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The Universal Breakthroughs of Big History: Developing a Unified Theory

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Abstract

The currently unfolding panoramic view of the eons, which the modern scientific and historical disciplines present, reveals an outstanding series of critical and transformative universal breakthroughs running throughout the history of the cosmos, life, and man. This paper begins to explore and develop an orderly framework for Big History based on this remarkable overall pattern of similarly sudden and rapid outbursts of expansive creative power marking the entire course of evolutionary manifestation. On this basis I consider and propose: (1) 'A Great Story of Origins' with sixteen 'Origin Events', each of which in turn dramatically establishes and defines a new 'Regime' and subsequent 'Evolutionary Era' with emergent qualities; (2) a reconsideration of current issues at the cutting edge of evolutionary theory including 'punctuated equilibrium'; (3) a recognition of the essential 'twofold' or 'biphasic' nature of developmental change in time; (4) an expansion of evolutionary thought in the context of Big History; and (5) approaches towards developing a Unified Theory.

Keywords: *thresholds, punctuated equilibrium.*

I. Introduction: Origin Events

The Big Bang theory of the origin of the universe, along with its profound implications, has been resonating in human awareness for only a relatively short time. It is certainly a striking and uniquely impressive discovery. However, if in addition to that one event we were to examine the currently unfolding Big Picture – namely the scientific and historical story of the cosmos, life, and man – the original Big Bang can be recognized also as the first phenomenal episode in a sequence of similarly outstanding outbursts of expansive creative power marking the entire course of universal evolution. In a sense, there has not been just one Big Bang, but one Big Bang after another! The unfolding panoramic view reveals a marvelous series of comparably critical and transformative breakthroughs running all the way from the Big Bang to the present. Indeed, we may very well be living in such a momentous time.

I will refer here to these awesome universal breakthroughs, during which entire new stages of irreversible evolutionary developments emerge, as the 'Origin Events' (including the eight 'thresholds of in-

creasing complexity' along with several others). This designation highlights what I find most significant about them: first, how they present us with a powerful Modern Origin Story about the emergence of the elements and qualities that make us what we are; and second, they reveal a pattern of evolution that unfolds largely as an eventful process, not just a slow, step-by-step, gradual and continuous one as we are more accustomed to thinking. These qualities are intrinsic to what the historical evidence in its entirety seems to be telling us, and ought to be primary factors in proposing a unifying story and general theory for the discipline of Big History.

This paper begins to explore and develop an orderly framework for the emerging discipline of Big History based on this essential 'Key Concept' that a fundamental and overall historical change on a grand scale takes place through Origin Events. Such an episodic pattern has often been noted in relation to each of the three Realms of Big History individually (Cosmos, Life, and Humanity), but never before have they been synthesized into a unified whole.

David Christian (2011a: 24) has posed the question, 'Are we on the verge of a grand unification of historical sciences?' including a Grand Unified Story (GUS) and Grand Unified Theory (GUT). A wide range of source material from diverse specialized disciplines must go into the making of any Big History theory. However, by treating history as a science of origins, a growing synergy and integration can begin to come forth directly from the historical knowledge itself through a process of pattern recognition along with inductive generalization. Initial considerations are introduced regarding how our Key Concept provides the basis for a coordinated approach that can:

- integrate the Realms of Big History;
- facilitate the Periodization of Big History;
- expand the newly emerging global creation story of Big History into 'A Great Story of Origins';
- provide elements to consider towards developing a Grand Evolutionary Synthesis and Unified Theory of Big History.

II. The Axial Period and Cultural History

The possibility of envisioning an intelligible structure of world history as a whole, first occurred to me years ago through a discovery inspired by my favorite professor, Huston Smith, upon being introduced to Karl Jaspers' intriguing concept of 'the Axial Period' (Jaspers 1953: 1–21). The remarkable mid-first millennium BC stands out on the timeline of history with the sudden, simultaneous, widespread, and independent appearance of prominent Culture Heroes and memorably innovative

figures across the Old World including: 1) the Buddha along with the many 'heterodox sects' and beginning of the classical schools of philosophy in India; 2) Confucius and the 'Hundred Schools of Thought' in China; 3) the major Old Testament Prophets along with the Exile and Restoration, and the 'new covenant' in Israel; plus 4) the Presocratics, Socrates and Plato, and the Golden Age in Athens.

The Axial Period was a time of widespread crisis and breakdown, but also a breakthrough because within a century or two, there is the beginning of a monumental shift in the orientation of human cognition from the previous mythopoeic type of thought and experience to a more abstract form of conceptual thought based on logic and reason (Frankfort *et al.* 1977). More recently, Robert Bellah and Hans Joas (2012) have edited an innovative volume of studies, particularly significant for Big History, looking further at the Axial Age in the broader setting of human cognitive and socio-cultural evolution. Some consideration is likewise given here to characterize the 'profound common element', which Jaspers indicated was the essential thing shared by all the movements of the time, as a new self-reflective way of thought and 'theoretic culture' that is more investigative and analytic than the previous more narrative-oriented 'mythic culture'. We are so used to taking our particular way of thinking and operating for granted that it is difficult to imagine how this cognitive orientation, along with its new form of collective learning, came into existence at a certain time in history, and that it did so, in its first appearance, dramatically and universally.

How deep, dramatic and sudden was the axial shift presumably from one cognitive and socio-cultural stage to another? We know this remarkable period well in the West particularly because of the birth of the classical forms of culture and society in Greece. Athens was in a distinctively pivotal position where the former world was culminating while the new one came into being (Finley 1966: 80–108). John Herington, professor of classics at Yale, is one of the many who has marveled at the 'great transition' which took place, describing how archaic society and the universal mythic vision and language, upon which it was based, were beginning to be radically transformed. He notes how a new type of civilization was emerging and the ancient ways were disintegrating under the impact, 'It is hard to measure the world-historical significance of that collapse. Geological analogies might be found in those natural catastrophes that seem to occur so many million years, obliterating entire life systems' (Herington 1986: 15).

