

Emergence and Agency

with Mikael Leidenhag, “*The Relevance of Emergence Theory in the Science–Religion Dialogue*”; Steven L. Peck, “*Life as Emergent Agential Systems: Tendencies without Teleology in an Open Universe*”; and Joseph A. Bracken, “*Actions and Agents: Natural and Supernatural Reconsidered*”

LIFE AS EMERGENT AGENTIAL SYSTEMS: TENDENCIES WITHOUT TELEOLOGY IN AN OPEN UNIVERSE

by Steven L. Peck

Abstract. Life is a relationship among various kinds of agents interacting at different scales in ways that are multifarious, complex, and emergent. Life is always a part of an ecological embedding in communities of interaction, which in turn structure and influence how life evolves. Evolution is essential for understanding life and biodiversity. Henri Bergson’s *Creative Evolution* suggests a way of examining “tendencies” without “teleology.” In this paper I reexamine that work in light of recent concepts in evolutionary ecology, and explore how agential aspects of life are essential for understanding how emergence provides a basis for a process-based metaphysics of life. In support of this project, I will explore how the major transitions of life on Earth have proceeded through increasing levels of cooperation among agents (e.g., mitochondria in animal cells forming a mutualistic relationship), which have allowed further emergences and complexity to evolve. This complexity always, however, emerges in the context of ecological relationships and a nonteleological evolutionary process. Yet, while nonteleological, the progression of life thus far on this planet seems to hold the promise of certain tendencies that seem inherent in life itself.

Keywords: Henri Bergson; complexity; creationism; emergence; evolution; intelligent design; niche theory; theology of nature; vitalism

Biology has something relevant to say to theology and vice versa (Cunningham 2010), and as a biologist I would like to hone in on some aspects of life that may gesture to perspectives that cross disciplinary lines. In particular, I would like to draw on the work of Henri Bergson, long ignored in biology. However, he is growing in relevance as problems in

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understanding what life is and how it enfolds in an emergent universe become more pressing and perplexing.

Life is a relationship among various kinds of agents interacting at different scales in ways that are multifarious, complex, and emergent. Life is always part of an ecological embedding in communities of interaction, which in turn structure and influence how life evolves. Evolution is essential for understanding life and biodiversity.

Evolution is underwritten by random genetic mutations and other sources of variance that arise in the chemically based genetic structures that underpin life on Earth. Natural selection sifts through mutations, which occur at random and without regard to the environment in which they arise, and finds those organisms better suited to the local environment in which those particular life forms find themselves. In addition, the stochastic nature of survival, the accidents and contingency of living in a dangerous world, ensures that genetic drift will also play an important role. These two processes structure the kinds of organisms that inhabit our planet by forging them in ways that are conditioned on the randomness and contingency of local environments. The history of evolution is one of false starts, dead ends, accidents, and mistakes. This, as seen through the lens of science, suggests a lack of teleological aim for the forms of life on this planet. Does this imply that the universe is therefore without certain tendencies? I would like to explore this question in detail by first looking at aspects of biology that appear over and over again in the history of life on Earth as broad scale patterns and regularities. Second, I would like to examine what is known about the “arrow of complexity,” the tendency of life to increase in complexity over time and how this creates opportunities for emergence and creativity to arise. Finally, I would like to explore these repeated aspects in the light of the work of Henri Bergson, particularly of that found in his *Creative Evolution* (Bergson [1907] 2005). This may point to certain kinds of teleology that might be permissible from an evolutionary perspective. Teleology of a certain kind is being rethought in biology (McShea 2012; Wattles 2006) and may be explored profitably in religion vis-à-vis biology (Sherman and Deacon 2007; Page 2006). I will focus here, however, on tendencies, as a new way to view the kind of teleology that seems to play a role in theological constructions that imbue the universe with certain ends.

LIFE ON EARTH AS STRUCTURED BY EVOLUTION

Evolution by natural selection is an a priori principle according to Christian Illies (2005). As given, it requires no empirical content to frame, nor is it a particular law in a given universe. Philosopher Daniel Dennett calls it a sorting algorithm (Dennett 1996), but it always holds under the following conditions (Lewontin 1970):

- (1) Variation in traits.
- (2) Selection on trait differences (different variants leave different numbers of offspring).
- (3) Trait attributes are to some extent inherited by “offspring” from “parents.”

These things are sufficient for evolution to occur. This process works whether the subjects are chemicals, digital computer programs, or beans in a jar—anything. This description of evolution by natural selection is not really in dispute. It is obviously just a procedure, in a functional sense, that sorts things based on some selection criteria, usually determined by some environment in which the traits vary on how well they fare in that environment.

