Big History and the Principle of Emergence

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Citation | Baskin, Ken. 2022. "Big History and the Principle of Emergence." *Journal of Big History* 5 (1): 77-91.

DOI | https://doi.org/10.22339.jbh.v5i1.5140

KEY WORDS

emergence

complexity theory

religion

self-transcending construction

ABSTRACT

Life is a raucous carnival, full of "games" and "rides" whose ongoing interactions continually surprise us. Yet thinkers are too often tempted to treat it as a machine that spits out linear time lines of events, one leading deterministically to another. By its interdisciplinary nature, big history is inclined to treat the world as a carnival; yet the temptation to treat it in the more linear way sometimes prevails. This essay treats one key dynamic that governs life's carnival—the principle of emergence. Emergence is the process by which a relatively simple entity interacts with its environment to become structurally complex, often in ways that seem impossible to anticipate. In this way, a seed becomes a fruit tree, a small community becomes a vast city, or a shamanic religion in a hunter-gatherer band evolves into a system of belief and practice shared by a billion people. By defining emergence and exploring religion as an extended illustration, this paper makes the case for more fully incorporating the principle of emergence into the study of big history.

Plant an apple seed, and, if the soil and weather conditions are right, an apple tree will grow. The apple tree, in turn, will produce apples, which just happen to contain more seeds capable of resulting in more trees. A single tiny seed can, over time, produce an orchard with a rich harvest of delicious fruit and all the shifts in the local ecosystem that an orchard invites. This is the process of emergence, by which a relatively simple coherent entity (the seed) can result in new structures, patterns, or behaviors through the interaction of its component systems and its environment. Emergence is not a new idea, especially in philosophy, where it can be traced to Aristotle's *Metaphysics*. In modern philosophy, interest in emergence goes back to John Stuart Mill, who called it "heteropathic" causation ("Emergence" 2020).

What makes emergence so fascinating is how different it is from the linear causality that had largely dominated scientific thought since the seventeenth century. With linear causality, a single action or set of actions will produce a specific effect: for instance, heat water to 100 degrees Fahrenheit at sea level, and it will boil. But a phenomenon such as the growth of an apple orchard, or language, or a city cannot be traced to a single cause; rather, these phenomena depend on a range of causes interacting to produce new states. Rather than *linear causality*, emergence demonstrates *systemic causation*. That is, as Nobel Prize Laureate in Physics Robert Laughlin points out, where a linear approach demands that we understand nature by "breaking it down into ever smaller parts," an approach grounded in emergence requires that we understand "how nature organizes itself" (2005, 76).[1]

What I will be calling the principle of emergence sits at the heart of big history. Consider the big bang cosmology that forms the context for everything else that is treated in our discipline: an almost unimaginably tiny homogeneous mass of matter/energy seems to have unfolded into an equally difficult-to-imagine universe of hundreds of billions of galaxies, including the almost equally unthinkable diversity of life forms on our planet. I want to discuss this principle and how big history can profit from incorporating it more fully into our studies. Big history already acknowledges emergence in its multi-disciplinary approach and awareness of the many causes that interact to create, say, a new species or a thriving city, both of which are emergent phenomena. On the other hand, the way people write and talk about big history sometimes seems far more certain than emergence suggests. In this way, the cosmological narrative is often discussed as a fact, from the Big Bang thirteen and a half billion years ago to the heat death of our universe billions of years in the future. As we will see, one of the key elements of the principle of emergence is the realization that the dynamics of our universe can be so complex that it is near-impossible to be certain what the outcome of many emergent processes will be. I believe that a look into what scientific studies of emergence are beginning to uncover may give us a more effective way to think about our studies in big history.

My purpose is not to criticize the current state of big history. Rather, I want to suggest a direction that might enable thinkers in the field to re-view their approach to the subject in a way that expands our vision and ties our methodologies more tightly into what is being done today in the physical sciences. To that end, I draw on work that has been done in complexity theory, especially its take on emergence. The first part of this essay will, therefore, examine what complexity theory has uncovered in its scientific exploration of emergence.

In the second part of this essay, I offer an extended example of what can be uncovered as we integrate the principle of emergence into a topic of interest in big history—religion. To that end, I examine several of the many evolutionary changes over the last four million years that allowed religion to emerge. Those changes range from shifts in climate to changes in body type and social structure. Once religion became part of being human, its nature continued to unfold as a key strategy in the social evolution that allowed our species to adapt from living in bands of thirty people using stone tools to cities of thirty million using electronics.

Finally, I discuss the benefits of more thoroughly incorporating the principle of emergence into big history. One such benefit is what may seem a subtle shift in the way we think about history. Consider my friend Carl, who received his bachelor's degree from MIT, is well read in quantum mechanics, and eventually went back to school to become a chiropractor. Because of the depth and breadth of his knowledge, I was surprised to learn that he disliked history in high school. When I asked why, he said it seemed to be mostly a matter of memorizing timelines, one event leading inevitably into another. I, on the other hand, have always thought of history as a carnival—groups of people interacting raucously as they play "games" and take "rides." Emergence, I have become convinced, gives us the tools for exploring history as this sort of carnival. With that in mind, let us turn to the understanding of emergence that complexity theory has developed.

Complexity Theory and the Principle of Emergence

While emergence first drew attention from philosophers, over the last forty years or so, it has become the object of scientific attention, especially with the rise of cybernetics, systems thinking, and complexity theory. This paper will draw predominantly on complexity theory. This discipline itself emerged in the 1970s, as desktop computers made it possible for scientists in fields from fluid dynamics to ecosystem studies to model the systems they studied with non-linear mathematics.[2] These scientists discovered that complex adaptive systems (CASs), as they are often called—systems with a variety of different components, whose interaction determines their behavior—produced remarkably similar patterns over time, one of which is emergence.[3] Such systems exist as nested networks on a variety of scales, from sub-atomic particles, atoms, and molecules to cells, organisms, and ecosystems, culminating with planets, solar systems, galaxies, and the universe. Each CAS is an integrated network composed of less extensive networks and is also embedded as a component in a larger CAS network.