In Israel, the exceptional circumstances of the breakthrough involved the destruction of the Temple followed by the Exile and Restoration. The great biblical scholar, Gerhard von Rad emphasized how important it is to realize 'there is this break which goes so deep that the

new state beyond it cannot be understood as the continuation of what went before' (von Rad 1965: 115, 271). He adds, 'we have still to consider the "revolutionary significance of the amazing new factor" the Axial prophets introduced, the prophecy of a "new covenant" no longer communal in emphasis but written in the "heart"' (Hebrew for mind and will) of the individual.

Likewise, in China (Creel 1960: 120–141, 169–170) and India (Thapar 1975: 119–132), with the spread of urbanization having set the stage for greater social mobility, the time was ripe for a new spirit of freedom and empirical inquiry to arise and a leap forward was made, setting the tone for millennia to come. Both Confucius and Buddha ('be ye lamps unto yourselves'), parallel to the other central figures of the time, taught the importance of thinking and arriving at the truth for oneself. In India 'this led to a new perspective on the significance of the individual' where 'Buddhism in particular, turned the earlier perspective inside out, and, and the focus shifted to the individual rather than the social group to which he belonged' (*Ibid.*: 125–126). In China also, 'a kind of critical, reflective questioning… a new vision', along with the Confucian teachings that made ethical learning available to all men, 'established a range of thought that was to shape all future developments' (Schwartz 1975: 3, 63, 68).

In summary, within the time frame of only a century or two, seeds were planted from the Orient to the Mediterranean, for the increasingly widespread and revolutionary transformation from the archaic, primarily oral and poetic, communal and mythopoeic civilizations to a new world of collective learning based on literacy and the written word (Thapar 1975: 130), education for all, an ethic of individual conscience, personal rights and responsibilities, democratic and egalitarian ideals, rational justice, the development of philosophy, systemization of mathematics, the growth of scientific thought, empirical methodology, and the principles of the world religions. Whatever we prefer to call it, the new type of collective learning emerging in the Axial Period came to inspire, characterize and pervade the cultural, social, artistic, political and technological developments throughout the centuries to come in all these regions.

The mid-first millennium conjunction has been marveled at by generations of historians as a unique phenomenon and a mystery for good reason. In the broader context of Big History, however, it may be seen as not such a singular occurrence after all. Mircea Eliade, the great historian of religion, spent much of his career brilliantly elucidating how people all over the world have memorialized in myth and ritual a series of 'Great Times' or 'Times of Origin' during which 'the central axis for all future orientation' comes into existence all at once (Eliade 1959: 21).

It occurred to me that this might also be the appropriate context for appreciating the outstanding significance of the Axial Period.

As I began to investigate Jasper's concept in more depth along with this larger perspective in mind, I saw that it could perhaps provide a 'Master Key' for the recognition of a universal structure to world history. Considering the nature and meaning of the mysterious mid-first millennium event, we may not be looking at a unique or anomalous occurrence at all, but a typical one. This transitional configuration might in actuality be just the most recent episode in a sequence of comparably dramatic turning points which characterize the entire course of cultural history, and ultimately as we are also beginning to see, Big History.

The key is to recognize and begin to appreciate how, as Giorgio de Santillana, MIT's eminent history of science professor, emphasized, 'Mistaking cultural history for a process of gradual evolution, we have deprived ourselves of every reasonable insight into the nature of culture… no one is willing to imagine that civilization appeared in a thunderclap' (de Santillana 1969: 68–71).

As we survey on the large scale, humanity's historical advance and the evolution of collective learning, it seems that fundamental change is an exception rather than a rule. The outstanding and universal innovations do appear as thunderclaps. There are immense intervening eras when there is little essential change: most societies during these times remain tradition-bound as similar cultural forms and experiences develop accordingly, based on a preceding original breakthrough.

For example, in both the Agricultural Revolution and the Urban Revolution we witness a sudden appearance in several locales of new worldviews and cultural orders, which thereafter spread and become the traditional ways of life for peoples throughout the world. The rapid transition during a few critical centuries to highly complex 'civilizations' has been observed but never explained by several scholars of ancient history. This has been noted by many including William McNeill (1963: 36–41) on Sumerian civilization, and Henri Frankfort (1956: 50–51) on the evidence from Egypt.

In the Narmer Palette and Memphite Theology, we find the archetype of Egyptian kingship and its method of artistic representation set once and for all. Within only a few centuries the conventions are fixed, and last for millennia; that is, until the mid-first millennium BC when as Jaspers (1953: 6) points out, 'the thousands of years old ancient civilizations are everywhere brought to an end by the Axial Period'.

III. Punctuated Equilibrium and the Paleontological Record

A similar pattern of change has become increasingly evident in the realm of geological and natural history as well. Paleontologists and bi-

ologists are increasingly recognizing that the evolutionary process of life on Earth can best be described at various levels, not only as one of gradual and steady change, but in terms of sudden, rapid and dramatic points of transition or 'punctuated equilibria' (Gould and Eldredge 1977: 115–151). Stephen Jay Gould (1978), in his article entitled 'Evolution: Explosion Not Ascent', explains this changing conception regarding the process of change in nature:

> In short, stasis and sudden replacement mark the history of most species… the history of life… is not as many people assume, a tale of slow progress, leading to greater complexity of forms and greater diversity of kinds and numbers. It is, in important respects, a series of plateaus punctuated by rare and seminal events that shift systems from one level to another.