A claim of evolution by natural selection is a claim that the system you are working with is one in which these conditions hold. Life on Earth seems just the sort of thing where these conditions are met. The claim that some group is a Darwinian population is the claim that it meets these criteria. In application however, it can be complex and messy, as philosopher of biology Peter Godfrey-Smith writes in his book *Darwinian Populations* (Godfrey-Smith 2009):

Darwinian populations are collections of things that vary, reproduce at different rates, and inherit some of this variation. The basic features of these collections are startlingly routine—births, lives, and deaths, with variation and inheritance. But Darwin saw that this set-up, this arrangement of ordinary features, is an extraordinarily important element of the world. Darwin's description was empirical and concrete. The last century's work has included a series of moves towards abstraction, attempting to say what is essential about the Darwinian machine—which features are not dependent on the contingent particularities of life on Earth. (107)

Variation on Earth, the first requirement for evolution by natural selection, arises through the random process of mutations. These random mutations are expressed in a particular environment and survive differentially based on how well they do in that particular environment. So over time, at the level of local environment, there is a kind of “matching” between the environment and the organisms that inhabit it. However, it is only in that local environment that any sort of direction can be observed. In such a system there can be no goal or aim toward which evolutionary change is moving—only local adaptation given the context of mutational changes.

However, even though this process draws on the randomness inherent in the genetic structure of life, there yet appear to be tendencies, repeated patterns, regularities, and strategies in which life engages at multiple levels. This seems to belie the idea that evolution is just randomness being

co-opted for local environments, because there seem to be aspects of life that bubble up over and over again, suggesting that there are things about life that appear to be tendencies of life itself, not just specific forms that reappear to solve specific engineering problems (e.g., those explored in Conway Morris 2003), but regularities that are used by many forms of life in many ways.

To begin, some effort in dissecting what life “is” may be useful. Eugene Thacker carefully unpacks some of the differences between “life” as such and “life forms” (Thacker 2010). Starting with Aristotle, he draws a useful distinction between the two concepts. Life is more than a nominalistic category and more than a summation of the instances of life forms. Life is something with properties, the exploration of which gives us a sense of what is possible in the world of actually realized life forms. What features of life seem to be repeatedly instantiated in the instances of life on Earth? Are there tendencies to which life seems drawn? There have been nice explorations of this from the theological side. Milbank (2011) in particular pays attention to the distinction between the instances of life and what constitutes and frames it, but here I want to draw on distinctions from the biological sciences and tease out how these might be relevant to more philosophical and theological considerations, especially as informed by Bergson’s thought. First, let us examine a few of these tendencies as seen in empirical studies of the biological sciences.

EXAMPLES OF TENDENCIES SEEN REPEATEDLY IN LIFE

It is useful to consider the history of life on Earth and point out key aspects of its evolution that highlight features that argue against disenchanting reductive views of nature, and perhaps even suggest a very Bergsonian view of the creative nature of evolution. I suggest that an ecological emergent view helps us see life as a nonessentialist unfolding that is established by dynamic networks of cooperating entities, which in turn allow for further creativity, innovation, and freedom in the universe.

Let me be clear how I am using creativity here. It is clear that life on our planet has responded to unique environments through evolutionary innovated solutions to the challenges it faces through the three processes described above. These are creative in that they did not exist before their appearance in life forms. They are novel (granting that they might have appeared “new” in several independent events), and creative in just this sense.

The universe is structured, as Latour (Harman 2009, 23), suggests, such that “entities (as broadly construed) have struck a hard bargain with reality to allow stable configurations of chemicals that allow life to get started.” How life got started on Earth from its chemical precursors remains an open scientific question, upon which progress is being made. As we learn more

about early planetary environments, and as we discover how frequent life is in the universe through surveys of distant solar systems, the question of how life begins will likely become clearer. Once life is off the ground there seem to be repeated patterns. While there is nothing specifically teleological about life on Earth in the sense that there are specific Platonic-like forms to which life is heading, there are repeated strategies that evolve independently, that seem constitutive of how life proceeds biologically on Earth.

Life solves engineering problems. The first tendency I want to examine is that evolution solves engineering problems.

While organisms on Earth have evolved in a number of distinct directions, life forms in similar circumstances have sometimes arrived at similar solutions for surviving well. For example, life on Earth has had multiple species evolve to solve the problem of swimming in the sea. Fish from chordate ancestors evolved into something with a torpedo shape, terminal tail movements to produce forward thrust, and fins to stabilize their motion. In addition to the initial evolutionary radiation of the fishes, this strategy for living in water has also evolved at least twice from vertebrate terrestrial organisms. In looking at the body “designs” of dolphins and ichthyosaurs, their similarity to fish and to each other is immediately apparent. Thus, solving engineering problems can create some startlingly specific designs.

Another example is found in saber-toothed “cats” that evolved independently from separate rat-like precursors in both marsupial and placental mammalian lines (Wroe et al. 2008). Biologist Simon Conway Morris (2003) speculates that given this propensity, it may mean that the human shape and form may be inevitable in the universe on similarly constituted planets with similar ecological underpinnings.