At each increasingly larger scale, CASs generally become more complex—that is, they have an increasing number of different components and scales of networks, whose interaction determines their behavior. Up to the scale of molecules, these systems appear simple enough to operate through cause-and-effect, where behavior can be explained with simple rules, as with the example of boiling water. At the scale of macro-molecules, such as DNA, they develop the ability to learn (e.g., Gell-Mann 1994). With that ability, they seem to acquire *agency*, the ability to participate in the carnival of emergence, in which they are continually responding to shifts in their environments and, in this way, helping to shape the responses of other agents. For example, the human brain contains about 85 billion neurons, all of which can become connected to any other. Learning occurs as a person's experience is stored in networks of neurons; each such network acts as an agent, a living entity whose purpose is to help us survive. The field of perception each of us experiences during waking hours depends largely on the interaction of these neural networks with information from our sense organs (Laughlin et al. 1990). In this case, individual nerve cells, our sense organs, and neural networks all function as agents within the brain.

As psychologist and electrical engineer John Holland explains in his book, *Emergence*, "We are everywhere confronted with emergence in complex adaptive systems—ant colonies, networks of neurons, the immune system, the Internet, and the global economy, to name a few—where the behavior of the whole is much more complex than the behavior of the parts" (1998, 2). As an example, Holland asks us to consider the complex systems that cities develop to feed, clothe, house, and entertain people who live in them. New York City, for example, grew from a community of a thousand in 1650 to sixty thousand by 1800 and a million by 1872. Yet, there was no central authority that planned where restaurants and department stores, apartment buildings and theaters should open. All these resources *emerged* as people interacted where needs created opportunities in a specific social environment.

From this perspective, the key qualities of any emergent phenomenon include these:

> Radical novelty—new things emerge that are unpredictable from knowledge of their components;
>
> Coherence—these new phenomena arise in the behavior of a system, an integrated network as a whole, whether the body of a living thing, a community, or a philosophy;
>
> Dynamics—the systems where emergence occurs are evolving so that both their components and the whole are continually adapting to changes in their environments; and
>
> Self-transcending construction—as emergent CASs unfold, their component systems change to meet new conditions in their environments and then recombine with other component systems to produce radically new behaviors in the whole.[4]

One other principle of complexity theory will be helpful for this discussion—the way evolving systems go back and forth between relatively long periods of stability (the *stable state*) and shorter periods of rapid change (*phase transition*). This principle is important because emergence occurs much more rapidly during phase transition, and examining why innovations emerge more rapidly there may offer suggestions for understanding how the process works.

This oscillation between stable states and phase transitions is an extension of the concept of an "attractor." In mathematics, an attractor creates the characteristic pattern of behavior, the "habits," to which any phenomenon is drawn under specific conditions (Cohen and Stewart 1994; Salthe 1993). Take a simple example: Put a chunk of ice in a pot on a hot stove. It will remain solid until it approaches its melting point, then enters a turbulent phase transition, and transforms into liquid. It will remain liquid until it approaches its boiling point, becomes turbulent again, and transforms into gas. The resulting alternation between turbulent phase transitions, in which their agents explore the environment for behaviors that enable them to survive, and the stable states in which their behavior conforms to established habits, can be represented in the "back-of-the-cocktail-napkin" Figure 1(Baskin 2008).

While the figure depicts a wide variety of phenomena of interest in big history, the most familiar may be punctuated equilibrium in biological

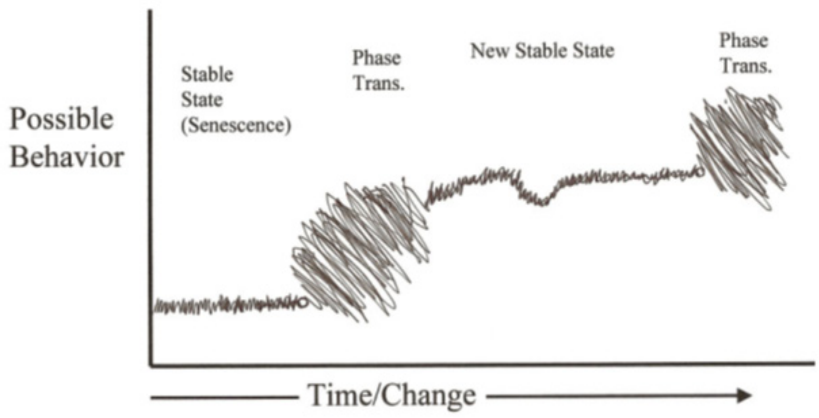

Figure 1: Life Cycle of an Attractor

evolution, where long periods of ecosystem stability are punctuated by shorter periods, following catastrophes, which make new and different ecosystems possible (Gould 2002). For example, the stable state of dinosaur-dominated ecosystems was punctuated by the comet strike that killed off the dinosaurs about sixty-five million years ago. That is, the attractor that made dinosaur-dominated environments a stable state for tens of millions of years dissolved, and the agents in it had to experiment in the resulting phase transition as they searched for physical structures and behaviors that would enable them to thrive in new conditions. As biologist Stanley Salthe (1993) notes, phase transition is the most creative period of any CAS's evolution, *precisely because of the freedom from the coherence among component agents imposed by an established attractor*. When the agents do find successful behaviors, they form habits, which continue as long as they succeed.

Over time, the agents build relationships practicing these behaviors. The longer habits succeed, the deeper the relationships become, and the more the agents rely on their relationships. The attractor that develops, such as that of the mammal-dominated ecosystems that arose after the comet, limits an agent's behavior because the agent now depends on it for its welfare. As experience accumulates and agents make more and more irreversible decisions, their freedom to adapt becomes further limited. Eventually, external change becomes so great that behaviors needed to adapt fall *outside* what the attractor allows. At this point, the phenomenon enters "senescence" (Salthe 1993), and even attempts to change end up reflecting old behaviors. Finally, environmental change becomes so great that agents can no longer survive if they remain limited by their attractor, an event that seems to be happening today in ecosystems around the world. The phenomenon's network collapses, and agents, still connected in smaller networks, must either fall apart or reenter phase transition and develop another attractor.