This pattern has long been evident to paleontologists. It was stasis in the geological strata, interspersed by the abrupt appearance of radically different layers of fossil species that made biostratigraphy work so well in the first place. It is important to underline that stasis during the relatively long stretches in which it occurs, does not necessarily mean no change at all, but that during these times it does not 'accumulate'. 'Instead, over time, the species wobbles about its phenotypic mean' (Sterelny 2007: 96). In other words, adaptations occur resulting in some minor variations but the basic phenotype remains. For example, proponents of punctuated equilibrium have pointed out how Cambrian species, while demonstrating variational changes, tend to maintain their basic forms through extended stretches of time. In addition, for Big History purposes, noteworthy stasis and punctuation occur at higher levels of taxa than speciation: the major phyla have remained basically stable for the entire Phanerozoic span of geological history since their rapid emergence together in the Cambrian explosion (Valentine 1995: 190–194).

There were basically two main components to Gould and Eldredge's original punctuated equilibria article: simply to highlight the long-standing paleontological evidence that life's history is better described by a picture of stasis interrupted occasionally by episodic events than by the notion of phyletic gradualism, and to offer species selection as a theoretical explanation for that pattern especially as it could apply to macroevolution. In fact, their focus on the overall pattern had been preceded in certain aspects by the Russian paleontologists (Ruzhentsev 1964; Ovcharenko 1969), and their proposed mechanism of speciation theory by their colleagues Ernst Mayr (allopatric speciation) and Steven Stanley.

Ongoing analyses of the data since then have generally confirmed the reality of the pattern, at least for paleontologists (Prothero 2007: 81). In conjunction, the relatively new and growing field of paleobiology has been inspired to explore the wide range of potential insights paleontology can provide towards further developments in evolutionary theory (Sepkoski and Ruse 2009). However clear the evidence may be for the punctuational pattern of the fossil record, the concept of stasis in particular has been a lightning rod for ongoing disagreement and debate even among some paleobiologists, let alone in the larger community of evolutionary biology.

Much of the issue here centers on whether macroevolution can be understood as 'just microevolution scaled up'. There is disagreement even about whether there is any need for expanding evolutionary theory based on the much greater amount of macroevolutionary evidence available today. For example, just regarding the possible role of group selection in evolution at all among prominent evolutionary biologists, David Sloan Wilson and Edward O. Wilson are its advocates, while Jerry Coyne and Richard Dawkins downplay it, still favoring the more traditional view of phyletic gradualism based on organismic gene-level selection. It is in this context that Australian philosopher of science, Kim Sterelny concludes his analysis of the differing views of Gould and Richard Dawkins: 'Dawkins is right about evolution on local scales, but maybe Gould is right about the relationship of events on a local scale, and those on the vast scale of paleontological time' (Sterelny 2007: 178). We will return later in this paper to this important and often charged issue.

There are various approaches now being taken towards understanding and explaining macroevolution in evolutionary biology. Some do take into account the fossil record, often proposing some form of species selection where ecological conditions are radically altered and phenotypic change is accelerated. However, there is not wide agreement on whether this is a sufficient alternative. Donald Prothero (2007: 81), a specialist in mammalian paleontology, is one of those who maintains that the punctuational pattern, and especially the prevalence of stasis in the fossil record, still presents a significant challenge: 'there is not yet any good mechanism in neo-Darwinian theory for it, suggesting we still have a lot to learn about evolution and speciation'.

IV. A Great Story of Origins

One of the great achievements of the scientific quest for knowledge is showing us that the universe we live in is quintessentially a story. The cosmos itself, beginning with the Big Bang, has now come to be seen, not as an inert or static backdrop for the planet, but an ever-

changing manifestation in which everything is essentially historical and developmental. Time and space, matter and energy, atoms and elements, stars and galaxies, the earth and the diversity of life, our bodies and civilizations, cultures and traditions, ways of thought, the qualities we possess, everything we see and are made of has had a marked and identifiable origin during some salient time of crisis and creative explosiveness.

That is why I believe research and current theories in both the sciences and humanities should begin to consider and investigate the perspective that evolution at all levels of manifestation, as I have emphasized, is not just a process of gradual and continuous development. From the larger universal perspective, it appears to be more like an impressive series of marked 'Threshold moments' or great 'Origin Events', punctuating much longer Eras of gradual elaboration and extension of what the punctuations produced. These outstanding paradigmatic and formative periods beginning with the Big Bang and leading up to the present time, provide the story with its major episodes, and ultimately I would suggest illuminate it with meaning and significance. A Modern Origin Story, featuring the universal breakthroughs of Big History, tells us we are part of a world that is, in some profound sense, still in process of becoming.

Thus, the universal breakthroughs provide not only the structure that brings the story together, but also mark the identity and duration of its major chapters as well. Each of the Origin Events in turn can be seen as a turning point that simultaneously concludes a previous 'Evolutionary Era' while rapidly establishing and defining a subsequent one characterized by the extension, with developmental variation, of its newly emergent 'Regime' as a principal order of being or way of life on a large scale. I will delineate sixteen Origin Events along with the characteristic Regimes and ensuing Eras they introduce. They are divided into three main 'Worlds' of manifestation (Matter, Life, and Mind) that I find to be a suitable and descriptive classification, corresponding with the three Realms of Big History and their consecutive phases of evolution (physical, biological, and cultural).

I am building here on the Big History term 'regime', introduced by Fred Spier (1996: 14). In this context the term does not refer only to a system's outer form or structure, but also to the 'core of the process' (Adams 1966: 1–2), the very essence of what originates in the universal breakthroughs, and then proceeds to manifest on a large scale throughout the following Era. They are each, in the famous words of Vergil, *novus ordo seclorum*, a 'new order of the ages', bringing a novel formative principle or quality into the universe at every movement of advance along the way of the general evolution.

