# Introduction

# Evolution and Big History: From Multiverse to Galactic Civilizations

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A macroevolutionary approach and the new field of Big History seek *to develop an inclusive view of the Cosmos, Earth, life and humanity* by erasing boundaries between disciplines. Big History is a versatile study that brings together constantly updated information from Astronomy, Physics, Geology, Biology, Chemistry, Anthropology, Psychology and other scientific disciplines, and then merges it with the contemplative realms of Philosophy and the Humanities. Big History evolved from the academic need to transcend the straightjacket of university disciplines in the early 20th century, beginning with subjects like Biochemistry and Astrophysics (Christian and McNeill 2008; Rodrigue and Stasko 2011).

The need to see this process of development holistically – in its genesis and growing complexity – is a fundamental characteristic of scientific and human cognition (see David Christian's article in the present Almanac for more detail about this). The growth of scientific specialization and the immense amounts of information in different realms of science hinders the capacity for inclusiveness, but, paradoxically, it amplifies the need for it too. This aspiration for integrated vision is especially salient among those scientists who would like to see beyond their narrow field of specialization. One can also see the growth of such interest in the framework of individual disciplines, as well as in interdisciplinary research. As we have already mentioned on a number of occasions, the rapidly globalizing world needs global knowledge and global generalizations (see Grinin, Korotayev, Carneiro, and Spier 2011; Grinin and Korotayev 2009). Indeed, globalization itself becomes a vehicle for this Big History expansion of awareness.

Cybernetics pioneer W. Ross Ashby noticed that the range of systems is enormously wide (1958). Nonetheless, it makes much sense to represent the history of the Universe (and even the Multiverse) as a single process. Without this, we are fated to live within a fragmented, endlessly shifting intellectual universe, deprived of the philosophical and ethical anchors of a more unified vision of how

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things came to be (again, see Christian's article). That is why the ideas of universal history (that is, covering all of the Universe's existence) never died, whereas the idea of Big History (under various names) emerged almost simultaneously and independently in different countries (Australia, the Netherlands, Russia, the United States).[1]

Such an aspiration towards a unified paradigm (or, at least, toward a unified evolutionary narrative) is interdisciplinary by its nature. Simple dialectical thought will not resolve the problems of our world today. It is not about resolving a few opposing questions, such as religion *versus* science or technocrats *versus* humanists. The problems are multivalent. It is a dilemma of antique, irrational perspectives hidden in modern, logical reasoning. A central issue is that people think in 'silos', in which a narrow focus masquerades as a holistic solution.

This is an administrative problem as well, one in which a confusing, vertical array of state agencies, private businesses, academic departments, federal ministries, public NGO's and all their personnel develop policies and carry them out in isolation from each other – not only duplicating each other's efforts but often in competition with them. This is nowhere more in evidence than just after a sharp, focused crisis: be it an earthquake, a military attack, a hurricane, the bursting of an economic bubble, or any other kind of natural or social catastrophe.

So, how do we develop holistic and cooperative models of existence, yet still maintain the humility of on-going enquiry? How do we implement and encourage such open models on a global scale? Part of the solution is to adopt wider views of existence, ones that transcend the silos and promote communication between all segments of societies. This quest is addressed in our present edition of the Almanac *Evolution*, which highlights approaches that could guide us out of the maze in which we seem to be trapped.

That is why we have tried to collect in this volume contributions by very different authors – not only from different countries, but also authors who have very different educational backgrounds (historians, astrophysicists, biologists, sociologists, geologists, psychologists, artists, poets and so on). All of them have come to the understanding that we need a unified picture of the evolution of the Universe in their own ways. Those ways are described in the many contributions to this Almanac (especially in its first Section).

The interdisciplinarity that is necessary for the development of such major theories may provide opportunities for a fruitful synthesis of ideas. There are a number of potential ways to develop a paradigm for the study of the history of the Universe. In general, those ways share a unified view of the process of evolution.

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[1] Big History was also a child of the Cold War and the Space Race, as scholars sought to collaborate beyond their national boundaries and ideological divides (Rodrigue and Stasko 2011: 36–38).

As we have already mentioned in the first issue of the Almanac *Evolution* (Grinin, Korotayev, Carneiro, and Spier 2011: 7), this shared vision is remarkable, given the fact that the application of the evolutionary approach to the history of nature and society has remained one of the most effective ways to conceptualize and integrate our growing knowledge of the Universe, society and human thought. Moreover, we believe that without using mega-paradigmatic, theoretical instruments such as the evolutionary approach, the scientists working in different fields may run the risk of losing sight of each other's contributions.