Figure 1 also reflects many of the important *cultural* phenomena for which big history must account. Philosopher Michel Foucault's (1974) description of the periods of continuity and discontinuity in the evolution of Western culture, economist Gerhard Mensch's (1979) explanation of the cycle of economic boom (stable state) and depression (phase transition), and economist Giovanni Arrighi's (2010) examination of the evolution of Western capitalism—all fit this pattern. Why do such different phenomena conform to it? They conform because *all phenomena that evolve* seem to oscillate between relatively long periods of structural stability and the shorter phase transitions, during which they re-organize their structures to meet changed environmental conditions.

This oscillating pattern is valuable in the discussion of emergence because, as Salthe notes, many more innovations arise during periods of phase transition, when the strength of relationships has broken down and many of the agents in any sub-system are free to search for new, more appropriate ways to behave. Subsequently, the dominant forms of life develop and become established during periods after mass extinctions. Similarly, many of today's most important religions—including those in Western monotheism, Buddhism and Hinduism in India, and Confucianism and Daoism in China—emerged during the Axial Age, circa 800-200 BCE, which followed the stable period of polytheistic agriculture states, circa 3000-800 BCE (see Baskin and Bondarenko 2014).

From this perspective, cultural innovations emerge most intensely when a society's structure/attractor can no longer hold the system together. Sub-systems are then driven to find new ways of behaving so that they can survive. As they find those new ways, they reform the larger social systems of which they were part. Religion, I shall argue, is a key sub-system in societies and, at least until the late modern era, has been critical in the process of emergence by which societies revitalize themselves (Wallace 1966). This dynamic, I suspect, is very much what complexity theorist Jeffery Goldstein (2014) suggests when he discusses a self-transcending construction.

Religion as an Emergent Phenomenon

Before examining religion as an emergent phenomenon, it is important to note that the question, "What is religion?" is more difficult to answer satisfactorily than most people would assume. Nearly sixty years ago, historian of religion Wilfred Cantwell Smith noted that "religion" is "notoriously difficult to define." He adds that while the "phenomena that we call religious undoubtedly exist," treating them as a distinctive category may not make sense (1991, 17). Fifty years later, anthropologist Robert Winzeler echoes that thought: "There clearly is something in society that we can call religion, although exactly what it is may not be that simple to specify" (2012, 1).

Consider just a few of the many definitions of religion: philosopher Bertrand Russell defines it as a "disease born of fear"(1967), while psychologist William James characterizes it as a way to achieve our "supreme good" (2009). Freud writes about religion as a psychological adaptation, comparing it to a neurotic obsession (Gay 1995); Marx examines it as a way to adapt to economic oppression, the "opium of the people" (2009); and anthropologist Barbara King (2007) discusses it as a way to meet the human need to belong. One of the most explored single focuses in defining religion in recent years concerns why people believe in a "counterintuitive and counterfactual" world inhabited by supernatural agents (Atran 2002). Among these writers, philosopher Daniel Dennett (2006) suggests that religion grows from a "belief in belief"; evolutionary biologist Richard Dawkins (2006) points to the "misfiring" of neuronal networks; and psychologist Ara Norenzayan emphasizes society's need for "Big Gods" who watch and punish people, enhancing cooperation in large, anonymous societies (2013).

These are only a few of what some scholars estimate as more than three hundred definitions for the word. There is an excellent reason for this difficulty. Religion appears in many, many forms—from Siberian shamanism to Jainism to the Prosperity Gospel. Religious rituals range from cannibalism and human sacrifice to High Mass at the Vatican or mandala-making among Tibetan Buddhists. In fact, "religious" phenomena take so many different forms that thinkers from W. C. Smith (1991) to Indian culture critic S. N. Balagangadhara (2005) make credible cases that religion is not a useful academic category. However, there is another way to think about the abundance of religious phenomena: the apparent incoherence of religion as a category is evidence, not of a problem of coherence, but, rather, of its complexity and importance in human history. After all, in only the last 11,000 years our species has moved from living in bands of about thirty to cities of thirty million. If as I have argued (e.g., 2021), religion has been a key survival strategy for our race, one would expect it to take on this wide variety of forms.

For me, religion is the use social groups make of myth and ritual in order to understand and respond to critical, often mysterious challenges that inspire awe and terror (see Otto 1923)—from the realization that life lives on death, including our own, to the feeling of oneness with the universe; from the birth of a child to being conquered by others. Because our brains are structured so that we need to know *why* such experiences happen, we tell stories (mythology) in order to answer these questions (Gazzaniga 2011). By presenting these challenges symbolically in that mythology, humans have been able to explore many of the mysterious forces that could not be examined rationally. By coupling these stories with ritual, religion also made it possible for human groups to respond to such challenges far more effectively. Because each group developed myths and rituals that reflect their particular conditions and values, it should be no surprise that the phenomena we call "religious" can seem nearly incoherent in their variety. The point I want to emphasize here is that the process by which the products of this conception of religion both arose and evolved (e.g., Hayden 2003; Bellah 2011) is emergence—the self-transcendence of religious forms and systems, as the many sub-systems within and around them change.

Other thinkers have begun to suggest that religion seems to be an emergent property. For instance, anthropologist Jonathan Turner and his coauthors explain that religion "emerges from *many* cognitive, emotional, and behavioral capacities and/or propensities that were hard-wired *for millions of years* in the neurology of higher mammals, higher primates, great apes and hominins" (Turner et al. 2018, 8; authors' italics). Similarly, cultural anthropologist Margaret Boone Rappaport and astronomer Christopher Corbally agree that it "is not one or even several . . . biological innovations that produce religious capacity. It is all of them. Without all these innovations operating at the same time, the human species would not have this neurocognitive trait" (2020, 15). A wide range of such biological innovations is involved. As examples, we will consider four of them: bipedalism and the opposable thumb, language, perception that transforms events around us into story-like models, and the enhancement of ritual.