First, in the Realm of Cosmic Evolution we can see marked steps in the increasingly complex organizations of Matter like atoms, galaxies, and higher elements. These are the Regimes at that level. In the Realm of Earth and Life's evolution we also see increasing degrees of complexity in the organic forms and nervous systems arising with each breakthrough, but in the organisms involved at each stage, there are also signs of awakening types of sensitivity and more coherent interactions with their developing ecosystems (eukaryotes; complex multicellular animals having primitive nervous systems, eyes, notochords, and hard parts; reptiles; mammals).

When we enter into the Realm of Human History and the evolution of Mind, where the parameters are not yet as apparent, there are at first some notable anatomical differences, but these are clearly not the essence of the story. The challenge then is to begin to identify the chief features of certain paradigmatic socio-cultural orders, powerful systems of collective learning characterizing distinct Eras, which in this case clearly also involves a particular status of cognition, self-awareness and identity out of which the human experience and overall development unfolds. Colin Renfrew's excellent survey of prehistory (Renfrew 2008) brings together several new approaches that can be useful here, including his 'material engagement theory' and the rise of 'cognitive archaeology'.

Fortunately, with increases in our knowledge of history and prehistory, we are now in the position to perceive, as David Christian (2011a: 23) has said, 'patterns of change so large that they appear to be emergent properties of human history as a whole', so there is a prospect for generalization on a grand scale. Renfrew acknowledges the large-scale patterns initiated by the Neolithic and Urban Revolutions that were originally brought to our attention by V. Gordon Childe. The revolutionary shift in human existence which came with the appearance of agriculture is already a familiar one in Big History, but I believe the breakthrough to the complexity of city-states and the emergence of 'civilizations' should be also considered as an Origin Event. Robert Adams (1966: 1–2) stresses both the comprehensive nature of this change and its relative rapidity in Mesopotamia and pre-Hispanic Mexico, aptly demonstrating how in significant ways they are 'variants of a single processual pattern' that is 'clearly one of these great transformations which have punctuated the human career only rarely, at long intervals'.

I offer an outline of these sixteen proposed Origin Events here for purposes of further consideration and discussion. In my view they share a number of peculiar qualities or features serving to identify and explain the reasons for why they in particular, and not others, have been chosen for inclusion. Due to space limitations, I will just mention several

of those features to reflect on for now: outstanding, emergent, universal and transformative, sudden (punctuated), and constitutive. In the future, there may also be more events to add as our knowledge of the past increases. This whole topic remains a matter of interpretation that calls for ongoing research, further analysis, deliberation, and prospective revision.

First of all, these events stand out because they are the major historical milestones pre-eminent to and arising out of the subject matter of the many contributing disciplines to Big History. David Christian has noted the beautiful association of the eight Thresholds with a particular discipline, and I am suggesting expanding that a little further.

Secondly, the Origin Events are 'emergent' in the sense that at each stage of the evolution they give rise to a particular quality or principle that is not specifiable or predictable in terms of what came before them. In other words, as Theodosius Dobzhansky put it, they 'surpass the ordinary, accustomed, previously utilized well-trodden possibilities of a system' (quoted in Stebbins 1982: 162). They are certainly prepared for in some necessary way by what came before, but then the breakthrough occurs and a newly emergent quality enters which 'creates the impression of something utterly new appearing almost out of nowhere in the universe' (Christian 2011b).

Thirdly, they are 'universal' and 'transformative' in the largest sense: they change the course of evolution as a whole. These are distinctively discontinuous before-and-after 'Threshold Moments', not explainable as just a continuation or culmination of what preceded them because their newly emergent principle produces an epochal shift in the overall direction of evolutionary change. After a new Regime emerges during each Origin Event, often synchronistically in several places at once, it steadily spreads and develops for an extended Era of time into an entirely new stage of manifestation.

Fourth, with regard to the question of punctuation, it is important to note that degrees of suddenness are evaluated relative to the vastly different time scales in each Realm. Whereas, a century or two may qualify an event for punctuational status in the context of thousands of year long cycles of human cultural evolution, a process of a few or several million years may qualify on the geologic scale for life's evolution where the longer Eras last tens or hundreds of millions of years, let alone of course even much longer on the immense and mind boggling astronomical scales of cosmic evolution.

Fifth, and ultimately, they have been 'constitutive' of our world and our being in a most essential way. Professor Eric Weil (1975: 23) in his article 'What Is a Breakthrough in History?' summed it up well, 'We are what we have become owing to certain events… precisely the break-

throughs, the Axial times, the bifurcations that mark the road that looking backward, we see as meaningful'. In witnessing the eventful emergence of these particular Regimes and their ensuing transformations, which have ultimately combined to make us what we are today, we have a unique perspective unprecedented in the history of humanity. The Modern Origin Story is a global one, and these are our roots on a grand scale.

'A Great Story of Origins'

> In that deep force, the last fact behind which analysis cannot go, all things find their common origin.
> *Ralph Waldo Emerson*

A. Evolution of Matter
1) The Big Bang
Space and Time
Matter and Energy
Radiation Era
2) Recombination Epoch
Atoms – Hydrogen and Helium
Matter Era
Decoupling and Transparency – Release of Cosmic Microwave Background Radiation
3) Galaxy Formation
Sudden emergence of Galaxies and Stars
'The universe transformed itself from gas clouds to billions of galaxies all in what amounts to a cosmological instant' (Swimme 2000).
4) Supernova Explosions
Heavier Elements of the Periodic Table
5) Origin of Our Solar System
Earth, Sun and Planets
The stable Solar System was likely born in a dramatic and eventful climax of long-standing planetesimal accretion when the Sun finally ignited, releasing a stream of outgoing matter and energy which suddenly blew the remaining debris and gas from the system.