This process may be denoted as *megaevolution* or *metaevolution*, *Universal History*, *Cosmic Evolution*, or *Big History.* The term 'Big History' has become especially popular, is used more widely than other terms, and has become the name of an academic movement. That is why we have decided to merge these two similar and basic concepts in the present Almanac: Evolution and Big History. This enables us to bring together people who are close to each other intellectually. Furthermore, this has made it possible to assemble a very comprehensive collection of views by Big Historians. In addition, it fulfils the task set up in the first volume of *Evolution:* The scientists working within the evolutionary *mega*paradigm should have an opportunity to know more about each other, to see and understand who does what, and to get enriched with the experience of scientists working in different fields of evolutionistics.[2]

It is not by accident that several founders of Big History came from organizations that were already seeking to bridge the gaps between disciplines. In addition to the laboratories and centres of many key scholars, several academic societies stand out for their contribution to and encouragement of Big History. These include the World History Association, the Historical Society (USA), and the Russian Academy of Sciences. As a result of such collaborative efforts, the International Big History Association (IBHA) was founded during a field seminar at the Coldigioco Geological Observatory in the Apennine Mountains of Italy in August 2010 (Rodrigue and Stasko 2011: 41; Osservatorio Geologico di Coldigioco [see http://www3.geosc.psu.edu/~dmb53/OGC/index.html]).[3]

A very important theme among all of us is the connection between the Universe's past, present and future. In this regard, it appears possible to agree with the point that the Big History movement is an important bridge between scien-

[2] 'Big History' is a simple and elegant term coined by historian David Christian that tends to be used in the English-speaking world by scholars in the Humanities and Social Sciences (Rodrigue and Stasko 2011: 37). However, it is hardly surprising that some contributors use alongside Big History other terms as synonyms.

[3] This cross-disciplinary cooperation continues, as shown by the World History Association conference in Beijing in July 2011, which includes 6 Big History panels, 2 roundtables and several individual presentations. The first conference of the International Big History Association is in Michigan (USA) in August 2012.

tific understanding of this past, varied views of humanity's place in Earth history, and practical environmental issues that affect our daily lives.

As has already been mentioned above, Big History ideas did not appear from out of nowhere. They have deep roots in philosophy and science; those roots ascend to the approaches of evolutionists and holistic thinkers of the past, such as Compte and Spencer. This can also to some extent be said about some Marxists and Hegelians, as well as Neokantians (see Grinin, Korotayev, Carneiro, and Spier 2011: 5–7; Grinin, Markov, and Korotayev 2011 for more detail). In his contribution to this edition, Eric Chaisson points out that:

> Other researchers have addressed life and complexity in a cosmic setting, among them Chambers (1844), who anonymously wrote a pre-Darwinian tome of wide interdisciplinary insight, and Shapley (1930), who pioneered 'cosmography' that classified all known structures according to increasing dimensions. Henderson (1913) regarded the whole evolutionary process, both physical and biological, as one and the same, Whitehead (1925) sought to broaden scientific thinking with his 'organic philosophy', von Bertalanffy (1968) championed a systems theoretic approach to physical, biological, and social studies, and Shklovskii and Sagan (1966) popularized the idea of intelligent life in the cosmos.

However, the theme of 'Big History' predecessors still needs much work, and we hope that we will be able to publish new articles on this subject in forthcoming issues of our Almanac.

The aspiration to embrace the evolution of the Universe from its 'beginning' up to the present is based not only on the needs of a cognition that seeks a certain order and completeness. The world, notwithstanding all its immense diversity, is also a single entity – not only epistemologically but also ontologically. There are many ways to describe this unity scientifically. One way is suggested by Eric Chaisson, according to whom 'specific energy flow (*i.e.* energy rate per unit mass) constitutes a useful complexity metric and potential evolutionary driver for all constructive events throughout universal history' (see his contribution to this volume).

We may also base ourselves on the idea that each subsequent phase of Big History is accompanied by the emergence of new mechanisms of evolution; however, the preconditions of these new mechanisms may be detected within the previous phase. The emergence of new mechanisms of evolution and the canalization of the Big History movement at certain phases does not abolish evolutionary mechanisms that appeared at earlier phases. As a result, one can observe the emergence of a complex system of interaction by various forces and mechanisms that determine the evolution of new forms. Biological organisms act in the framework of the laws of Physics, Chemistry and Geology; social systems and humans behave in the framework of biological limitations. The un-

conscious 'search' for new forms of evolution goes in various directions, as a result of which basically similar forms emerge – not only at the point of a macro-evolutionary breakthrough but also at what may be called 'evolutionary blind alleys'. This 'search', however, finally leads to the transition to a new phase of Big History.

We have already written that one may find contradictions between the world and its sentient beings within evolutionary theories, perhaps even more so than with other theories. And, the wider the scope of research, the sharper this contradiction.

We view the boundless Universe (let alone Multiverse) in different ways. That is why our Almanac brings together contributions in various formats and styles. They reflect our perceptions of enormous scales and incredible complexities in different ways. These differences in perception are also an important feature of our world, and the contributions to this volume throw light on its various aspects. That is why the contributions to the present Almanac display a representative panorama of our ideas of the Universe, life and human society.

This Almanac is divided into three sections.