Worth noting is that religion seems to have emerged as an adaptation to changes in the environment of our evolutionary ancestors over the last ten million years:

> Early in this period, several million years of warming began to turn parts of the East African rainforests into savannahs. By three to four million years ago, our ancestors had been driven out of the forests and onto the savannahs. The difference between living in the trees of a rainforest and on the ground of the savannahs would prove critical in our evolution, driving our ancestors to walk more and more exclusively on two legs and to live in small, nomadic bands. This difference would also drive two key sets of innovation.
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> Our hominin[5] ancestors would now need to develop a different way of living. The great apes that evolved into hominins had lived in the rainforests for more than twenty million years. They had developed instincts and habits that made their lives familiar; now, our ancestors were nomads, strangers in strange lands. In addition, the rainforests provided easily available food and water all year long; on the savannahs, both food and water were spaced out over far larger areas, and much of it was seasonal. As a result, our ancestors would have to live a far more adventurous life in which memory and the ability to plan were far more vital.
>
> They would also need to become much more closely bonded in their bands than the great apes were in the rainforest. The rainforest, after all, was dense with vegetation and places to hide from a limited group of predators to which our ancestors had long become accustomed. Travelling on the savannah, they were far more exposed to predators, and they would come into contact with species of predators with which they had no experience. So, as Robin Dunbar notes, "large social groups would . . . have been their main defence against predators on open pans and flood plains" (2016, 127). As a result, natural selection would favor innovations that would build much tighter bonds between members. (Baskin 2019)

As our australopith ancestors traveled through this new world, they would evolve to develop new ways to live in the world, as a variety of mutations enabled them to survive in it. As Rappaport and Corbally (2020) point out, these innovations, which made them far better hunters and scavengers, also made religion possible. Consider four of the most important sets of these innovations:

Bipedalism and the opposable thumb. At some point, about 4 million years ago, australopiths began walking predominantly on two legs. We can be pretty sure, from the fossil of "Lucy," a female *Australopithecus afarensis*, that our ancestors had become bipedal by about 3.2 million years ago. Walking on two legs would have had several advantages. It enabled our ancestors to see farther and to move faster; it may also have led to larger brains because the brain has to work harder to monitor perception for individuals that walk on two rather than four legs; finally, it freed the hands to perform jobs such as making and using both tools and weapons. By about two million years ago, *Homo habilis* ("handy person") was doing just that. The opposable thumb also evolved between four and two million years ago, as Lucy's fossil demonstrates. Opposable thumbs are free to rotate and swivel in opposition to the other fingers (Wilson 1999). As a result, our ancestors would have become much more formidable scavengers and hunters, fulfilling the promise of bipedalism to make and use tools. While it may be possible to argue that these innovations resulted from a few mutations, the rise of bipedalism and the opposable thumb in roughly the same period to perform some of the same functions makes it more likely that they developed as a result of emergence, in the interaction between networks of genetic material.

Language. With language, the difference between a linear and an emergent approach toward evolution is even more clear cut. Linguistic theorist Noam Chomsky (1957) does theorize that language might have begun with a single mutation that created a language engine in the brain. Yet, given the number of innovations that were needed to make language possible, I find this difficult to accept. For me, even more than bipedalism and the opposable thumb, language[6] reflects the systemic causality of emergence. The sub-systems that contributed to the emergence of language include several areas of the brain—including the larger cerebellum, which provides the muscle control needed for articulate speech; Broca's Area, which controls production of speech; and Wernicke's Area, which processes speech comprehension. Another set of anatomical innovations in the throat and mouth make highly articulate speech possible. The hyoid bone, for instance, is part of the anatomical equipment that enables humans to articulate clearly. Exactly when these innovations came together to make language a reality has been widely discussed. Fossils of our evolutionary ancestors suggest that language as we know it—as a way of representing sophisticated thought—is likely to have begun no earlier than with *Homo erectus*, maybe about a million or million and a half years ago (Donald 1991; Everett 2017). Other scholars date language to the period of Neanderthals or even early *Homo sapiens*. Whatever the truth of this matter, the complex of functions that had to exist makes it likely that language developed as an emergent phenomenon.

Perception as Story-like Models. When I look around the office where I am writing this essay, I feel as though my senses were an organic HD video camera projecting images of what is "out there" onto my consciousness. What is actually happening is an act of selective reconstruction of *a model of what is out there*. In this process, people's sense impressions mix with memories, and the mixture is evaluated according to their mental models—the neural networks that store what they have learned to expect in various situations (Laughlin et al. 1990). Any details that do not fit the mental models are likely to be filtered out (Siegel 2010). In an area of the brain that Gazzaniga (2011) calls the interpreter module, the unconscious mind then creates several scenarios to explain what is happening and delivers the scenario that seems most likely to allow the person to survive to consciousness. These story-like models of what is happening enable that person to figure out how to respond.

Once again, this style of perception emerged from the interaction of a variety of evolutionary innovations.

These innovations begin with the expanded neo-cortex that provided increased memory and the "executive functions" that mediate abstract thought, anticipation of the future, planning, and the construction of images (Laughlin et al. 1990, 116-7). While these shifts in brain function probably evolved to enhance the hunting and scavenging of our australopith ancestors (Rappaport and Corbally 2020), they would prove essential in the development of story-like model construction. Another key innovation was the emergence of the left-brained interpreter, a concept that psychologist Michael Gazzaniga and neuroscientist Joseph Le Doux developed. Gazzaniga refers to the products of the interpreter as "make-sense stories" (2011). The need for such "make-sense stories" seems to reflect a human need to know *why* things happen. My speculation is that this way of perceiving is at the heart of mythology because, along with increased memory and the executive functions, it created the human tendency to experience events—in the case of mythology, the powerful, often mysterious events that elude rational understanding—in story-like models that explain *why* events happen. With a brain structured this way, it seems likely that hunter-gatherers, confronted, for example, with flooding or famine, would create stories that anthropomorphized the natural causes of these catastrophes as spirits or gods (Baskin 2019).

The Enhancement of Ritual. Another key set of innovations that made religion possible was the human enhancement of animal ritual.[7] Ritual behavior emerged about 150 million years ago among the first "social animals," certain early insects. Social animals—from ants and bees to cockatoos, wolves, and chimpanzees—live with several generations, hunt and defend the group together, and rely on group learning. As a result, they profit from having ways to communicate complex messages quickly and to strengthen group cohesion. With the increased social complexity of animals such as wolves and, even more so, chimpanzees, ritualized behavior became even more important. Wolves, for instance, have rituals to enforce group leadership (d'Aquili et al. 1979). One chimpanzee ritual, where groups of about fifty males will hoot, scream, and drum old logs, struck Jane Goodall as shockingly like human rituals (Turner et al. 2018).