This allows us to ask about how the evolutionary trajectories of specific life forms have evolved. Moreover, there are more general tendencies that seem to be repeatedly repeated in vastly different organisms and seem to underpin what makes life a successful enterprise in increasing complexity and innovation in the universe. And while specifics are nonessentialist and lack formal (in the Platonic sense) underpinnings, there are repeated patterns that allow for increased complexity. These other tendencies are usefully examined by looking at attributes of organisms closer to the chemical basis of life-like bacteria. (There would have been a temptation in previous eras, when a Great Chain of Being was seen to structure life, to call these simpler, or more recently “less evolved,” but given the complexity we are discovering in the microbial world, abandoning such notions seems important.) These are representatives of an early instance of cellular life and these organisms have continued to evolve since their emergence on Earth to be successful contenders in the struggle for existence on this planet.

A trend toward individuality, then to societies of individuals. There is a trend toward individuality. Let me be specific about what I mean by that. Individuals are always collections of other individuals. In this I follow the work of Pradeu (2012) and Buss (1987), who have rigorously explored how societies of entities form from individuals to individuals. So while humans might be rightly called an ecology—for example, we are a conglomerate network of ancient bacteria (mitochondria), cells, commensal species of bacteria and fungi, all necessary for our survival—we are tightly bound as an entity and functionally interact and survive as individuals. This appearance of such tightly bound “systems” allows individuals to be identified and delineated in ways that go beyond a nominal approach. For example, Pradeu (2012) uses the immune system’s host recognition system to delimit what belongs to the individual and what does not.

The first instances of life were likely the simple packaging of chemical systems creating an inside and an outside. To put it crudely, a “me” and a “not me.” If we look at a prokaryotic cell we see definitive structures that carve it from the common chemical milieu.

This move to individuality occurs at multiple scales in a back and forth movement between societies of individuals framing the creation of new kinds of individuals that have as their makeup other individuals. This means that while individual objects are the foundation of life, these individuals can be composed of other confederations of objects and individuals. Life seems to move from individuals to an ecology and society of individuals that create new individuals, which in turn frame new ecological and societal relationships. This is one of life’s strongest tendencies. An example may be helpful here.

Bacteria are an especially good example of this in light of their supposed simplicity. The societal and ecological relationships of bacteria constitute an area of growing interest, in part because of the surprises they hold.

For example, bacteria have social communicative networks that enhance their ability to survive. Quorum sensing—the ability of a bacterial population to communicate with other conspecifics to perform coordinated activities like the building of a protective film that offers them protection, allows the use of shared resources, and provides opportunities for greater dispersal (Goryachev 2009)—has been seen as one of the more important discoveries of microbiology in recent years. Communication through detecting and sending chemical signals allows others within the film to assess the condition and structure of the population. In addition, through quorum sensing, biofilms can provide a shared resource to other species. For example, oxygen-using bacteria can use the boundaries of the film where the gas is more abundant, while abiotic species, which thrive in the absence of oxygen, can exploit more anterior positions, providing food and chemical resources that are beneficial to the bacteria on the edges secreting the biofilm, thus supporting commensal relationships among differing

species. These cooperative relationships establish ecological networks that take place on multiple scales and among very different species.

A spectacular example comes from the relationship between the bioluminescent bacteria, *Vibrio fischeri*, and the squid, *Euprymna scolopes* (Nyholm et al. 2009). The squid contains a light organ that allows the colonization of the bacteria. The organ provides specific nutrients to the bacteria that allow for its own thriving. The bacteria can live individually among the oceanic plankton. However, using quorum sensing, when the population reaches a certain size, the bacteria turn on genes that produce the bioluminescence. This is a benefit to the squid because by glowing it reduces its shadow as seen by predators looking toward the surface lit by a bright moon. So both species benefit. It is a complex dance between two different species, on vastly different size scales, which have to coordinate their behavior with other members of the population. This attribute of life to move to social cooperation to solve complex problems is ubiquitous in Earth's biota.

Another move made by life along this continuum of individuality and societal relationships is the differentiation and specialization of individual function for the benefit of the whole. The most extreme example of this is where individuals give up their potential for reproduction. But differentiation of individual roles is quite common in the microbial world and includes things like domicile creation, cooperative hunting, specialized food provisioning, specialized defenders, specialized dispersal forms, altruistic suicide, and communication (Crespi 2001).

Two examples can be mentioned. The first is the jelly-fish-like Portuguese man-o-war (*Physalia physalis*) (Clarke 2010), which is not a single organism but rather a colony of individuals. Although each individual has taken on a different role—for example, some are stinging cells, while some are part of the air bladder—the “organism” itself is a colony. Only the individuals that have differentiated into gametophores reproduce, so, much like a beehive, only a few of the individuals retain the ability to reproduce. Another example is the slime mold (Bonner 2008), which similarly create fruiting bodies and other types of cells, which will reproduce. Some form a stalk to facilitate dispersal.

So we see that within life the repeated strategy of cooperation, differentiation, and individuation is ubiquitous from the smallest to the highest scales. Also important to explaining life on Earth is understanding its vast, growing complexity since its inception 5.5 billion years ago, when abiogenesis got off the ground. What allows this clear increase in complexity? In part it seems to be the bootstrapping that occurs as complexity generates more complexity.

