Stengers, the universe *had to be in nonequlibrium conditions* at the time of the formation of matter, in that "without nonequilibrium and . . . the irreversible processes linked to it, the universe would have a completely different structure . . . [with] no appreciable amount of matter" (231). If the initial conditions of the universe were in equilibrium, there would be no impetus for action and no energy flows occurring. Likewise, if the universe were to ever reach equilibrium, this would result in an equally inactive state. Thermodynamic equilibrium can therefore be understood as the antithesis of life—especially in regards to a universal heat death. Non-equilibrium thermodynamics provides the conditions for life, with the meaning of life—according to thermodynamics—being *activity.* For Gare, equilibrium thermodynamics therefore reveals "the necessity of conceiving the world as a process of creative becoming" (*Nihilism* 337) and highlights the dynamic state of reality and the fundamental role that change plays in maintaining living systems.

Relativity and Quantum Theory

Advances in physics also support a process-based ontology. Einstein's general theory of relativity and developments in quantum mechanics have not only invalidated the Newtonian cosmology at the micro level, but have thrown into doubt its implications of an ordered universe.

Essentially "a rejection of the Newtonian view of space and time as the containers of moving matter," relativity theory favors an ontology in which space and time are seen as relative to one another as emergent orders of potentiality (*Postmodernism* 125). According to Einstein's general theory of relativity, "mass is no longer the property of matter," but the product of *motion* and *activity* (*Postmodernism* 125). Developed in 1905, Einstein's theory of relativity states that:

i. All inertial frameworks are equivalent for the description of all physical phenomena.
ii. The speed of light in empty space is constant for every observer, regardless of the motion of the observer or the light source. (Blackburn 326)

The consequence of this theory is that while light is constant, "space, time, and mass become relative to the observer" (Blackburn 327). For instance, the same event that occurs for one observer can occur at different times for others, depending upon their relational position to it. When we look out into space at distant galaxies, we are also looking *through time* and into the past, able to observe events that have already unfolded through the pipeline of a space-time provided by light.

By introducing relativity into the scientific framework, Einstein "broke down the divide between subject and object" as two distinct "things" existing in space and time (Best and Kellner 211). Rather it is the *relationship* between them that truly matters. This relationship between subject and object has been shown to be interdependent rather than strictly opposed. "There is no inertial point in the universe that is absolute, constant, or privileged . . . everything is moving relative to everything else" (Best and Kellner 212). This undermines the classic concept of objectivity (Prigogine and Stengers 218) and has revealed "how all knowledge in the world is situated within a process of becoming" (*Nihilism* 328). It has also demonstrated how spatio-temporal orders emerge. It is the ordering of activity into patterns of *relations* that creates spatio-temporal orders (*Nihilism* 329). Therefore, "it is no longer possible to conceive of these relations…in terms of a set of continuous Cartesian co-ordinates" (*Nihilism* 329). Rather, space and time must be defined in relationship to one another.

Einstein also identified matter as energy (Best and Kellner 212), which conforms to the process view that activity constitutes things through its ordering and constraint. Gare argues that through relativity theory, "it is possible to develop a better understanding of energy as activity and its relationship to matter as mass," with mass understood as "the sum of both inward and outward activity" (*Nihilism* 330). Thus, matter can be understood as the structures that are maintained and held in the dialectical tension of colliding processes arising from initial disorder. By breaking with the mechanistic conception of the universe as composed of separate parts, Einstein instead saw reality as a "unified field," which anticipated "the holistic logic of quantum theory" (Best and Kellner 212).

Best and Kellner describe quantum theory as "the culmination of [the] postmodern movement against mechanistic science" (213). Initially developed by Max Planck in 1900, quantum theory was "the first serious scientific departure from Newtonian Mechanics" (Blackburn 314). Concerned primarily with the interaction between matter and radiation (Prigogine

and Stengers 219), this theory postulated that "certain physical properties can only assume discrete values" (Blackburn 314). Unlike Aristotelian and Newtonian theories, which contended that matter only moves in "smooth and continuous" ways, "Planck discovered that atomic oscillators emit energy in abrupt, discontinuous bursts," involving "packets of energy" called "quanta" (Best 197). By 1927, quantum mechanics was established as a coherent theory when Louis de Broglie introduced the idea that a particle may also be regarded as a wave (Blackburn 314).

While quantum mechanics "acknowledges the validity of Newtonian laws . . . in the macroscopic world," it explores "a new subatomic world where indeterminacy prevails and the behavior of matter fails to conform" to these laws (Best and Kellner 213). As a result, quantum mechanics "requires the abandonment of a number of basic assumptions of classical physics" (*Postmodernism* 215). The first of these is observation and objectivity: no "independent reality" can be abstracted (*Postmodernism* 215). Observation needs to be treated as a whole, and the subjective and the objective cannot be separated. Quantum action is indivisible and "transitions between stationary states are discrete." Systems can move from one state to another "without passing through intermediary states" (*Postmodernism* 215). Matter exhibits a "wave-particle duality" in which particles behave sometimes like a wave and sometimes like a particle, "but always in certain ways like both together" (*Postmodernism* 215). This flickering between states introduces the idea of a "quantum leap"—an illogical or discontinuous transition from one state to another. Finally, "it is impossible to predict in detail what will happen in each individual observation," which implies some degree of indeterminacy inherent in the world (*Postmodernism* 215).