With human beings, however, rituals became even more intense. For one thing, our evolutionary ancestors developed, perhaps three million years ago, a wider palette of emotions, including key social emotions such as guilt and shame, which allowed more powerful feelings of belonging. Moreover, as psychiatrist Eugene d'Aquili and his coauthors (1979) note, the rhythmic movement and chanting of ritual entrain the nervous systems of participants so that they can feel similar emotions. In this way, ritual creates a biologically based sense of community (see also Winkelman 2010). By the time of *Homo erectus*, who emerged around 1.8 million years ago, the brain had evolved to make it possible for our ancestors to mimic each other, creating what psychologist Merlin Donald (1991) calls "mimetic culture," grounded in the newly developed ability to rehearse and refine body movement. In this way, it became possible to use dance and mime to make symbolic statements and to tell stories through body movement. Such a capability would have made it possible to tell mythic stories without language. Of course, any mimetic myth, probably performed as ritual, would have been very different from what we think of in the linguistic myths we know. Still, such a form of mimetic ritual/myth would have been a powerful way to enhance social coherence. It might also have begun an integration of ritual and myth in an early form of religion as I have defined it.

In this essay, we can only touch on a few of the many shifts in genome, body type, and behavior that would interact to produce what we think of as religion. Still, this discussion illustrates how many sub-systems, which evolved to adapt to more immediate survival challenges, interacted to make religion possible. From this perspective, religion began in a gradual unfolding of innovations, which arose to meet different challenges. Their application of these innovations to religious ends would have been all but impossible to anticipate before they were used that way, as the principle of emergence suggests. For instance, bipedalism and the opposable thumb made our ancestors more effective scavengers and hunters, leading to higher intake of protein and, very likely, larger brains. Those larger brains would make them even more efficient toolmakers and hunters. In addition, the increased memory and planning capabilities would lead to the story-like perceptions that, over time, would make them even more efficient toolmakers and hunters, as they developed the ability to tell mythical stories.

The principle of emergence also seems at work in the way religion has evolved over the last ten thousand years.[8] The earliest human religions seem to have been similar to shamanic animism found in small, nomadic hunter-gatherer bands, where the dependence of groups on the rhythms of nature leads to experience everything in the world as invested with living spirits. There, one person, the shaman, is able to intervene with those spirits to maintain the group and its members in harmony with their world. In addition, ritual was a shared responsibility of the group as a whole (Winkelman 2010). When the Ice Age ended, human communities became sedentary and group populations climbed to hundreds and thousands. Such groups, where it was impossible to know everyone, required political leadership. Recent archaeological evidence suggests that those political leaders appear to have transformed religion so that the spirits among which people lived became gods who were to be worshiped. Those leaders also appear to have developed secret societies that allowed them to identify themselves as conduits to the world of their gods (Hayden 2018). They also created rituals that they, themselves, were responsible for performing. This transformation—I believe—is another example of Goldstein's self-transforming construction so critical to emergence.

A similar set of transformations would occur during the Axial Age, as increased population and trade, iron metallurgy, and the use of writing to manage culture overwhelmed the ability of the older agricultural states to govern large societies. Axial transformations in Israel and Greece, India and China would lead to another stable state—the agricultural empire—starting about 200 CE. One key to driving the emergence of this new stable state during the cultural phase transitions would come from rewriting a society's mythology.[9]

Judaism, for instance, seems to have included a wide range of mythic sub-systems in order to begin fully emerging after the first reading of the Torah in Jerusalem in the middle of the fifth century BCE. Its God—YHVH, because Hebrew is written in only consonants, the accurate pronunciation of his name is honored as a mystery—is an amalgam of mythic forerunners from other cultures. They include the creator god of Ancient Mesopotamia, Marduk, and that culture's flood story; the thunder god/god of war of Canaan, Baal (Miles 1995); and a range of influences from Ancient Egypt, including possible borrowings from the monotheistic god and religion created by Pharaoh Akhenaton, its emphasis on personal piety and its judgment of the dead, and even what seem to be borrowings from Akhenaton's "Great Hymn" in the Bible's Psalm 104 (Assmann 1997). All those borrowings would be redirected in the Hebrew Bible, much of which was written after the Babylonian destruction of Jerusalem and Solomon's Temple (c. 587 BCE). In order to save the culture of Israel, the existing mythology was rewritten to make the conquered people responsible for their own demise—because they worshipped other gods than YHVH, the one true god. At the same time, they were promised that YHVH would again favor them—if they mended their ways (Akenson 2001). This sense of being active agents, even in catastrophe, seems to have been critical to Judaism's ability to survive all the subsequent catastrophes that it has absorbed over the nearly 2,500 years since the Torah was first read.

This transformation was typical of the societies that experienced the Axial Age as a cultural phase transition. In China, the traditional religion of the Zhou period (c. 1100-256 BCE) would evolve to adapt to the terrible chaos of the Axial Age, bringing together the traditional orientation of Confucianism with a range of other influences, from the many schools of religious philosophy of the time to the challenges provided in Daoism and, later, Buddhism (Graham 1989). Similarly, Axial Age India would see the flourishing of both Buddhism and the Vedic tradition that the English would misidentify as Hinduism. Here, a focus on the human internal world would lead to what, to this day, seems to be among the most effective way to heal the sense of something being wrong with human life that Buddhists call *dukkha* and Christians call original sin (Armstrong 2006).

In this way, the Axial Age functions as the phase transition during which the polytheistic kingdoms of an age of agricultural states in four very different societies transformed their cultures so that they could thrive in what would become an age of agricultural empires. As anthropologist Dmitri Bondarenko and I show, the creation of a new way of thinking about the world would emerge, in the technical sense of the word, as people in those societies rewrote their mythologies and reconstructed their societies (Baskin and Bondarenko 2014).