It is in such social communities that we first find individuals leaping forward in creative networks that allow for greater complexity and creativity in the life forms that structure life on Earth. In so doing, they exemplify

the three separate but entangled trends that allow novelty in life on Earth to emerge: complexity, cooperation, and sociality.

Niche Construction. Another tendency of life can be illuminated in the creative power described by niche construction theory (Odling-Smee et al. 2003). Niche construction theory was developed in the early 1980s, and while growing in influence is still a nascent field. While a complete accounting of the main features of this theory is beyond the scope of this paper, the basic idea is easy to grasp. Life evolves in contexts, that is, the struggle for life is always embedded in an environment. It is clear that this environment is not static and is in constant flux, but while we often take note of that, we fail to acknowledge that what is causing and substantiating that flux is life itself, creating a constant back and forth between organisms and the environment they inhabit. This not only changes the habitat for the biotic creature that initially found themselves in the environment in question, but creates new opportunities for survival and evolutionary change among all the organisms living within that context.

The American beaver is an oft-cited example of niche construction. These North American animals build large dams that block streams and change the environment significantly. They cut down and move trees to make their dams and lodges, creating ponds, which can in turn create wetlands, provide habitat for fish and birds, and restructure completely the ecological community. Their presence provides new energy flows that can allow new levels of complexity and opportunities for evolutionary directions to expand. Dawkins uses the beaver as an example of the extended phenotype for his gene-centered view of evolutionary change (Dawkins 1982). However, he misses the changes that feed back and forth between the beaver and its environment. Dawkins assumes a static landscape that misses much of how life structures and restructures itself. Niche construction theory suggests that the landscape is in constant flux, and that life unfolds generously, from more to more. In the evolution of ecology it can be truly said, "For to every one who has, will more be given, and he will have abundance; but from him who has not, even what he has will be taken away" (Matt 25:29 RSV).

Niche construction is key in understanding how life unfolds. That it is missing in current reductive thought becomes very apparent in the models that are used to construct evolutionary explanations and predictions. A good example is the failure of the "climbing Mount Improbable" models (Dawkins 1996) that have been used to explain evolutionary change. As philosophers of science have noted, all such models have in some sense failed to capture the fact that life forms have increased in complexity as life progressed over evolutionary time scales (Bedau, 2009). (Contra Gould [1989], who strangely argued that complexity has not increased.) Recently, Korb and Dorin (2011) argue that models have failed to

reproduce the increase in complexity that is obvious in the directional arrow of complexity—things move from lesser to greater complexity. Most models of evolutionary processes have missed the obvious trend of increasing complexity that is apparent in the fossil record. Korb and Dorin (2011) argue further that this is because niche construction theory has been ignored and that using static landscape models misses this feature of nature. They argue that to capture this feature, only simulation models are adequate for the task, because they are able to target what life actually does—change the selective landscape in which it evolves, thus providing increases in complexity. The metaphor that Dawkins uses of climbing Mount Improbable fails because the complexity of life is a moving target. Life changes the nature of the landscape. I will come back to this momentarily.

This suggests that life is constantly reinventing itself, changing, becoming more than it was, unfolding in new and creative directions. In short, life on Earth is emergent. This is clear from the empirical evidence we have about the way life has unfolded on this planet; moreover, this may be a distinguishing feature of life itself, as it is hard to imagine a kind of life that could evolve without this kind of creative necessity that allows it to adapt to the new circumstances it must confront (Kauffman 2008).

Life created an oxygen atmosphere, which allowed for more complex autotroph-like fungi and plants to create more niches. Following this, motile animals evolved, more niches opened, plants invaded bare and lifeless landmasses, which in turn provided more niches. The transformation of life on Earth has been the story of increasing complexity, opening and creating new niches, and advances in sociality, cooperation, and coevolution. A wildly emergent world full of genuine surprises has been the result. It seems possible that this is a general feature of life in the universe.

Emergence and Complexity. Niche theory introduces the possibility of emergence. Let me be careful with that word because it has come to mean many things to many people and tends to be a fraught concept. I am defining it in the sense of Bedau (2008). Bedau argues for three types of emergence. In all three types, the foundational concept is the idea that a property is emergent if it is a property that can be possessed by the macro scale, but which cannot be possessed by the micro scale. The classic example of this is an avalanche comprised of overloaded snow banks. An accumulation of snowflakes composes an avalanche, but individual snowflakes possess no property of avalanches.

Bedau divides emergence into three kinds: nominal, weak, and strong. The first, nominal emergence, is emergent in the sense in which wholes are dependent on their parts, and are autonomous in the sense that parts do not have the properties of the whole. For example, a herd of zebras is a herd just as a result of individual zebras aggregating in a certain way. The herd emerges because of individual behavior.