According to Best and Kellner, the fundamental insight of quantum mechanics is that in the process of observing and perceiving subatomic particles, scientists inevitably influence their behavior (Best and Kellner 214). The thought experiment called "Schrödinger's cat" demonstrates how this is possible:

> A cat is locked in a box with a capsule of cyanide, which will trigger if an atom in a radioactive substance in the box decays. There is a 50% chance of this happening. Otherwise, the cat will be alive. The system is in an intermediate state, but when we look we will find either a dead or alive cat. Quantum mechanics forces us to say that the cat is both dead and alive until we observe it. (Blackburn 343)

When we observe a quantum particle, we interact with the conditions and determine what we see. Indeterminate systems then become determinate when an observation is made. As a result, "quantum mechanics has no choice but to postulate the coexistence of two mutually irreducible processes" (Prigogine and Stengers 228).

Similarly, Heisenberg's uncertainty principle states that both the coordinates and the momentum of a particle cannot have well-defined values (Prigogine and Stengers 223). According to Prigogine and Stengers, "we can make [coordinates] as small as we want, but then [momentum] goes to infinity, and vice versa" (223). The more we measure one aspect of quantum reality, the less we can measure the other. Heisenberg's uncertainty principle means that we can never be completely certain, and this leads to a revision of the concept of causality (Prigogine and Stengers 224).

Scientists cannot identify "both the position and velocity of a subatomic particle," and so must choose which aspect of reality to measure in the most accurate manner (Best and Kellner 214). In doing so, they must acknowledge the existence of the unknown and immeasurable attributes. Whereas classical physics views the notion of objectivity as describing *a system as it is in its totality*, quantum mechanics shows that it is impossible to do so (Prigogine and Stengers 225).

While quantum mechanics can be regarded as highly reductionist in the sense that it reduces reality to a miniscule, subatomic level, it ironically invokes the acceptance of vagueness, indeterminacy, and imprecision. The reductionist, analytic approach to nature has found that reality is intrinsically indeterminate and chaotic.

Chaos and Complexity

Chaos theory indicates the unpredictability in deterministic systems. Best and Kellner argue that "like quantum mechanics, chaos theory is a dynamic view of reality . . . that understands the behavior of matter to be . . . complex and unpredictable" (219). Beginning with Kurt Gödel's undecidability theorem in which "no formal system of arithmetic can be complete…[or] entail all its truths . . . within the logic of the system" (Best and Kellner 216), chaos theory is "a field . . . in applied mathematics that studies the behavior of dynamical systems that tend to be highly sensitive to initial conditions" (Deacon 548).

While "chaos" typically implies erratic behavior, complexity theorists

understand chaos "in terms of complex order and 'limited predictability'" (Best and Kellner 220). A distinction is therefore drawn between sheer "noise" and "chaos," with the latter yielding complex patterns (Best and Kellner 220). While modern science typically looked for "simple and repeatable regularities, laws, and causal mechanisms," and came to view "chaos and complexity . . . as negative [constraints]…to overcome," complexity theorists take this underlying chaos as a new way of comprehending and interpreting natural processes (Best and Kellner 220).

In chaotic systems small differences in the initial conditions can produce large differences in later states. That is, in chaotic systems, change is not equivalent; it is amplified. While chaotic systems can thus in a sense be deterministic, they are not predictable (Blackburn 61). Conversely, "even the most simple deterministic systems can be highly complex and operate in non-predictable ways" (Best 200). Like relativity and quantum mechanics, chaos theory adopts "a relational logic" that views entities and events as existing "within a larger whole or relational field" (Best 213). In chaotic systems there is a dialectic between order and disorder, in which "any appearance of deterministic order must be seen as emerging from an indeterminate order . . . at one level, while generating unpredictable outcomes at another" (*Nihilism* 337).

Complexity theorists have found that from seemingly random conditions, new forms of order and disorder can emerge and coexist (Best and Kellner 220). This has enabled scientists to see and appreciate previously unknown patterns, structures, and order, as well as the disorder that constrains this order (Best and Kellner 220). Chaos, as form-giving dynamic change, becomes the principle for the universe as a whole (Best and Kellner 220-221).

Hierarchy Theory and the Emergence of a Self-Aware Universe

Through complexity theory, the emergence of order from quantum chaos can be made intelligible. This is achieved through hierarchies of constraint. Hierarchy theory explains how, from the initial conditions of the Big Bang, life and consciousness can emerge in the universe.

According to Bickhard and Campbell, at its origin the universe itself "was a superhot flux of quantum fields." Everything that has emerged since is "the result of condensation, symmetry breaking, and organization out of that original flux" (Bickhard and Campbell 326). These quantum

fields are understood as processes that can only exist in various patterns (Bickhard and Campbell 331). They are not static "things," but active phenomena. Order arises from the combination and stabilization of quantum quarks, which represent the "building blocks" of the universe (*Nihilism* 332) coming into unison with one another to form "atoms, which combine chemically to form molecules, which combine gravitationally to form planets . . . rocks, water, cats, humans, and . . . minds" (Bickhard and Campbell 326).

This is consistent with thermodynamics. Lovelock maintains that our own solar system "must have been formed in close in conjunction with a supernova event" (Lovelock 16), with the amount of light, heat, and radiation produced by such a supernova event equal to "the total output of all the other stars in the galaxy" (Lovelock 15). This conforms to the laws of thermodynamics, in which energy cannot be *created* or *destroyed* but only *transformed*. From a supernova event the energy released is constrained into new levels of order in the form of stars, which in turn radiate energy (as high entropy chaos) that can be constrained and transformed into higher forms of order.