Worth noting is that Christianity would emerge similarly, beginning as a form of messianic Judaism, as a sort of secondary wave of Axial Age transformation (Armstrong 2006). After the destruction of the Second Temple (70 CE), Christianity would increasingly appeal to non-Jews, mostly Greek Roman "pagan" communities, taking on elements of their "foreign" religious traditions. Perhaps most notable was Constantine's apparently successful attempt to make Christianity acceptable to his soldiers, many of whom worshipped Mithra. In this way, Mithra's birthday, December 25, would also become the birthday of Jesus, even though the gospels suggest that Jesus was born in the spring.

Even with this brief discussion, it seems clear to me that treating religion as an emergent phenomenon shows how powerfully it has helped people survive the dramatic changes of the last ten thousand years. For me, religion is one of the key survival strategies in human history. I am convinced that scholars need to approach religion very differently, in a way that incorporates the principle of emergence. Such an approach can help all of us understand the richness of history as a carnival, rather than as a timeline, with a methodology that is deeply embedded in work that was done in the physical sciences, from which complexity theory itself emerged.

With that in mind, I want to conclude this essay with some thoughts on how more deeply embedding the principle of emergence into the practice of big history might enhance our studies.

Emergence and Big History

First of all, I want to emphasize that much of what I have written here will be familiar to readers of this journal. After all, the multi-disciplinary approach I have connected with an emphasis on emergence is key to big history. Pick up any book on big history and you are likely to find references to fields ranging from quantum mechanics to archaeology, from geology and chemistry to economics and demography. In addition, a big history approach often explores the complexity of a world where a wide variety of causes can contribute to the way events unfold. I believe, nonetheless, that more fully incorporating the principle of emergence can open possibilities that may enable students of big history to examine the world in a richness that has the power to help them see things in ways that can take us beyond what we have done without it.

Before I explain why I believe emergence can be so valuable in the study of big history, it will be worth revisiting the key points about this principle. Emergence depicts the processes we see all around us as self-transcending constructions that are continually responding to many scales of change going on around them. As the apple seed sprouts into a tree, its transformation is guided by its DNA, its other internal matter, and the conditions of soil and weather that surround it. The relatively simple seed is thus driven to transcend itself to become the far more complex apple tree. To think this way demands that we think of our world as a dynamic, unfolding dance of matter—that is, energy-storage systems—that can best be described "in terms of forces and flows rather than a succession of equilibrium states" (Ho 2008, 29). So, as we consider life on a planet such as Earth, emergence, with its dynamic, non-linear assumptions, can push us to think of the world as a riotous carnival, rather than the mechanical timeline that a more traditional, linear approach to history suggests.

In thinking about the world as a carnival, where emergence seems to be almost everywhere, several dynamics kick in that enable us in big history to perceive and explore the world differently. For one thing, the world we examine is suddenly full of agents, whose qualities and movements are continually enriching that carnival. As Bruno Latour notes (2005), in the human world, these agents begin with people but also include other living things, ideas, technologies, and even natural processes, such as global warming or the fall of a comet. Consider, for instance, how fundamentally technologies such as the automobile or the computer reinvented America's social carnival in the twentieth century. Moreover, what matters most is not the nature of individual things, but their relationships. This dynamic approach is unlike the traditional linear approach, which follows individual clumps of passive matter, driven to move as they respond to the universal laws of nature. In this way, the environment is no longer a collection of passive objects to be manipulated and controlled; it becomes a nested network of agents, many of which are capable of having deep and lasting effects on our world as they affect each other, a fact that people across the planet have recently witnessed in the emergence of the COVID-19 virus.

For another, integrating the principle of emergence shifts the way we think about how the processes around us function, transforming from the mechanics of determinism to the dynamics of uncertainty. As we just noted, the linear paradigm views matter as passively responding to its encounter with the laws of nature. Theoretically, then, if one could know all those laws and the position of every bit of matter, it would be possible to calculate the future, which had been determined from the beginning of the Universe. Nobel Laureate in Physics Robert Laughlin characterizes this quality of the Newtonian paradigm as "the idea that things tomorrow, the day after, and the day after that are completely determined from things now through a set of simple rules and *nothing else*" (2005, 24; author's italics). Once we incorporate the principle of emergence, all that changes. Viewed as a carnival, life on Earth is so abundant, and there are so many CASs interacting, that we *should* expect to be surprised. Consider the events of 2020. It was clear for decades that at some point the world would again experience a pandemic, yet who would have predicted that such a pandemic would undermine the reputation of the United States as fully as the Trump Administration's refusal to take COVID-19 seriously has damaged it? Former administrations had *quite literally* written the book on dealing with a pandemic, but the interplay of social sub-systems very nearly destroyed the country's ability to respond. As a result, at this publication, more than six million people worldwide have died of COVID-19 complications with more than one and a half million of these in the United States; America has become the object of ridicule; and the country's anti-science movement has become more and more vocal—all this while both China and Russia are becoming increasingly powerful.

This shift to the dynamics of uncertainty is important to big history because it can change the way thinkers within the discipline approach a wide variety of issues. For instance, consider the cosmology of big history, which currently charts a course from the Big Bang to the entropic death of our Universe. While this narrative emerges from some of the most impressive scientific advances our culture has made, it is also regularly articulated as deterministic. Once we incorporate the principle of emergence, however, we introduce an element of uncertainty that may open the way to think very differently about all sorts of issues. This point of view encourages us to look for alternative futures that might arise from systemic interactions that we have not examined, ones that we may not even be aware of yet. It also pushes us to approach such issues with a great deal more uncertainty. After all, for more than two centuries after Newton wrote his *Principia Mathematica*, scientists largely assumed that time and space were separate dimensions. With

Einstein's theory of special relativity, it would become clear that space and time were deeply interconnected. Such an observation does not diminish Newton's accomplishments. Rather, it emphasizes that the models of the world that scientists create depend on the best information available *when they are created*. As the amount of available knowledge continues to explode—and the tools we have for studying nature improve—it seems inevitable that many of the ideas we are surest of today may have to shift tomorrow, as new evidence appears. More fully integrating the principle of emergence into the study of big history may lead to understandings of the dynamics of the cosmos that provoke the sorts of questions about the origins of the universe—such as those voiced by astrophysicist Lee Smolin (2013)—offering a deeper understanding. Perhaps, we shall find further evidence that the cosmos did begin with a big bang and is likely to end with an entropic death. What is important here is to avoid the temptation of treating *any* model of the cosmos with the certainty that many scientists showed for Newton's model of space and time as separate and distinct.