At the other end of the spectrum of emergence, strong emergent properties are characterized by supervenient powers that create irreducible causal influences. In this sense, emergent properties, although dependent on micro-level properties, create causal powers that cannot be reduced. These are thought to be extra-scientific in that they cannot in principle be explored through reductive methods. The subjective experience of the mind is the only example that is usually given, and there is skepticism that strong emergence is a coherent concept.

Falling between these kinds of emergence, weak emergence is defined in this way: The system's global behavior derives just from the operation of micro-level processes, but the micro-level interactions are interwoven in such a complicated network that the global behavior has no simple explanation. Getting more specific, Bedau argues that weak emergence is underivable except through simulation, and he suggests that micro-level changes are dependent on the situation in which they find themselves and which allows for the updating of their reaction. A clear example of weak emergence would be a beehive, in which individual bees are making "decisions" based upon the needs of the hive and its situation within the hive. A bee can assess the conditions and needs of its hive and change its behavior accordingly. Within a beehive individual bees are not only making decisions, but they are exchanging information with each other and assessing the situation within the hive and with the outside world in complex ways that make the hive much more than an aggregate of bees, in the sense that a herd of wildebeest is just an aggregate. Although one can see that a herd is a continuum and there is some assessment going on within it (e.g., what is my neighbor looking at and why is it so nervous?), it is not as complex as the hive nor is its behavior as complex. The information exchange used to create such a complex network as a hive is also more abundant.

The beehive is especially intriguing because the colony that emerges appears to be a new kind of individual, one where the entire hive becomes the unit of selection. Some individuals have given up their reproductive capability to allow for something new.

This outline has given a sense of the main themes of life: individuation, sociality among individuals, ecological relationships among the biotic and abiotic worlds, niche construction, and emergent complexity. It is difficult to assess whether these are necessary features of life in our universe, as we only have access one actual instantiation of life, this Earth. However, we have hints from studies of artificial digital life that these may be necessary, as simulations have seemed to have had limited success in replicating aspects of life's complexity without them (Korb et al. 2011).

Life may be then a combination of contingency in that specific forms that emerge are novel (given resemblances created by solving certain engineering problems as noted) but conditioned on the three themes discussed above.

BERGSON: LIFE AS TENDENCY

From the above it is clear that there are tendencies in the way that life has evolved on Earth: individuality, societies of interacting individuals, the creation of habitat through niche construction, increasing complexity, and the emergence of novelty.

These tendencies suggest possible universal aspects of the deep structure of the universe. Note that this hunch is not mysterious, nor does it argue for some sort of intelligent design to force these tendencies into existence. However, these aspects do seem to appear over and over in the life histories of Earth's organisms, as well as in simulations of artificial life, making it a wager worth considering.

Henri Bergson in his book *Creative Evolution* argued that, for life to evolve creatively, there must be an initial push, a striving that allowed for life to press forward into new creative ventures. This *élan vital* was structured into the beginning of life's forward motion and continues from duration to duration. In the gap between these durations Bergson poses the existence of opportunities for creativity to blossom and provide fodder for adaptive evolutionary processes. His creative evolution is not merely evolution in a Darwinian sense, as life is seen as endowed with certain tendencies. Miquel (2007) makes this explicit:

What is life, according to Bergson, then? First of all, life is not adaptation by divergence of characters. This is the difference with Darwin: there is for Bergson an internal impetus, which can be described by neither the principle of divergence, nor the law of natural selection. *It is a tendency acting through its counter tendency.* (Italics in the original)

Marrati (2005) points out that for Bergson life has an essence and that essence of life is a tendency to a "motion" that creates divergence. This is the *élan vital* in which life finds its creativity and complexity.

There is a temptation in biology to dismiss Bergson's idea of a first impulse as a kind of vitalism, in which the *élan vital* functions as an influencing force that moves life in certain directions or provides the necessary spark that animates life and in some sense defines what it means to be alive. However, this reading is not quite correct, as life for Bergson is the movement or tendency to push through negative influences by dividing itself in new, creative, and emergent ways (Fujita and Lapidus 2007). This is largely congruent with the findings of biology. Since the modern synthesis of Darwinian biology and genetics, the idea of a first impulse can be translated into our current conceptions of evolutionary change in ways that accord with how they currently stand. Bergson's view of life is borne out by our current understanding of evolutionary biology.

In *Creative Evolution*, Bergson argues that this forward impetus is structured by "durations" that specifically provide a temporal "place" in which

creativity could arise. However, there may be other, differently structured “places” that provide this kind of creativity in the moments between durations. Let me unpack this.

For example, randomness itself can be viewed analogously with Bergson’s *élan vital*, with random mutation marking the end of a duration and the mutation becoming the source of creativity, like Bergson’s initial push. This is much more complex than I can describe in this article, but in broad brush it is possible to see how randomness plays out in life on Earth. Empirical observations of randomness seem to capture everything that Bergson required for this initial impulse. Embedded in the structure of the universe is a push forward from the constant stream of randomness that unfolds and the sorting of the randomness according to local environmental conditions.