Therefore, while we can accept that everything is merely "organizations of quantum processes" (Bickhard and Campbell 330-331), this view is not a reductive ontology, as it is the *organization* of these quantum processes that is "emergent and ontologically real" (Dix 15). These quantum fields therefore need to be understood as being *more than the sum of their parts*. The emergence of life and mind must therefore be understood as a product of this process of cosmic evolution, with all values and meanings derived from the initial, chaotic conditions released in the Big Bang.

Consequently, life and the development of meaning on earth must be viewed as a product of this process of cosmic evolution and emergence. Deacon argues that "there was nothing resembling a function on Earth until just over 3 billion years ago," with "no hint of mental awareness…until just a few hundred million years ago" (144). Nothing was considered "right or wrong, valuable or worthless, good or evil," until the first humans began thinking in symbols (Deacon 144). Deacon describes such "major transitions" as emergent due to their spontaneous appearance. While they are not "something . . . from nothing," they have a quality of discontinuity about them (144). In this sense, they can be conceived as something novel and *profound* emerging from something that is otherwise chemically unremarkable. Thus, emergence is a concept "used to describe

the way that living and mental processes depend upon chemical and physical processes," yet these are able to exhibit properties that are *foreign* to non-living processes (Deacon 549). This accounts for the "discontinuous transition" from causal properties to higher levels of complexity, which involve increases in scale "in which lower-order component[s] … contribute global properties that . . . [are] irreducible to lower-order interactions" (Deacon 549).

Therefore, we can understand the emergence of order out of chaos to be hierarchical, with hierarchy theory involving "a theory of observation in the face of complex systems" (Ahl and Allen 200). According to Dix, "hierarchy theory provides an understanding of contexts of emergence," and explains how emergent properties "can be self-organizing contexts for [further] emergence" (13). Hierarchies are seen to organize not as "a series of connections, but . . . [as] a series of constraints" (Allen and Starr 11). For instance, the ecological hierarchy must be considered "logically prior to the genealogical hierarchy" (Salthe 192), and thus, human beings are emergent from, and constrained within, this set of conditions.

Emergence implies activity, and the emergence of life can only be accounted for in process terms. Gare argues that:

> To accord with process philosophy, humanity must be understood as an emergent process or complex of processes within nature, as part of the biosphere, [as] the complex of dissipative structures which has emerged in the thermodynamically far from equilibrium situation maintained on earth by the sun. (*Postmodernism* 132)

It is through such hierarchical emergence that arguments can be made for a universe that is becoming increasingly self-aware. Gare argues that it is "within the creative process of becoming" that organisms have evolved and developed awareness about themselves and the world (*Nihilism* 351). Human beings are seen as "processes which define their environments as their world" through the construction and reconstruction of historical narratives that orient them "to evaluate actual and possible social and cultural transformation" (*Postmodernism* 132-134). It is through participation in these dialectical processes of becoming that organisms are individuated as subjects (*Postmodernism* 137). By developing this sense of self, human beings are able to become more than mere organizations of matter; conceptual thinking indicates higher level, non-physical emergence (although this relies upon physical constraints). Meaning, in the form of narrative

and symbols, can then be understood to have emerged from humans, who are emergent from nature, which is emergent from the universe. This is the nature of hierarchical emergence.

Having developed the capacity "to reflect on the conditions of . . . existence, to take responsibility for its conception of the world . . . and to strive to live life accordingly" (*Postmodernism* 137), humanity represents a self-aware universe. Through communal, intergenerational narrative accrual, humanity has been able to develop a collective consciousness and memory about the world. As human beings are emergent from nature, this amounts to a universe that is capable of actively reflecting upon itself. Even if we accept the reductionist ontology that we are no more than bits of stardust derived from the Big Bang, we cannot ignore our subsequent agency and consciousness in the world. If we accept that we are merely *bits* of the universe, then we are forced to accept that we are the bits of the universe that have become self-aware.

However, the emergence of this consciousness is not planned or absolute; it is thoroughly accidental. Developments in post-modern science show how randomness and irreversibility have become the dominant rules of nature, with reversibility and determinism now understood to apply only in limited and simple cases (Prigogine and Stengers 8). While these developments undermine substance metaphysics, they tend to validate Gare's metaphysics and the process view of the world. Thermodynamics points toward *activity* as the meaning of life, with non-equilibrium transfers of heat a requirement for living systems. Quantum mechanics demonstrates the underlying reality of *flux* that pervades reality, while complexity theory shows how it is possible for higher forms of order to emerge and actively *become* from chaotic and indeterminate systems.

PART III: CAMUS AND ABSURIDTY

While modern science promised clarity and simplification through reduction, we seem to have found the opposite—a world that is increasingly vague and complex. When contrasted with the naturalized assumptions of substance metaphysics, post-modern science presents a world that is properly absurd. The world can now be understood as intrinsically chaotic without any predetermined or unidirectional meaning to life. How, then, are we to come to terms with this absurdity and respond to the meaningless and accidental world from which we have emerged as conscious beings?