Finally, when we combine the increased agency of the non-human world with the dynamics of uncertainty, we reframe the question of how we humans should participate in our planet's carnival life. As opposed to the linear worldview, which views human beings as the only source of active agency in the universe, a worldview that incorporates the principle of emergence makes it clear that we are an important part of the network of agency that is creating the future, but only a part. As we are learning from a number of sciences, climate change is an emergent phenomenon. As a result, we can trace today's global warming to deforestation—the intentional burning of forest areas—which started about fifteen thousand years ago and accelerated as societies burnt down forests so they could use the land for agriculture. Where rainforests once covered fourteen percent of our planet's surface, today they cover only six percent and continue to shrink ("Deforestation" 2021). The changes our species provoked accelerated with the beginnings of the Industrial Revolution in the eighteenth century and today threaten to lead to problems ranging from the spread of tropical disease to the flooding of coastal cities and largescale migration. With the linear Newtonian paradigm, we humans were the only active agents. The plants, animals, and geological formations among which we live were merely "resources" to be manipulated and controlled. The result has, at least partially, been the degradation of our environment with a very real possibility of a mass extinction in the near-term future (e.g., Kolbert 2014).

On the other hand, a paradigm that incorporates the principle of emergence offers a different way of thinking about our world, a way of thinking that is much more like the animism of hunter-gatherer societies. Here, we are part of a world that supports us. In that world, every bird and mammal, rock and stream has the agency that could make our lives easier or more difficult. Each has its own "spirit," in the sense that it is a participant in life's carnival, for good or ill. Is this not one of the key messages that has emerged from our studies in big history?

Let me close by repeating that I do not intend to criticize the current state of big history. Rather, I want to encourage thinkers in the discipline to consider shifts that might help us improve our studies. After all, in discipline after discipline, the last thirty to fifty years have witnessed an explosion in our understanding of the world, much of which is only slowly becoming widely known. My purpose in this paper has been to explain how more fully incorporating the principle of emergence might be helpful in big history. I hope you will agree it is, at the very least, worth discussing whether this position is valuable to us.

Notes

1. The emphasis on cause-and-effect to explain causality is a Western development. In Chinese philosophy, causation is generally thought of as systemic (Baskin 2007).

2. For a full discussion of how desktop computers made complexity theory studies possible, see Pagels, 1989.

3. I use the word "system" here because it is the most easily understood by the largest group of readers. Unfortunately, "system" sounds slightly mechanical. As a result, there is a strong argument for using other words, including "network" (Latour 2005) or "bundle" (Ingold 2011). I would prefer to side step that discussion, noting that I do not find the word "system" entirely accurate.

4. For a full examination of the history, dynamics, and implications of emergence, see Goldstein's three-part discussion, which appeared in *Emergence: Complexity and Organization* (2013a, 2013 b, and 2014).

5. I use the word "hominin" in its most recent sense, to identify the line of primates that broke off first from the great apes of the East African rainforest and then from the line of chimpanzees and bonobos. For a fuller discussion of the word, see Blaxland, 2020.

6. S.R. Fischer defines language as "the medium through which one conveys complex thoughts using arbitrary symbols . . . in a significant syntax" (1999, 33).

7. The key examination of this topic is *The Spectrum of Ritual* (1979), edited and predominantly written by d'Aquili, Laughlin, and McManus, which, as far as I know, remains the most comprehensive treatment of animal ritual as a precursor to human ritual.

8. For a full exploration of how religion has evolved, see Bellah, 2011.

9. For a full examination of the Axial Age as a cultural phase transition, see Baskin and Bondarenko, 2014, Chapter 2.

References

Akenson, D. H. 2001. *Surpassing Wonder: The Invention of the Bible and the Talmuds*. Chicago: University of Chicago Press.

Armstrong, K. 2006. *The Great Transformation: The Beginning of Our Religious Traditions*. New York: Anchor Books.

Arrighi, G. 2010. *The Long Twentieth Century: Money, Power and the Origins of Our Times*. New and updated edition. London: Verso.

Assmann, J. 1997. *Moses the Egyptian: The Memory of Egypt in Western Monotheism*. Cambridge, MA: Harvard University Press.

Atran, S. 2002. *In Gods We Trust: The Evolutionary Landscape of Religion*. Oxford: Oxford University Press.

Balagangadhara, S. N. 2005. *The Heathen in His Blindness: Asia, the West and the Dynamic of Religion*, 2nd ed. New Delhi: Manohar.

Baskin, K. 2007. "Ever the Twain Shall Meet." *Chinese Management Studies* 1 (1): 57-68.

Baskin, K. 2008. "Storied Spaces: The Human Equivalent of Complex Adaptive Systems." *Emergence: Complexity and Organization* 10 (2): 1-12.

Baskin K. 2019. "Religion as the Ultimate Human Evolutionary Survival Strategy." *Evolution: Evolutionary Trends, Aspects, and Patterns,* edited by L. E. Grinin and A. V. Korotayev. 145-166.

Baskin, K. Forthcoming. "The Three Questions: Understanding Religion Epistemologically." In *Science, Religion, and Deep Time*, edited by L. Gustafson, D. Blanks, and B. Rodrigue. New Delhi: Routledge India.

Baskin, K., and D. M. Bondarenko. 2014. *The Axial Ages of World History: Lessons for the 21st Century*. Litchfield Park, AZ: Emergent Publications.

Bellah, Robert N. 2011. *Religion in Human Evolution: From the Paleolithic to the Axial Age*. Cambridge, MA: Belknap Press.

Blaxland, B. 2020. “Hominid and Hominin—What’s the Difference?” Australian Museum. Accessed December 22, 2020. https://australian.museum/learn/science/human-evolution/hominid-and-hominin-whats-the-difference/.

Chomsky, N. 1957. *Syntactic Structures*. Berlin: Mouton de Gruyter.

Cohen, J., and I. Stewart. 1994. *The Collapse of Chaos: Discovering Simplicity in a Complex World*. New York: Penguin Books.

D’Aquili, E. G., C. D. Laughlin, and J. McManus, eds. 1979. *The Spectrum of Ritual: A Biogenetic Analysis*. New York: Columbia University Press.