B. Evolution of Life
6) Origin of Life
Simple Life
7) Oxygen Crisis and Opportunity
Eukaryotes (Complex Cells)
8) The Cambrian Explosion
'Biology's Big Bang'
Complex Multicellular Organisms

Origin of Nearly All the Major Animal Phyla
Organized and Selective Sensitivity
Paleozoic Era

Douglas Erwin and James Valentine (2013: 5, 226), in their new book on the subject, date this event precisely to 'a geologically brief interval between about 530 to 520 Ma'. Many other Cambrian experts, including MIT geochronologist Samuel Bowring and others (Bowring *et al.* 1993: 1293–1298), have also been focusing on this particular window, or an even narrower one of five-six million years when most of the higher morphological novelty appeared, and defining the explosion as such. Robert Carroll (2000: 27–32) noted that, 'The extreme speed of anatomical change and adaptive radiation during this brief time period requires explanations that go beyond those proposed for the evolution of species within the modern biota'. The Chengjiang site in China, with fossils ten million years older than the Burgess Shale, strongly supports this view. Previous interpretations calling the Cambrian a 'slow fuse' instead (Prothero 2007: 161–171), and redefining it as a series of stages continuous with the Ediacaran, I find to be less refined and possibly outdated.

9) Permian Mass Extinction
'The Great Dying'
'Age of Reptiles'
Symbiotic Biosphere (on Land and Sea)
Ecological Sensitivity (Co-adaptation)
Mesozoic Era
10) Cretaceous Mass Extinction
Extinction of Dinosaurs
Golden Age of Mammals
Varieties of Sensitivity
Cenozoic Era

C. Evolution of the Mind
11) Pleistocene Glaciation
Emergence of genus Homo
Origin of the Human Brain
12) Paleolithic Transition
'The Mind's Big Bang'
Emergence of Modern Man (Cro-Magnon)
13) Neolithic Revolution
Origin of Agriculture and Domestication
Settled Societies based on the Mythico-Ritual Fertility Culture
14) Urban Revolution
Transition from Prehistory to History

Origin of 'Civilization'

City-States and Territorial States based on the Classic Mythico-Ritual Culture of Sacral Kingship.

15) The Axial Period

Emergence of a new type of cognition and collective learning

'Theoretic Culture' (Bellah 2012: 3).

The Axial Regime emerged rather suddenly during the sixth-fifth centuries BC with the synchronistic but independent appearance of the central figures and events in each region. This marked the breakthrough to a more critical, analytic, and self-reflective thought and culture at a time when the thousands of years old ancient civilizations were breaking down, previous communal and ritualistic traditions had lost their spark and were being questioned, and societal orders were in flux (Weil 1975: 21–36).

T. W. Rhys Davids (1903), one of the great scholars of early Buddhism, reflects on how, 'In each of these countries similar causes, the same laws regulating the evolution of ideas, had taken just about the same number of centuries to evolve, out of similar conditions, a similar result. Is there a more stupendous marvel in the whole history of mankind? Does any more suggestive problem await the solution of the historian of human thought?'

While an economic historian would likely add the Industrial Revolution next, I interpret it not as an Origin Event in itself but rather, like the American Revolution and other movements around the same time, as chiefly a prominent extension and culmination of certain principles of thought and activity originated in the Axial Period. These two revolutions shared a common purpose: promoting individual freedom. The United States was founded on the ideal of a government 'of the people, by the people, and for the people', and the industrial developments of the time stand out especially because for the first time in history, the living standards and opportunities available for the masses of common people experienced steady growth. It was not until the outbreak of World War I in 1914 that we enter the crises of the Modern Age and are at the threshold of the next Origin Event.

16) The Twentieth Century

An extraordinary time of culminating developments, tremendous change, crisis, opportunity, and emergent possibilities.

Holistic Thinking

Global Identity

Human Unity.

V. Evolutionary Theory in Big History

1. Evolution as History

In a century and a half after the concept of evolution arose to prominence, it has been a keynote of human thought and become increasingly a central theme for many modern disciplines. One of the leading figures in the establishment of the 'Modern Synthesis', Theodosius Dobzhansky (1973), published an essay entitled 'Nothing in Biology Makes Sense Except in the Light of Evolution'. With the scope of the concept of evolution expanding since to include cosmic and cultural history as well, the same observation is appropriate to Big History now.

The principles of evolution would seem to be a *sine qua non* to any grand unifying theory. However, what are those principles? There is no real issue as to whether evolution as 'developmental change in time' has occurred, but questions regarding the tempo, mode, source, and meaning of the evolutionary process have continued to swirl since its inception, and still do today. In this section and the next, I will offer some suggestions regarding tempo and mode which I find worthwhile from the scientific angle of establishing as accurately as possible what has happened in the past, along with briefly considering some of the alternative interpretations and perspectives arising recently with regard to cause and explanation, the how and the why.

One might think that since evolution is essentially about what has occurred in history, that traditionally the knowledge we have about the past would have been the foundation stone for constructing any theory regarding the historical development of life. Remarkably, however, this has not been the case. The insightful Berkeley historian and social scientist of the early twentieth century, Frederick J. Teggart (1977: 141), emphasized that, 'no study of "how things work" to produce something new in the course of time can dispense with historical inquiry and historical evidence'. He goes on to explain how, 'viewed in this light, the difficulties and contentions which have occupied so prominent a place in biological literature since 1859 follow inevitably from Darwin's initial acceptance of the idea of "progressive change", and his adaptation of Lyell's "uniformitarianism", with its negation of historical evidence and its emphasis on "continuity" and "present process"'.

As we have pointed out, this discussion is still with us – at least for paleontologists and a growing number of evolutionary biologists – and I maintain rightly so. Just last year the Smithsonian paleobiologist, Douglas Erwin (2011), likewise pointed out how 'the Modern Synthesis is a curiously ahistorical view of a historical discipline'. From a larger perspective, the growth of biodiversity is not only a question of alterations in species, but also the origin and relatively rapid spread of higher

taxa during periods when circumstances and ecological relationships are radically changing and we witness the rise and fall of entire ecosystems. In such a case, and thus without the uniformitarian assumption, the present is not always the key to the past. Erwin (1999: 626), who specializes in the Cambrian, emphasizes how, whatever caused, such a macroevolutionary event was active in biological systems back then in a certain way different from today. These higher order changes are not continuously happening all the time and gradually accumulating: they are special events that occur once-and-for-all, relatively rapidly under certain unique circumstances only at a particular time in history, and thus, in retrospect remain outstanding on a vaster scale of universal significance.