The Dialectic of Absurdity

Contrary to the reductionist approach, Camus argues that "what matters . . . is not following things back to their origins," but knowing "how to live in [the world]" (*Fastidious* 2-3). He proposes that to do so, we must confront and embrace absurdity. Generally speaking, what is "absurd" is what is contrary to logic. Camus notes that if something is absurd it typically means that it is impossible or contradictory. He uses the example: "If I see a man armed only with a sword attack a group of machine-guns, I shall consider his act to be absurd" (*Myth* 28).

However, in Camus' philosophical works, man encounters the absurd "when he attempts to understand the world" (Earnshaw 96). As a philosophical concept, the absurd "is born of the confrontation between the human need [for meaning] and the unreasonable silence of the world" (Camus, *Myth* 26). It is "a recognition that the universe is without intrinsic meaning" and that "all human endeavor is ultimately . . . pointless" (Earnshaw 95). Rather than a nihilistic approach to nature, Camus seeks to overcome this. As Petersen notes:

> The works of Camus represent a serious attempt to teach us how to transcend . . . nihilistic lessons and limits. We can learn from Camus to cling passionately to life—despite…our awareness of the meaninglessness of life. (57)

To transcend nihilism, we need to participate in an active engagement with nature and the absurd. Camus can therefore be interpreted as a dialectical thinker, with the absurd condition representing an ongoing dialectic between human consciousness and nature. As Boisvert notes, Camus' "entire intellectual effort was to maintain a position which sought a difficult-to-find middle ground between easy simplifications" (9). As such, the majority of his philosophical work wavers between an overarching "yes" and "no"; that is, a "yes" that accepts the inherent meaninglessness of an indifferent universe, and a "no" that still demands meaning in spite of this.

Opposed to France's philosophical heritage, "which prized clarity, distinctness, and the need for certainty" (Boisvert 9), Camus' philosophy is anti-absolutist and anti-reductionist. Going against the mechanistic thinking that has dominated modern science since the Enlightenment, Camus maintains that while "the laws of nature may be operative up to a certain limit," beyond this limit "they turn against themselves . . . [and]

give birth to the absurd" (*Myth* 35). This is congruent with developments in quantum mechanics, in which Newtonian science breaks down, and science leaves "the realm of common sense," and enters into "a new conceptual plane . . . ruled by paradox and . . . absurdity" (Best 196).

Camus' philosophy is not fixed and like a quantum particle it exhibits a yes-no duality; it requires us to accept both "yes" and "no," while acknowledging that neither of these can ever be total or complete. The more we narrow down to one as a "measurable attribute," the more we feel the glaring absence of the other, which, in its stark omission, bears down on us as an increasingly relevant and ominous missing piece.

Camus argues that a simple "yes" or "no" is "too easy" (*Myth* 5). He insists that "allowance must be made for those…who continue questioning" (*Myth* 5). Camus asks us to embrace neither a simple "yes" nor a simple "no." Rather, we should seek an integrative "yes" that also makes room for a "no" (Boisvert 9). However, this requires going beyond easy simplifications and occupying a much more complex and difficult position.

Insight into the Camusian "yes" is found in the novel *L'etranger*, translated in English as *The Stranger* or *The Outsider. The Outsider* tells the story of a young French-Algerian man, Meursault, who murders an Arab on a beach and is subsequently sentenced to death. When viewed from a traditional standpoint, Earnshaw argues that Meursault presents himself as "amoral and heartless" (Earnshaw 101). Petersen notes:

> He lives without firm commitments and knows responsibility . . . only to himself. He does his daily work mechanically…complies with the rules of decency mechanically . . . [and] fulfills the commands of humanity minimally. (45)

Meursault is a man at the mercy of existence: "He allows impressions and influences to come and affect him as they will. He is like a house without doors. He feels, but he never analyzes his feelings" (Petersen and Gode 45). He is pushed and pulled by events, persons, and conventions without really believing in them. Somewhat selfish and indulgent, he does what he feels without recourse to a higher meaning other than to his own surface level sense experience. When asked why he killed the Arab, Meursault simply answers "because of the sun" (Ellison 56). While at his trial this response is met by "derisive laughter" (Ellison 62), thermodynamically there is more to this than perhaps even Camus intends.

The sun features predominantly in *The Outsider* as an ever-present,

oppressive, literary device that plays a pivotal role in dictating Meursault's actions. As Ellison notes, "Meursault is driven to commit his crime by a force that seems to reside outside himself, [and] outside his conscious will" (Ellison 52). For example, Meursault describes the moments leading up to his crime:

> The Arab drew his knife and held it out towards me in the sun. The light leapt up off the steel and it was like a long, flashing sword lunging at my forehead . . . . All I could feel were the cymbals the sun was clashing against my forehead and, indistinctly, the dazzling spear still leaping up off the knife in front of me . . . like a red-hot blade gnawing at my eyelashes and gouging out my stinging eyes…the sky seemed to be splitting from end to end and raining down sheets of flame. My whole body went tense and I tightened the grip on the gun. (*Outsider* 60)

Meaursault pulls the trigger, not because he intends to kill, but because the sun compels him to do so. Although he then fires four more bullets into the lifeless body, this merely demonstrates the arbitrary nature of the latter bullets; the Arab is already dead, so these shots represent a meaningless action.

Even if Meursault's killing of the Arab is a conscious decision, it is still quite literally a product of the sun—it is the heat of the sun that is transformed into all human thought and action in the world. Thermodynamically, it is correct to say that the sun caused Meursault to kill the Arab. However, this is a reductionist view of thermodynamics and one that would seemingly seek to account for *all* actions in the universe as predetermined. For the purposes of demonstrating indifference in the world, however, it could be argued that thermodynamically Meursault is not at fault.