Life’s processes are often mischaracterized as a simple reductive scheme, but that misses some of life’s most astonishing features. Bergson criticized this as *finalism*, in which the whole was given. This “whole” can be seen in philosopher Daniel Dennett’s idea of a design space, which he uses to argue for a deterministic universe, because there are only so many possible combinations of DNA that produce viable “creatures.” From a given starting point, the unfolding of different life forms must wander around in this design space, driven by local selection regimes, but the set is finite, and the steps must be small ones. Richard Dawkins uses the same notion in his view of “climbing Mount Improbable,” in which he demonstrates how evolution can entirely explain the designed complexity of life on Earth. Dennett and Dawkins are right that evolution completely explains complexity, but the question that deserves some consideration is where does the design space itself come from? Of course that question is in principle unanswerable from a scientific perspective.

One of the interesting things about the flat naturalism that is rarely commented on is the “given all at once” (as Bergson called it) nature of the static landscape. In a deterministic universe with all the possibilities being fixed from a God’s eye perspective, the entire landscape of physical reality is fully given: from the perspective of space–time, the entire complex structure of the universe is just a static “now” and is fully present. The question of the source of the landscape seems especially odd from the point of view of a strict deterministic naturalism. Such a point of view assumes, and it seems to me it must assume, a metaphysics in which the marvelous landscape of bacteria, beavers, eyeballs, and ecological niches are given completely from the initial starting event like the Big Bang, because the unfolding of the universe, by their view, is entirely deterministic and noncreative. The entire extant landscape must be all there from the first moment. What unfolds must be necessary and conditioned on this given landscape and must be given *a priori* to the universe’s unfolding. Strict flat deterministic naturalism then shares a stance with naive creationist views that assume

that the entire landscape is present in its entirety. If it is determined it must be “all there” or “given,” as Bergson suggests. In this sense ontological materialism actually embeds an easy creationism.

This idea of an ontological design space approach also misses the precise point that Bergson made: where do the creativity and complexity come from in the design spaces conjured to explain the evolution of life? This brings up a related question—what aspects of life (as opposed to life forms) seem to be those that give us broad scale principals of what life is?

The richness of the universe appears to argue for even higher levels of creativity, opportunity, and grace (where grace is defined as what is given at a given time; Miller 2008). Unlike the apprehension of biological reality described earlier in this article, the flat landscape seems to be missing something essential, namely, the creative nature that seems inherent in evolutionary processes, which create new landscapes on which to work using the tendencies inherent in life itself.

Bergson saw this as a key aspect of what we mean by “life,” as Ansell-Pearson explains (2005):

Bergson then turns his attention to life. It is necessary, he argues, to deal with tendencies that are to be explained by the necessity of living. By “living” Bergson means the formation of distinct material zones, in short, bodies. It is my own body and that of others that I have the most right to distinguish in the continuity of the universe. A body is led by its various needs—the need for food, or the need for self-preservation, for example—to distinguish and constitute other bodies. It is the life of living bodies, therefore, that establishes a primary discontinuity within matter: “To establish these special relations among portions thus carved out from sensible reality is just what we call living” (Bergson, *Oeuvres*. Paris: PUF, 1959. 334; Bergson, *Matter and Memory*. Trans. N. M. Paul & W. Scott Palmer. New York: Zone Books, 1991. 198).

This seems to coincide nicely with the habit of life to seek individuality, but does so not by positing a fixed design space like Dennett’s, but through the tendency of life to create now openings for life through processes like niche creation.

Bergson’s view captures aspects of life that the kind of landscape Dennett posits misses in its static givenness; it is ironic that Bergson is principally remembered, at least in biology, for the *élan vital*, when in fact he wrote extensively against teleology (or “finalism,” as he called it). It seems to me that this flat naturalism is an insidious teleology in which the entire landscape is given and organisms move through it with the only possibilities being those that appear in this static landscape. Bergson notes,

To speak of an end is to think of a pre-existing model which has only to be realized. It is to suppose, therefore, that all is given, and that the future can be read in the present. It is to believe that life, in its movement and in its entirety, goes to work like our intellect, which is only a motionless and

fragmentary view of life, and which naturally takes its stand outside of time. Life on the contrary progresses and endures in time. (Bergson [1907] 1965, 34)

He notes that life is what we now might call emergent and contextualized only on what has gone before, but not as if following a landscape. He continues:

... but, in the adaptation of an organism to the circumstance it has to live in, where is the pre-existing form awaiting the matter? The circumstances are not a model into which life is inserted and whose form life adopts [think of Dennett's design space here]. This is indeed to be fooled by a metaphor. There is no form yet, and the life must create a form for itself, suited to the circumstances that are made for it. It will have to make the best of these circumstances, neutralize their inconveniences and utilize their advantages—in short, respond to our actions by building up a machine which has no resemblance to them. Such adapting is not repeating, but replying—an entirely different thing. (Bergson [1907] 2005, p. 39)

He is not imagining life here as an intelligent agent and he fully supports the idea that evolution is what does the replying, but he suggests that life is creative in just the sense that there are novel responses and opportunities embedded within the evolutionary process, just as niche theory would imply.