The modern synthesis has long advocated that macroevolution takes place like microevolution only faster, as the result of natural selection operating upon small-scale genetic mutations or variations of organisms within populations. Nevertheless, this consensus is no longer so solid, notes Erwin (2007): 'In the past few years every element of this paradigm has been attacked'. What developmental biologist Scott Gilbert once referred to as 'an underground current in evolutionary theory' has been rising ever since the famous macroevolution conference in 1980 at the Field Museum of Natural History in Chicago. In addition to numerous paleontologists and paleobiologists like Erwin (2000: 78–84), many evolutionary biologists and geneticists have also begun to confront the same issue of how to explain large-scale macroevolutionary change from their special vantage points, now that the adequacy of incremental changes at the genetic level ('survival of the fittest') in explaining large-scale morphological innovation (actually 'arrival of the fittest') is being widely questioned (Gilbert, Opitz, and Raff 1996; Müller and Newman 2003).

Such prospects for new approaches to evolutionary theory have been part of the discussion ever since the concept of 'punctuated equilibria' arose in an effort to bring evolutionary theory more in alignment with the patterns of geological and biological history that are evident in the fossil record. Punctuated equilibrium theory questioned the sufficiency of phyletic gradualism as a mechanism to account for the punctuations, but its alternative solution of allopatric speciation or species selection in various forms, rather than the more traditional gene-centered or organismic selection, has also been found wanting for significant reasons.

One of these reasons has to do with a central paradox of life's history related to how and when the 'diversity' of various distinct species in a group appear in the evolution, in contrast to the emergence of 'disparity' in the different body plans or higher taxa (Gould 1989: 49). Based

on neo-Darwinian theory, whether evolution occurred via the conventional phyletic gradualism, or a revised version of species selection accelerated by the radical alteration of ecological niches, one would expect to see species diversity appearing beforehand so that small-scale variations could little by little accumulate through natural selection to produce the increasingly complex forms that ultimately led to taxonomic disparity. The evidence of life's history in the fossil record, however, reveals an opposite evolutionary pattern. The disparities of each of the higher taxa emerge before the multiple diversities of the lower taxa, as Erwin, Valentine and Sepkoski (1987: 1183) explain, 'This is not to say that each higher taxon originated before species (each phylum, class, or order contained at least one species, genus, family, *etc.* upon appearance), but the higher taxa do not seem to have diverged through an accumulation of lower taxa'.

For example, this remarkable pattern in the Cambrian has proven to be quite pronounced with evidence now from not only the Burgess Shale, but also the more recent dramatic finds at Chengjiang in southern China. These fossil records demonstrate the clear absence of any accumulated multitude of diverse species upon which either neo-Darwinian mechanisms or species selection could have acted to generate this striking and relatively sudden first appearance of the higher taxonomic categories, already distinct enough to be definitively classified. As a result, Valentine and Erwin (1987: 96–97) have concluded that 'neither of the contending theories of evolutionary change at the species level, phyletic gradualism or punctuated equilibrium, seem applicable to (explaining) the origin of new body plans' and that a new theory is needed to account for the 'evolution of novelty'.

Another issue in extrapolating microevolution to macroevolution has arisen with regard to genetics. Prof. Eric Davidson of Cal Tech is a pioneering leader in the field of developmental biology and embryology as they relate to evolution. He has been investigating interactions between developmental gene regulatory networks (dGRNs) and the evolutionary emergence of new body plans, receiving the 2011 International Prize for Biology in recognition of this work. What he has discovered is that these dGRNs, which control the development of an organism, are so intricately complex that mutational alterations significant enough to produce morphological changes on the macroevolutionary level – as distinct from the microevolutionary level variations of 'enzymes or flower colors' – are not survivable, thus leaving natural selection with nothing to continuously act upon. Davidson (2006: 195) explains how, 'contrary to classical evolution theory, the processes that drive the small changes

observed as species diverge cannot be taken as models for the evolution of the body plans of animals'.

A paradigm shift may or may not be underway yet within evolutionary biology, but it is in the air with a variety of issues. There have been growing calls for open-endedness in evolutionary theory and new approaches to how evolution operates from several angles but a consensus is yet to emerge (Erwin 2007). In this regard, sixteen evolutionary biologists met in 2008 for a conference in Altenburg, Austria to discuss some of the possibilities for an extended evolutionary synthesis including: evolutionary developmental biology, epigenetic inheritance, niche construction, symbiosis, systems biology, plus evolution of the brain and cognition among others (Pigliucci and Müller 2010).

Biologist and genomics specialist, Eugene Koonin (2007: 21), a Senior Investigator at the National Center for Biotechnology Information, has summed up the present 'postgenomic era' in evolutionary thought – in which 'all major tenets of the modern synthesis have been, if not outright overturned, replaced by a new and incomparably more complex vision of the key aspects of evolution' – as a 'pluralism of processes and patterns… that defies any straightforward generalization' (Koonin 2009: 473–475). The alternative he offers, 'the Biological Big Bang model for the major transitions in evolution' (*Idem* 2007: 21), is remarkably similar to the punctuated equilibrium pattern highlighted here. It is a biphasic model of evolution in which novel forms rapidly emerge at higher levels of complexity in the first phase, and then the process slows down in the second phase where multiple variations on the new forms develop more gradually.