However, his crime is not so much the murder, but the fact that he refuses to lie in order to avoid death. Meursault could argue convincingly that the Arab attacked him first. But for Meursault, that would be a lie; it was the sun. While Meursault appears cold and unfeeling, Camus notes that Meursault is simply someone who refuses to lie:

> Meursault doesn't play the game . . . he refuses to lie. Lying is not only saying what isn't true. It is also . . . saying more than is true and, in the case of the human heart, saying more than one feels. We all do it…to make life simpler. But, contrary to appearances, Meursault doesn't want to make life simpler. (*Outsider* 118)

Meursault has an extreme commitment to truth in the sense that he refuses to commit wholly to something he knows *cannot be true*. Camus notes that Meursault ultimately represents "the Christ we deserve" as "a man who, without any heroic pretensions, agrees to die for truth" (*Outsider* 119). Meursault therefore maintains a high degree of integrity as a "man who consistently keeps faith with his truth and will not deny it or betray it at any price" (Petersen and Gode 45). He is thus the outsider "in a world standardized by the aesthetic conventions that men use to conceal from themselves . . . the ultimate impossibility of unraveling the meaning of life" (Petersen and Gode 49).

One could argue that Meursault has come to terms with complexity and indifference in the extreme. Rather than being overawed or defeated by it, he is comforted by the truly remarkable nature of his own existence:

> I looked up at the mass of signs and stars in the night sky and laid myself open to the benign indifference of the world. And finding it so much like myself, in fact so fraternal, I realized that I'd been happy, and that I was still happy. (*Outsider* 117)

Aspiring "to a state of primordial innocence and tranquility that is inaccessible in reality" (Ellison 66), Meursault dies for truth; he accepts an absolute "yes" through his commitment to the true indifference of the world. The world that he dies for is "fraternal" and "so much like [himself]," it is as if he and it were one and the same; that he had emerged from it and upon death would return to it, thereby ending the absurd confrontation that occurs between the self and the world.

An extreme acceptance of indifference, *The Outsider* forms only one-half of Camus' dialectic. For Camus, an absolute "yes" is not enough. As Boisvert notes, "[Meaursault's] was such a cold, emotionless, indifferent life . . . some 'no,' some rebellion, would give it flavour as fully human" (9). This is where the Camusian "no" takes into account human agency in an otherwise meaningless world.

This "no" is found in his later novel *La Peste*, translated in English as *The Plague*. An analogy for occupied France during the Second World War, the plague documents not only the cruel nature of an indifferent world, but also celebrates those who rebel and say "no." In *The Plague* Camus shows that "humans need not see themselves as fully woven into the fabric of things," and that "humans can revolt" (Boisvert 10). In responding to the plague, some in the city adopt a defeatist perspective,

while others pool their efforts to confront it (Ellison 97). The plague is nihilistic and destructive; it kills men, women and children indiscriminately with no regard for life. It is the ultimate indifference. Camus' argument is that while the world may be indifferent to us, we cannot afford to be indifferent to it (Boisvert 10); we can engage with an indifferent world, we can influence it, and we can feed on the flux of indifference to create, for instance, pockets of negative entropy to sustain life.

However, an absolute "no" is just as problematic as complete indifference—it refuses to relinquish any sense of control or indeterminacy to the universe. Again, when this concept is drawn to an extreme, reductionist conclusion, it vindicates the modernist quest to control and destroy nature entirely. It presents a resistance to complexity, favoring simplicity, calculability, passivity, and domination. We cannot embrace an absolute "no" and we cannot seek to control the world entirely. We cannot do this precisely because it is indifferent, it is complex, and it is practically uncontrollable.

The Question of Suicide

Camus' dialectic is also accompanied by a staunch rejection of suicide. In *The Myth of Sisyphus* Camus asserts that there is only one serious philosophical question, and that is suicide; of whether or not taking one's own life can be justified as the logical solution or inevitable consequence to the absurd (Ellison 69). Using the Greek myth of Sisyphus as an example, Camus' answer is a resounding "no." Life is worth living.

In the Greek myth, Sisyphus is punished for attempting to avoid death and must ceaselessly roll a rock to the top of a mountain. Upon reaching the top of the mountain, the rock falls back to earth and Sisyphus is condemned to repeat this process for all eternity. Usually interpreted as an allegory for the torturous grind of meaningless existence, Camus inverts this, maintaining that "one must imagine Sisyphus happy" (*Myth* 119). Sisyphus' labor is "the price that must be paid for the passions of this earth" (*Myth* 116), since for Sisyphus the alternative is death. Camus argues that "if this myth is tragic, it is because its hero is conscious." However, it is also this same consciousness that crowns Sisyphus' victory (*Myth* 117).

Camus asks, "is one to die voluntarily or to hope in spite of everything" (*Myth* 15)? Meaninglessness is the price we pay for conscious existence.