This suggests that there may be the possibility of a new Bergsonianism that recognizes that his views are compatible with our current understanding of biology. It appears that creative evolution has relevance today as we look at life as having just the kind of tendencies that Bergson described in his important work.

THEOLOGICAL IMPLICATIONS OF THE NEW BERGSONIANISM

Are there theological implications in Bergson's creative evolution? I would like to focus on some aspects of his theory which might be of value in interpreting theologies of creation. First, what we see unfolding in life on Earth seems to imply the nonclosed nature of the cosmos—that life is ongoing, creative, and emergent. The flat naturalism that posits an intact design space would imply that there is some sort of creation more like that of the intelligent designer of creationism in which God's role is to nudge things along that would otherwise be improbable, but the flat landscape is still given up front. However, an open universe in which niches create new opportunity and infinite possibilities suggests, as John Haught terms it, endless promise (Haught 2003). This does not forestall certain ends; as I've shown above in certain kinds of universes, certain engineering problems seem to recommend certain ends. This kind of openness does not limit theologies of divine purpose, but it does necessarily do away with teleological specifics that creation is less than continuing process.

Again, turning to Bergson:

The truth is that adaptation explains the sinuosities of the movement of evolution, but not its general directions, still less the movement itself. The road that leads to the town is obliged to follow the ups and downs of the hills; it adapts itself to the accidents of the ground; but the accidents of the ground are not the cause of the road, nor have they given it its direction. At every moment they furnish it with what is indispensable, namely, the soil on which it lies; but if we consider the whole of the road, instead of each of its parts, the accidents of the ground appear only as impediments or causes of delay, for the road aims simply at the town and would fain be a straight line. Just so as regards the evolution of life and the circumstances through which it passes—with this difference, that evolution does not mark out a solitary route, that it takes directions without aiming at ends, and that it remains inventive even in its adaptations.

But, if the evolution of life is something other than a series of adaptations to accidental circumstances, so also it is not the realization of a plan. A plan is given in advance. It is represented, or at least representable, before its realization. The complete execution of it may be put off to a distant future, or even indefinitely; but the idea is nonetheless formidable at the present time, in terms actually given. If, on the contrary, evolution is a creation unceasingly renewed, it creates, as it goes on, not only the forms of life, but also the ideas that will enable the intellect to understand it, the terms which will serve to express it. That is to say that its future overflows its present, and cannot be sketched out therein in an idea. There is the first error of finalism. (Bergson [1907] 2005, 68)

This opens the possibility of tendencies without teleology, in which the universe really does bring out certain features. These appear again and again. Could these features allow for the consideration of a universe, unfolding into new and perhaps nonteleological ways, and speak to divine purpose—one without the need for a God to intervene in specific ways as in the flat design space and those envisioned by intelligent design and Dawkins's Mount Improbable?

It also speaks to the uniqueness of life because it is novel and open-ended and gives reasons for preserving, perhaps as a theological mandate, the treasures of this ongoing creation. It gives reasons for supposing that there is something precious and sacred about life on Earth because it has not been manufactured like a boat crafted for a purpose; rather, creation is exemplified by life itself as manifest in the history and unfolding of the universe. This kind of open, unfolding view of creation highlights the importance of ecological considerations in the world.

The word "process" is appropriate here because there seem to be affinities between with this ecological view of creation and process theologies, as distinct from Paley-esque kinds of natural theology or theo-drama views of theologians like Deane-Drummond (Deane-Drummond 2009). However, this new Bergsonianism may point to a new kind of natural theology based

not on the specifics of life forms but on general tendencies of life like sociality, individuation, complexity, and creativity.

Finally, emergence seems to imply that the universe is becoming freer and more open-ended in certain senses, and that freedom further implies that the universe itself generously creates new levels, based on features of life that seem ubiquitous and move back and forth in ways that are agential and individualized, that grow in complexity, and that emerge in beauty as a magnificent universe.