I find this to be quite a valuable formulation worth focusing on in the next section as it applies not only to the broadest patterns in the Evolution of Life, but also – as 'A Great Story of Origins' demonstrates – to Big History overall. In this context then, it becomes a distinctive contributor to a much larger and ongoing effort for considering the basic structure of Big History in general and how evolutionary changes take place throughout all of time.

2. The General Biphasic Process of Evolutionary Change

The nature of historical change in such a comprehensive evolutionary context appears to be a twofold process that occurs by way of what could be called two different types of time: 1) the rare and opportune in-between or before-and-after moments of crisis and opportunity, in which something of special quality happens; and 2) the longer stretches of chronological time, ordinary and steady with more of a quantitative nature. Ultimately, the two phases function as complementary facets of the universal process as it unfolds in time through Macroevolution and

Microevolution. In such a context, the old uniformitarian-catastrophist debate could turn out to be not necessarily a matter of either/or, but a both/and combination of the two.

In 1944, the great American paleontologist, George Gaylord Simpson (1944: 206), anticipated punctuated equilibrium, referring to the moments of macroevolutionary change as 'quantum evolution'. He considered this idea 'the most important outcome of (my) investigation, but also the most controversial and hypothetical'. Inductive reasoning, based on the overall view we now have, elicits the general nature of the concept. Outstanding, sudden and relatively brief but very special Origin Events or Threshold Moments, featuring the emergence of utterly new Regimes, initiate much longer 'Evolutionary Eras' of 'adaptive radiation' and developmental variation, with the more gradual elaboration, extension, diffusion and culmination of each of the new Regimes.

In this view, the relatively brief Origin Events are not created by their previous Eras, but rather they each in turn create their subsequent Era. These universally definitive moments do build upon and incorporate the developments that preceded them, but are discontinuous emergent events in their own right bringing unprecedented principles or qualities into the evolution. We will consider how these thresholds come about in the concluding section.

This principle characterization of evolution in general as a dual or biphasic process has previously appeared in the works of both Professor Teggart, and the prominent American anthropologist Marshall Sahlins. Teggart (1977: 148–149) had referred to the two complementary phases as (1) 'advancement', which occurs distinctly through events; and (2) 'fixity', featuring stability and continuity, predicting that with their recognition, 'the conceptual model for the study of change in time will be subjected to a radical alteration'.

Likewise, in the Introduction to their edited volume *Evolution and Culture*, Sahlins and Service (1988: 4–11) sought to embrace both biological and cultural evolution within one overall perspective by proposing just such a biphasic process, based on the work of their great predecessor, Edward Burnett Tylor. They consider the evolution of life and culture to be not just analogous but homologous in the sense that they both can be understood in terms of these same two aspects of the total evolutionary process: general progress and specific adaptation.

Sahlins (Sahlins and Service 1988: 12–44) continues to elaborate this theme in his chapter of the book, referring to the grand and universal macroevolutionary movement as 'General Evolution', in contrast to the adaptive phase of 'Specific Evolution'. The former features the emergence of higher forms of life and is also the means by which culture progresses 'stage by stage'. The more 'specific' microevolutionary de-

velopments occur in the latter adaptive, phylogenetic 'succession-of-forms' phase, applying also to variations in the 'evolution of culture along its many lines'.

In the view of Sahlins (*Ibid.*: 11, 39–40), quoting Julian Huxley before him, the 'much lauded modern synthetic theory' of biology, combining genetic principles with natural selection, is devoted primarily to the unraveling of not the overall progression of general evolution but specific evolution's 'mere frill of variety… a biological luxury without bearing upon the major and continuing trends of the evolutionary process'. Adding that although a prospective 'triumphant synthesis' which would unify the particular and general aspects of evolution did not exist in biology – and still does not as many other scientists have been saying – he did anticipate that 'a broadly similar course' towards such a synthesis, embracing anthropology as well, could eventually take place.

Now almost a century later, Gould (2002: 884–885, 951) affirms how this 'probable generality of punctuation and stasis as a powerful… style of change across all scales must lead us to reassess our previous convictions about "important" and "interesting" phenomena in evolutionary theory and the history of life'. He stresses how the basic problem of evolution itself now needs to be re-conceptualized, since the nature of evolutionary change revisited 'requires a different set of explanatory concepts and mechanisms – a different view of life, really'.

It is a boon for Big History to be in such a propitious position, due to its comprehensive subject and opportune timing, for contributing towards the development of a new and wider evolutionary synthesis, both by bringing together and integrating whatever developments may already be underway within particular disciplines, and by advancing its own theoretical prospects. I will conclude with some thoughts about what such an approach might look like.

VI. Towards a Unified Theory: Probing the Mystery of the Universal Breakthroughs

> Every advance in knowledge brings us face to face with the mystery of our own being.
>
> *Max Planck*

Evolution in the context of Big History, with its three Realms, is certainly about the changes of living forms through time, but it is also about the spectacular unfolding of the cosmos and the epic adventure of human history. The growth of the idea of evolution in our time involves nothing less than the emergence of a new worldview with unique possibilities and unknown dimensions that are still being explored and formulated. Big History gives us a renewed and larger perspective on

both what it is that we see changing throughout time, and the patterns and principles related to how the changes occur.

In this paper, we have been considering two distinctive perspectives for extending the scope and depth of a newly developing evolutionary worldview. Firstly, evolution in the past has generally been understood as a slow and gradual movement in a straight line with each successive state or condition directly related to and arising from, perhaps even logically or materially necessitated by, what came before it. However, as we have seen, there are many with good reason and standpoint who have been indicating that this interpretation does not fully fit the historical evidence for the cosmos, life, or humanity. Therefore, our whole view of evolution begins to change. Rather than minute and steady gradations developing gradually and continuously from one stage to the next, it is now being suggested that there are also relatively sudden and rapid outbursts, surprising and dramatic punctuations, marking the course of evolutionary transformation not just in the history of life but throughout Big History as a whole.