Like Sisyphus, we are continually pushing our rock, which is our existence, forward. Our "torture" is our insatiable quest to find absolution in an indifferent world. However, this quest is one worth having, especially if the only alternative is death. That we have consciousness in an indifferent world is our victory and it is this miraculous gift of life that we must cling to. As Petersen and Gode note, *The Myth of Sisyphus* teaches us that:

> Man…has the duty to take a stand against death with all the freedom of the mind he can muster, with all the passion of his heart, for beyond death no realm of extraterrestrial hope is awaiting him. (53)

Camus places the highest value on life above all else, arguing that:

> Absurdist reasoning . . . recognizes human life as the single necessary good, because it makes possible that [absurd] confrontation . . . because without life the absurdist wager could not go on. To say that life is absurd, one must [first] be alive. (*Fastidious* 5)

Suicide is not a logical answer to the absurd, since it follows that "he who commits suicide disavows the absurd" by acknowledging "the possibility that death, by contrast to life, may have a meaning" (Petersen and Gode 54). Camus notes:

> One kills oneself because life is not worth living, that is certainly a truth…but does that insult to existence, that flat denial in which it is plunged, come from the fact that it has no meaning? (*Myth* 7)

Because "dying voluntarily implies that you have recognized . . . the absence of any profound reason for living," Camus asserts that those who commit suicide are more certain about life than those who choose to continue existing (*Myth* 4). By contrast, "to live" is to always have the absurd in front of us, to contemplate it . . . [and to] always have present our confrontation between the world and our obscurity" (Earnshaw 98). The Camusian ethic of absurdism demands that we do not negate the absurd through death, but rather, live in spite of it.

Analytical Thinking and Suicide

As with suicide, Camus rejects murder, with both murder and suicide amounting to the same thing (*Fastidious* 5). However, we find ourselves in increasingly suicidal times. Despite our best efforts to control the natural world, the likelihood of environmental collapse presents both murder

and suicide as realistic prospects for human civilization. The problem lies, as Whitehead might put it, in "the fallacy of misplaced concreteness" (Whitehead 64). That is, there is an inherent problem with concrete, analytical thinking that predisposes it towards suicide.

Certainty and absolution are characteristic of suicidal individuals. Baumeister argues that "suicidal thinking is very concrete," with "tunnel vision" the term coined to describe the "narrow, concrete focus" of the psychological state preceding suicide attempts (100). Baumeister notes that suicidal individuals enter into a "cognitively rigid state" in which they reject integrative meanings and avoid "new ideas, thoughts or interpretations" (101). Furthermore, suicidal people tend to be "unusually neat, meticulous, fastidious, and otherwise very concerned about details," displaying what Baumeister describes as "low-level thinking" (101). Whereas people facing involuntary death tend to write in "abstract, meaningful terms," genuine suicide notes are "severely concrete," and "devoid of abstract terms and other expressions of higher mental awareness" (Baumeister 100). For example, a genuine suicide note is likely to include specific, mundane instructions, like "don't forget to pay the electricity bill," while forged notes will exhibit proof of meaningful, long term cognitive functions such as "teach my son to be a good man" (Baumeister 100). This narrow, short-term focus of suicidal individuals is one of certainty and supposed clarity; as Camus argues, to take one's own life, one must be sure that life is not worth living. By contrast, to go on living is to continue with uncertainty.

Baumeister also notes that suicide is often "preceded by events that fall short of high . . . expectations," with evidence of suicidal people having "unrealistically high standards" (95). Reductive science, which values clarity and explicit detail, can be understood as an implicitly suicidal mode of thought. Not only does the concrete rigidity of analytical thinking resemble that of a suicidal person, the quest for absolute knowledge sets an unrealistically high standard that is doomed to fail in a world that is, by nature, indeterminate. Adopting this kind of analytical thinking makes it easy to ignore and block out the complexity of reality. It should be no surprise, then, that we find ourselves poised for environmental collapse, given the prevalence of this kind of thinking.

In the face of an indifferent universe, analytical thought is not only impotent, it is also dangerous. Analytical thinking sets a precedent for ecocide in its demand for absolute clarity without any vagueness. This is

incompatible with the intrinsically vague, dynamic, and indeterminate nature of life and living systems. We can therefore associate simplistic, binaristic, and low-level thinking with suicidal individuals, with suicide being a rejection of indeterminacy.

By contrast, Camus' philosophy requires both an integrative "yes" and "no," which entails a degree of vagueness and high-level thinking concerning which suicidal people are not capable. Attempting to understand the world in analytical terms is "absurd" only in the sense that it is akin to attacking a group of machine-guns armed only with a sword. Again, as Camus says:

> Lying is not only saying what isn't true. It is also . . . saying more than is true and, in the case of the human heart, saying more than one feels. We all do it…to make life simpler. (*Outsider* 118)

However, life isn't simple. Tarrou, a character who resists in *The Plague*, notes that "the most appalling vice . . . [is] the ignorance that thinks it knows everything and which consequently authorizes itself to kill" (*Plague* 101). We can apply this to the reductive mindsets that undermine our ecosystem through their barefaced denial of complexity—for instance, the ignorance that would reduce all of reality to simplistic economic values and seek to live life according to them. This is an ignorance that has proven to be profoundly dangerous and ecocidal.