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REFERENCES

- Ansell-Pearson, Keith. 2005. "The Reality of the Virtual: Bergson and Deleuze." *Modern Language Notes* 120: 1112–27.
- Bedau, Mark A. 2008. "Downward Causation and Autonomy in Weak Emergence." In *Emergence: Contemporary Readings in Philosophy and Science*, ed. M. A. Bedau and P. Humphreys. Cambridge, MA: MIT Press.
- . 2009. "The Evolution of Complexity." In *Mapping the Future of Biology*, ed. Anouk Barberousse, Michael Morange, and Thomas Pradeu, 111–30. New York: Springer.
- Bergson, Henri. [1907]2005. *Creative Evolution*, trans. A. Mitchell. New York: Barnes & Noble.
- Bonner, John Tyler. 2008. *The Social Amoebae: The Biology of Cellular Slime Molds*. Princeton, NJ: Princeton University Press.
- Buss, Leo W. 1987. *The Evolution of Individuality*. Princeton, NJ: Princeton University Press.
- Clarke, Ellen. 2010. "The Problem of Biological Individuality." *Biological Theory* 5: 312–25.
- Conway Morris, Simon. 2003. *Life's Solution: Inevitable Humans in a Lonely Universe*. Cambridge: Cambridge University Press.
- Crespi, Bernard J. 2001. "The Evolution of Social Behavior in Microorganisms." *Trends in Ecology and Evolution* 16(4): 178–83.
- Cunningham, Conor. 2010. *Darwin's Pious Idea: Why the Ultra-Darwinists and Creationists Both Get It Wrong*. Grand Rapids, MI: William B. Eerdmans.
- Dawkins, Richard. 1982. *The Extended Phenotype: The Long Reach of the Gene*. Oxford: Oxford University Press.
- . 1996. *Climbing Mount Improbable*. New York: W. W. Norton.
- Deane-Drummond, Celia. 2009. *Christ and Evolution: Wonder and Wisdom*. Minneapolis, MN: Fortress Press.
- Dennett, Daniel C. 1996. *Darwin's Dangerous Idea: Evolution and the Meanings of Life*. New York: Simon & Schuster.
- Fujita, Hisashi, and Roxanne Lapidus. 2007. "Bergson's Hand: Toward a History of (Non-)Organic Vitalism." *SubStance* 36(3): 115–30.

- Godfrey-Smith, Peter. 2009. *Darwinian Populations and Natural Selection*. Oxford: Oxford University Press.
- Goryachev, Andrew B. 2009. "Design Principles of the Bacterial Quorum Sensing Gene Networks." *Wiley Interdisciplinary Reviews: Systems Biology and Medicine* 1(1): 45–60.
- Gould, Stephen Jay. 1989. *Wonderful Life: The Burgess Shale and the Nature of History*. New York: W. W. Norton.
- Harman, Graham. 2009. *Prince of Networks: Bruno Latour and Metaphysics*. Melbourne, Australia: re.press.
- Haight, John F. 2003. *Deeper than Darwin: The Prospect for Religion in the Age of Evolution*. Boulder, CO: Westview Press
- Illies, Christian. 2005. "Darwin's A Priori Insight: The Structure and Status of the Principle of Natural Selection." In *Darwinism and Philosophy*, ed. V. Hosle and C. Illies. Notre Dame, IN: Notre Dame University Press.
- Kauffman, Stuart A. 2008. *Reinventing the Sacred: A New View of Science, Reason, and Religion*. New York: Basic Books.
- Korb, Kevin B., and Alan Dorin. 2011. "Evolution Unbound: Releasing the Arrow of Complexity." *Biology and Philosophy* 26: 317–38.
- Lewontin, Richard Charles. 1970. "The Units of Selection." *Annual Review of Ecology and Systematics* 1: 1–18.
- Marrati, Paula. 2005. "Time, Life, Concepts: The Newness of Bergson." *Modern Language Notes* 120: 1099–1111.
- McShea, Daniel W. 2012. "Upper-Directed Systems: A New Approach to Teleology in Biology." *Biology and Philosophy* 27: 663–84.
- Milbank, John. 2011. "Immanence and Life." Available at http://theologyphilosophycentre.co.uk/papers/Milbank_StantonLecture2.pdf.
- Miller, Adam. 2008. *Badiou, Marion and St Paul: Immanent Grace*. London: Continuum.
- Miquel, Paul-Antoine. 2007. "Bergson and Darwin: From an Immanentist to an Emergentist Approach to Evolution." *SubStance* 36(3): 42–56.
- Nyholm, Spencer V., Jennifer J. Stewart, Edward G. Ruby, and Margaret J. McFall-Ngai. 2009. "Recognition between Symbiotic *Vibrio Fischeri* and the Haemocytes of *Euprymna scolopes*." *Environmental Microbiology* 11: 483–93.
- Page, Lyman A. 2006. "Teleology in Biology: Who Could Ask for Anything More?" *Zygon: Journal of Religion and Science* 41: 427–34.
- Pradeu, Thomas. 2012. *The Limits of the Self: Immunology and Biological Identity*. Oxford: Oxford University Press.
- Odling-Smee, John, Kevin N. Laland, and Marcus W. Feldman. 2003. *Niche Construction: The Neglected Process in Evolution*. Princeton, NJ: Princeton University Press.
- Sherman, Jeremy, and Terrence W. Deacon. 2007. "Teleology for the Perplexed: How Matter Began to Matter." *Zygon: Journal of Religion and Science* 42: 873–901.
- Thacker, E. 2010. *After Life*. Chicago, IL: University of Chicago Press.
- Wattles, Jeffrey. 2006. "Teleology Past and Present." *Zygon: Journal of Religion and Science* 41: 445–64.
- Wroe, Stephen, Michael B. Lowry, and Mauricio Anton. 2008. "How to Build a Mammalian Super-Predator." *Zoology* 111(3): 196–203.