Secondly, especially when surveying the Big Picture including human history, we can begin to realize that it is not just the physical form, that is the world out there, that is evolving, but also the world inside us. It is about what it is like: to be a trilobite able to see for the first time and react to a world suddenly full of newly complex predators; to be a bat with sonar (Nagel 1974); to construct 'the world's first temple' at the 12,000 year old megalithic site of Gobekli Tepe in Turkey (Mann 2011); to recite the Enuma Elish at the Babylonian New Year's celebration; to reject mythological explanations of the world as a Presocratic philosopher in order to ask questions and reason about the essential unity of things; to behold the wondrous primordial spectacle of the original galaxies bursting forth in the Hubble Deep Field. As Klaus Schmidt, director of the German archaeological team excavating Gobekli Tepe reflects, 'Twenty years ago everyone believed civilization was driven by ecological forces. I think what we are learning is that civilization is a product of the human mind' (quoted in Mann 2011: 58).

It has become clear in our time, as advances toward an evolutionary worldview and a Big History perspective show, that in this world we are part of a universal process that is, and has always been, on the move. We are not static beings, but transitional ones; we are becoming. However used to this general idea of formal evolution we have become though, we are not so familiar with the perspective that the inner quality of being itself is something that has also been evolving, and still is. Such a frame of reference can be valuable in exploring alternative ex-

planations for how and why the punctuational breakthroughs of Big History's Grand Narrative occur as they do.

Combining these general indicators together and considering them along with the particular properties and insights we have seen arising out of the sciences and cultural history, I have found that our perspective on evolution can be extended and prospectively transformed. In addition, new light is shed on how to approach the question of cause, and whether this increasingly evident universal evolutionary process even has a cause we can theorize about and begin to comprehend.

All of the great origins and breakthroughs in the history of the cosmos, earth, life, and humanity evoke wonder, and to some degree, mystery. What force drives them, and what is their source and goal? If evolution at large shows a biphasic pattern of punctuated equilibrium, with awesome and unexpectedly new properties or qualities appearing at every critical step along the way, what is the explanation for this? I propose one answer lies in considering what strikes me to be the crux of the matter: the fundamental mystery of 'emergent novelty'.

The idea of 'emergence' was introduced around the time of Aristotle, and has since been discussed by various scientists and philosophers, but it has recently come to the fore and acquired a more solid and scientific footing in both 'complexity theory' (Bedau and Humphreys 2008) and in relation to evolution (Corning 2002; 2005). In Big History, Fred Spier (2011: 36–38) has drawn attention to how the 'Goldilocks Principle' characterizes the circumstances for the emergence of complexity. Morowitz (2004) presents emergence as a new more holistic way for science to view the world's evolutionary unfoldment that is complementary to reduction. I find, as Goldstein (1999: 58) notes, that although complexity theory adds much towards giving us a clearer picture of emergent phenomena in nature, it still functions as more of a descriptive term than an explanatory one. In this case, for now, the causation of the punctuated pattern of emergence in evolution, along with the source of such awesome novelty, remains a mystery.

To further address this question, and consider a possible explanation for the patterns we see unfolding, I would postulate the presence of what could be called an 'evolutionary force' in nature analogous to the force of gravity. We cannot see either of these forces directly, but we can perceive and experience the processes, patterns, and characteristics of their operation in the world. For evolution on a grand scale, the great scientific advances along with the extension of knowledge in all the disciplines have brought this possibility to the human mind. Such a force of evolution could be posited to have not only quantitative characteristics, but also evidently the capacity to kindle the development of the novel

qualities that emerge throughout history. Perhaps, the experience of awe and wonder that the great story of Big History evokes is indicative of this force in a similar way that heaviness is an experience of gravity.

The evolutionary manifestation of increasing levels of complexity, along with the emergent novelty of their Regimes and Eras, is what the Origin Events all have in common. In a unified theoretical synthesis applicable at all levels of Big History, the properties of outer form and inner force or quality of being function like the basic factors of matter and energy in physics which originally burst forth in the Big Bang. Eric Chaisson's explanation of rising complexity in 'cosmic evolution', utilizing the concept of increasing energy flows, is a case in point (Chaisson 2001). I am suggesting adding a qualitative aspect to the conception of energy in addition to the quantitative measurements of Chaisson's research. But whether using the term 'energy' or 'inherent force', shall we say that it is the material complexity which gives rise to the energy/force, or is it the energy/force that evolves the complexity in order to manifest in the universe?

In this sense, evolution is about not only the development of increasingly complex material forms, but also essentially the 'strong emergence' of already involved forces or energies of existence at each stage when the forms and conditions of the time have become ready and able to manifest them. I submit that this is – in addition to whatever the other physical mechanisms or explanations turn out to be – a considerable cause of the Origin Events, each appearing with their definitive Regimes intact. Taking an evolution of inherent forces or qualities of being into account contributes to a fuller elucidation of the punctuated pattern we see where these indelible universal breakthroughs burst forth so impressively in brilliant flower the way they do, and then are followed by a wide-ranging but relatively stable development of the various potentialities they contain throughout their microevolutionary Eras.

Such an extended view of the evolutionary process ultimately explains how the spectacular organizations of matter and energy in the cosmos, the existence of living organisms with their increasing sensitivities, plus the cognitive and collective learning capacities of humanity, in all their manifold expressions have emerged in the world; not after all as accidents or contingencies, nor necessarily as the result of some hypothesized intervention from without, but rather out of a deep force or essential energy contained within all along. Novel principles and capabilities can be seen to arise with each ascending level of complex order in the universe. A grand evolutionary synthesis for Big History, rather than remaining solely based in a reductionist approach to complexity, can embrace a more pluralistic and ultimately holistic outlook, a variety

of complementary perspectives, and the reality of multiple levels of causation.

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