We must resist these simplifications that disavow the complexity of life and the absurd. Camus further argues through Tarrou that:

> What is natural is the microbe. The rest—health, integrity, purity, if you like – are an effect of will and a will that must never relax. The decent man, the one who doesn't infect anybody, is the one who concentrates most. And you need will-power and nervous tension not to let your mind wander! Yes . . . it is very tiring being a plague victim. But it is still more tiring not to want to be one. This is why everyone is a little infected. But this is why a few, who want to cease to be victims, experience an extreme form of tiredness from which nothing except death will deliver them. (*Plague* 195)

In regards to truth more broadly, we must recognize it as a process of becoming and maintain a nervous tension between "yes" and "no." Like Sisyphus, we must continually push our rock, constantly questioning and never relaxing back into binary simplifications. Process philosophy, as the ontology of becoming, is also the ontology of this nervous tension and in this sense can be understood as the metaphysics of absurdity.

Conclusion: The World Is Not A Stage

In his play *As You Like It*, Shakespeare's character Jaques famously states that "all the world's a stage, and all the men and women merely players." In Christian theology, it was God who created this stage and placed human beings onto it as actors to have dominion over it. Mechanistic materialism has not progressed beyond this. This dominant metaphysics situates human beings outside of nature as beings external to it. Camus describes "this divorce between man and his life, the actor and his setting" as "properly the feeling of absurdity" (*Myth* 5). This opposition between a human being and the world is something that needs to be overcome.

Process philosophy is the tradition that places humanity squarely *within* the world—if the world is a stage it is a stage on which we play an active part. As Rescher puts it: "The world . . . [is not] a museum where objects are displayed but . . . a show where things happen—a theater, as it were, in full productive stir" (174). Postmodern science vindicates this process view of the world. Thermodynamics sees activity as the meaning of life, with nonequilibrium transfers of heat the fundamental requirement for living systems. In terms of thermodynamics, equilibrium and inactivity equate to death. Similarly, quantum mechanics has shown that reality, when reduced to its most fundamental level, is active, random, unpredictable, and objectively unobservable. Quantum particles are non-Parminedean and particularly un-thing-like; they exist in a vague state of wave-particle duality. Complexity theory has shown how it is possible for order to emerge from this chaos and how emergent hierarchies in nature can make life and knowledge possible in a world where randomness rules. While the second law of thermodynamics states that there will always be an overall increase in disorder, chaos theory indicates that from this disorder higher forms of order can emerge. While chaos and entropy might seem antithetical, these processes actually give rise to new and complex forms of order, which are manifested as dissipative structures and negative entropy. Complexity theory therefore accounts for the ways in which otherwise chaotic activity, such as quantum particles or fields of quantum particles, can trend towards higher forms of order. When combined with the second law of thermodynamics, we can see how dissipative structures are able to emerge and achieve order out of chaos.

Meaning, too, is a dissipative structure. It is a higher-level emergence from human beings. However, emergent properties are not wholly constrained

by their conditions; *they are more than the sum of their parts*. Emergent entities have autonomous and transformative qualities over their own conditions. One way in which this has become particularly apparent is in humanity's ability to influence and undermine the Earth's ecosystem. While the biosphere is a supervening structure that human beings are constrained within, the agency of human beings as emergent processes enables us to transform and influence our initial conditions. Just as human beings have a degree of autonomy within the ecosystem, emergent values and meanings like "justice" have a degree of autonomy over human beings. These relationships are non-linear, and concepts can influence humanity just as humanity can create, define, and redefine concepts in an ongoing dialectic.

That the world is without designer or meaning is what makes life all the more remarkable. We exist solely by virtue of our miraculous emergence from the many possible worlds inherent in the initial conditions of cosmic potentiality. The absurd condition is an invitation to live in spite of this lack of prescribed meaning. By adopting the Camusian approach to this absurdity, we gain insights into how we can come to terms with an indifferent and complex world. There is consolation in this indifference, as with Meursault, but there is also a challenge that needs to be taken up. This is the challenge of existence in the face of indifference. Gare's process philosophy is coherent with Camus in that it provides an ontology that is never fixed, never final, and never relaxed. By interpreting Camus through this process framework, we can overcome the absurdist opposition between human beings and nature. Taking into account the process notion that human beings help constitute nature, we go some way towards finding Camus' elusive middle ground between "yes" and "no." This middle ground is what occurs in the vague spaces generated by disorder and order—the spaces between an absolute "yes" and an absolute "no." Therefore, from the benign indifference of the world, we can argue that meaning(s) can and do emerge.

In regards to ecosystems, we need to acknowledge the limits of our own capabilities and understand that total control and understanding will always be impossible. However, we also need to recognize the agency we have as conscious beings within this system. It is not enough to say that we are just the products of thermodynamic equations or chaotic quantum particles. While it is true that we exist as dissipative structures composed of arbitrary chemical reactions and quantum fields, the fact that we *are*

these structures means that we have the capability to be much more than this. We can make decisions about *how* we maintain our structure and integrity in a complex world. We have the capacity to act in an indifferent world and to create—not find—meaning.

Human life is fragile and accidental. Ultimately, we are at the mercy of the universe. As Clark notes:

> Early in 2002, the earth experienced a near-miss: an asteroid passed within a whisker . . . of the planet. Had it struck, it would have done so with a force six hundred times greater than the bomb dropped on Hiroshima. No observer saw it coming, and it was tracked only after it had passed. (559)

There will always be things beyond our knowledge and control. The universe is indifferent—there are absurd asteroids hurtling through space that could very well destroy us—but that doesn't make it meaningless. It is meaningful because we exist within it and are able to attribute meaning to it. While it is possible that there are pockets of conscious life elsewhere in the universe, it is also possible that there are not. There is every chance that an asteroid could wipe out life on earth, but there is also the possibility that this may not occur. What we do know is that we have emerged from nature as conscious beings and we are capable of maintaining or destroying life on earth through our actions. Gare notes that while many species become extinct because they undermine the environmental conditions for their existence, he argues that due to our conscious engagement with the world, "unlike other species, the extinction of humans will be … [our] own responsibility" (*Nihilism* 375). For now, we risk destroying the only conditions for known conscious existence in the universe. We have decisions to make about how we live in the world. Do we maintain the systems and hierarchies that provide the conditions for existence, consciousness, and meaning to emerge, or do we actively destroy them? Do we commit ecocide, which is tantamount to suicide, or do we keep pushing our rock?