Dawkins, R. 2006. *The God Delusion*. Boston: Mariner Books.

“Deforestation.” 2021. *Wikipedia*. Accessed February 1, 2021. https://en.wikipedia.org/wiki/Deforestation#Prehistory.

Dennett, D. C. 2006. *Breaking the Spell: Religion as a Natural Phenomenon*. New York: Penguin Books.

Donald, M. 1991. *Origins of the Mind: Three Stages in the Evolution of Culture and Cognition*. Cambridge, MA: Harvard University Press.

Dunbar, R. 2016. *Human Evolution: Our Brains and Behavior*. Oxford: Oxford University Press.

“Emergence.” 2020. *Wikipedia*. Accessed December 20, 2020. https://en.wikipedia.org/w/index.php?title=Emergence&action=history.

Everett, D. L. 2017. *How Language Began: The Story of Humanity’s Greatest Invention*. New York: Liverlight Publishing Corp.

Fischer, S. R. 1999. *A History of Language*, London: Reaktion Books.

Gay, P., ed. 1995. *The Freud Reader*. New York: W. W. Norton & Co.

Gazzaniga, M. S. 2011. *Who’s in Charge? Free Will and the Science of the Brain*. New York: HarperCollins.

Gell-Mann, M. 1994. *The Quark and the Jaguar: Adventures in the Simple and the Complex*. New York: W. H. Freeman and Co.

Goldstein, J. 2013a. “Re-imagining Emergence, Part 1,” *Emergence: Complexity and Organization* 15 (2): 77-103.

Goldstein, J. 2013b. “Re-imagining Emergence, Part 2,” *Emergence: Complexity and Organization* 15 (3): 121-138.

Goldstein, J. 2014. “Reimagining Emergence, Part 3: Uncomputability, Transformation, and Self-transcending Constructions,” *Emergence: Complexity and Organization* 16 (2): 116-176.

Gould, S. J. 2002. *The Structure of Evolutionary Theory*. Cambridge, MA: Belknap Press.

Graham, A. C. 1989. *Disputes of the Tao: Philosophical Argument in Ancient China*. La Salle, IL: Open Court.

Hayden, B. 2003. *Shamans, Sorcerers, and Saints: A Prehistory of Religion*. Washington, D.C.: Smithsonian Books.

Hayden, B. 2018. *The Power of Ritual in Prehistory: Secret Societies and Origins of Social Complexity*. Cambridge: Cambridge University Press.

Ho, M. W. 2008. *The Rainbow and the Worm: The Physics of Organisms*, 3rd ed. Singapore: World Scientific Publishing Co.

Holland, J. H. 1998. *Emergence: From Chaos to Order*. Cambridge, MA: Perseus Publishing.

Ingold, T. 2011. *Being Alive: Essays on Movement, Knowledge and Description*. New York: Routledge.

James, H. 2009. *The Varieties of Religious Experience: A Study in Human Nature*. Seven Treasures Publications.

King, B. J. 2007. *Evolving God: A Provocative View of the Origins of Religion*. Chicago: University of Chicago Press.

Kolbert, E. 2020. *The Sixth Extinction: An Unnatural History*. New York: Henry Holt and Co.

Latour, B. 2005. *Reassembling the Social: An Introduction to Actor-Network-Theory*. Oxford: Oxford University Press.

Laughlin, C. D., J. McManus, and E. G. d’Aquili. 1990. *Brain, Symbol & Experience: Toward a Neurophenomenology of Human Consciousness*. Boston: Shambhala Publications.

Laughlin, R. B. 2005. *A Different Universe: Reinventing Physics from the Bottom Down*. New York: Basic Books.

Marx, K. (1843) 2009. Introduction to *A Contribution to the Critique of Hegel's Philosophy of Right*. Accessed January 31, 2021. https://www.marxists.org/archive/marx/works/1843/critique-hpr/intro.htm?source=post_page.

Mensch, G. O. 1979. *Stalemate in Technology: Innovations Overcome the Depression*. Cambridge, MA: Ballinger Publishing Co.

Miles, J. 1995. *God: A Biography*. New York: Alfred A. Knopf.

Norenzayan, A. 2013. *Big Gods: How Religion Transformed Cooperation and Conflict*, Princeton: Princeton University Press.

Otto, R. 1923. *The Idea of the Holy: An Inquiry into the Non-rational Factor in the Idea of the Divine and its Relation to the Rational*. Translated by J. W. Harvey. London: Oxford University Press.

Pagels, H. 1989. *The Dreams of Reason: The Computer and the Rise of the Sciences of Complexity*. New York: Bantam Books.

Rappaport, M. B., and C. J. Corbally. 2020. *The Emergence of Religion in Human Evolution*. New York: Routledge.

Russell, B. 1967. *Why I Am Not a Christian and Other Essays on Religion and Related Subjects*. New York: Touchstone.

Salthe, S. 1993. *Development and Evolution: Complexity and Change in Biology*. Cambridge, MA: MIT Press.

Siegel, D. J. 2010. *Mindsight: The New Science of Personal Transformation*, New York: Bantam.

Smith, W. C. 1991. *The Meaning and End of Religion: A New Approach to the Religious Traditions of Mankind*. Minneapolis, MN: Fortress Press.

Smolin, Lee. 2013. *Time Reborn: From the Crisis in Physics to the Future of the Universe*. Boston: Houghton Mifflin Harcourt.

Turner, J. H., A. Maryanski, K. P. Anders, and A. W. Geertz. 2018. *The Emergence and Evolution of Religion: By Means of Natural Selection*. New York: Routledge.

Wallace, A. F. C. 1966. *Religion: An Anthropological View*. New York: Random House.

Wilson, F. R. 1999. *The Hand: How Its Use Shapes the Brain, Language, and Human Culture*. New York: Vintage Books.

Winkelman, M. 2010. *Shamanism: A Biopychosocial Paradigm of Consciousness and Healing*, 2nd ed. Santa Barbara, CA: Praeger.

Winzeler, R. L. 2012. *Anthropology and Religion: What We Know, Think, and Question*. Lanham, MD: Altamira Press.