WORKS CITED

Ahl, Valerie, and T. F. H Allen. *Hierarchy Theory: A Vision, Vocabulary, and Epistemology*. New York: Columbia U P, 1996.

Allen, T. F. H., and Thomas Starr. *Hierarchy: Perspectives for Ecological Complexity*. Chicago: U of Chicago P, 1982.

Atkins, Peter. *The Laws of Thermodynamics: A Very Short Introduction*. Oxford: Oxford U P, 2010.

Baumeister, Roy F. "Suicide As Escape From Self." *Psychological Review* 97 (1990): 90-113.

Best, Steven. "Chaos and Entropy: Metaphors in Postmodern Science and Social Theory." *Science as Culture* 2.11 (1991): 188-226.

Best, Steven, and Douglas Kellner. *The Postmodern Turn*. New York: Guilford P, 1997.

Bickhard, Mark H., and Donald T. Campbell. "Emergence." In *Downward Causation: Minds, Bodies and Matter*. Ed. P.B. Anderson, et al. Aarhus: Aarhus U P, 2000: 322-348.

Blackburn, Simon. *Oxford Dictionary of Philosophy*. Oxford: Oxford U P, 1994.

Boisvert, Ray. "Camus: Between Yes & No." *Philosophy Now* 98 (2013): 8-10.

Bowler, Peter J. *The Earth Encompassed: A History of the Environmental Sciences*. New York: W.W Norton & Company, 1992.

Camus, Albert. *The Outsider*. Tr. Joseph Laredo. London: Penguin, 2000.

___. *The Myth of Sisyphus*. Tr. Justin O'Brien. London: Penguin, 2005.

___. *The Fastidious Assassins*. Tr. Anthony Bower. London: Penguin, 2008.

___. *The Plague*. Tr. Robin Buss. London: Penguin, 2009.

Clark, J. C. D. "Providence, Predestination and Progress: Or, Did the Enlightenment Fail?" *Albion: A Quarterly Journal Concerned with British Studies* 35.4 (2003): 559-589.

Deacon, Terrence W. *Incomplete Nature: How Mind Emerged from Matter*. New York: W.W Norton & Company, 2012.

Dix, Michael. "Living and Knowledge: How Nature Makes Knowledge Possible." *Cosmos and History: The Journal of Natural and Social Philosophy* 9.1 (2013): 1-34.

Earnshaw, Steven. *Existentialism: A Guide for the Perplexed*. New York: Continuum, 2006.

Ellison, David R. *Understanding Albert Camus*. Columbia: U of South Carolina P, 1990.

Gare, Arran. *Postmodernism and the Environmental Crisis*. London: Routledge, 1995.

___. *Nihilism Inc.: Environmental Destruction and the Metaphysics of Sustainability*. Como: Eco-Logical Press, 1996.

Kirkpatrick, Andrew. "Modernity, Post-Modernity, and Proto-Historicism: Reorienting Humanity Through a New Sense of Narrative Emplotment." *Cosmos and History: The Journal of Natural and Social Philosophy* 10.2 (2014): 22-77.

Lovelock, James. *Gaia: A New Look at Life on Earth*. Oxford: Oxford U P, 1979.

McLaren, Glenn. "Unifying Process Philosophy: Secular Metaphysics and Fragmentary Influences." *Applied Process Thought I: Initial Explorations in Theory and Research*. Ed. T. Kelly and M. Dibben. Frankfurt: Ontos Verlag, 2008: 43-118.

Petersen, Carol, and Alexander Gode. *Albert Camus*. New York: Frederick Ungar Publishing Co., 1978.

Porush, David. "Fictions as Dissipative Structures: Prigogine's Theory and Postmodernism's Roadshow." In *Chaos and Order: Complex Dynamics in Literature and Science*. Ed. N. K. Hayles. Chicago: U of Chicago P, 1991: 54-84.

Prigogine, Ilya, and Isabelle Stengers. *Order Out of Chaos: Man's New Dialogue with Nature*. London: Heinemann, 1984.

Rescher, Nicholas. *Process Metaphysics: An Introduction to Process Philosophy.* Albany: State U of New York P, 1996.

Salthe, Stanley N. *Development and Evolution: Complexity and Change in Biology.* Cambridge: MIT P, 1996.

Toulmin, Stephen. *Cosmopolis: The Hidden Agenda of Modernity.* Chicago: U of Chicago P, 1990.

White, Eric Charles. "Negentropy, Noise, and Emancipatory Thought." In *Chaos and Order: Complex Dynamics in Literature and Science*. Ed. N.K. Hayles. Chicago: U of Chicago P, 1991: 263-277.

Whitehead, Alfred North. *Science and the Modern World*. 1925. New York: Free Press, 1967.