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***Section 1 ('Evolution and Understanding of Big History')*** provides a wide-ranging overview of this new field, including articles by astrophysicists, historians and philosophers. These articles analyze the evolution of views on the development of the Universe that led to the emergence of a paradigm that is capable of describing that mega-process known as "Big History" (the authors also provide rather interesting accounts of the evolution of their own views). On the other hand, most articles in this section convey the authors' understanding of Big History: its possibilities, goals and tasks. Naturally, as within any other scientific paradigm, one may find discussions and different views. One can even observe a difference in respect to the simple tradition of writing its very name – as 'big history' or 'Big History'.[4] This is good and normal. Hence, in this section, Big History is represented in its evolutionary and epistemological aspects.

In his brief but bright contribution ('The Evolution of Big History: A Short Introduction') **David Christian** demonstrates that Big History represents a modern, scientific form of an ancient effort: that of constructing unified, coherent and universal accounts of reality. Such efforts can be found within the origin stories of most human societies. But in the late 19th century, universalistic efforts tended to disappear within both the Humanities and the Sciences, as scholars in field after field coped with the modern tsunami of information by narrowing

[4] The style of using capital letters or lower case letters in the name of Big History might appear a simple issue, but actually is very complex. It touches on disciplinary and interdisciplinary perceptions, political etiquette, academic tradition, linguistic perception and others.

the scope of their research. The Sciences began to return to larger and more universalistic perspectives from the middle of the 20th century, as new unifying paradigms emerged in field after field, and physicists even began talking of 'Grand Unified Theories' of everything. New information and new dating techniques made it more reasonable than ever before to attempt scientifically grounded universal histories, and such attempts began to re-appear in the 1980s. But not until the first decade of the 21st century has that effort really begun to take off.

**Fred Spier** ('Big History Research: A First Outline') provides a first outline of how to define Big History research, including an overview of the types of research that could be profitably undertaken. Practical issues are also discussed, such as how to obtain funding, where to publish the results, and whether the research results might have practical applications. Because this contribution is, to our knowledge, the first attempt to outline Big History research, Spier's observations should be considered preliminary. We hope that they will stimulate a healthy discussion about Big History research, one that will lead to formulating a Big History research agenda.

**Eric J. Chaisson** ('Cosmic Evolution – More Than Big History by Another Name') offers simultaneously a broad description of the Big History panorama and the history of his own intellectual pursuits. As with many other contributors to the present Almanac, this history is tightly connected with the search for the most adequate ways of teaching Big History to students. Chaisson suggests that evolution – ascent with change of Nature's many varied systems – has become a powerful unifying concept throughout the Sciences. In its broadest sense, Cosmic Evolution, which includes the subject of Big History, comprises a holistic explanatory narrative of countless changes within and among organized systems, extending from the Big Bang to humankind. Chaisson presents his principal working hypothesis in Cosmic Evolution: Mass-normalized energy flow, termed 'energy rate density' and denoted by $\Phi_m$, is possibly the most universal process capable of building structures, evolving systems, and creating complexity throughout the Universe. This theory allows us to quantitatively account for the ranked order of increasingly complex systems across the many successive phases of Big History. One may agree with Chaisson's conclusion that better metrics than energy rate density may well describe each of the system categories – within the more restricted domains of physical, biological and cultural evolution – but no other single metric seems capable of uniformly describing them for Cosmic Evolution as a whole.

**Alexander Mirkovic** ('Big History and the End of History') situates Big History in the context of the rise of religious fundamentalism in the last twenty years. While Francis Fukuyama in his 'The End of History' (1989) argued that the end of the Cold War would produce the end of grand narratives, as well as

the triumph of democracy and liberal capitalism, in reality the world saw a resurgence of religious fundamentalism that orchestrated a resolute attack on science and thereby came into conflict with Big History. Mirkovic argues that Big History emerged in opposition to resurgent and often politically sustained religious fundamentalism. This oppositional stance presents some dangers for Big History. For example, the concept of a modern creation myth, while useful in the debate with religious fundamentalism, hides the true character of Big History. Big History should not endorse the once fashionable triumphalism of science. As Thomas Kuhn warned, science goes through paradigm shifts and is not immune to shift in power/knowledge relations. The author argues for understanding of Big History as a branch of the history of science. The strength of science is that it is able to change and survive a paradigm shift. Mirkovic also points out some inconsistencies in the fundamentalist challenges to Big History. While fundamentalists reject human evolution, they also advocate the ideal of ever-increasing economic prosperity extending into the limitless future. This question of the future is something to which Big Historians do not pay enough attention. In this context, Mirkovic calls attention to Peak Oil theories. If some of the predictions made by Peak Oil 'doomers' were to come true, major chapters of Big History would need to be re-written. Big Historians should, in the author's opinion, seriously analyze various kinds of possible futures, as the future is also a major part of the 'map of time'.

**Barry H. Rodrigue** ('The Evolution of Macro-History in the United States') points out that the inclusion of large-scale studies in the world's educational systems is of great importance for resolving the most serious problems that humans face today. A problem encountered by today's scholars is how to reconcile competing visions of existence, not only for our global benefit but for our very survival. One suggestion is to continue moving with the current trajectory and adopt a model of macro-studies, such as the example provided by Big History. He argues, however, that evolutionary beliefs have come to provide almost as much comfort to ordinary people as religion. As a result, the belief in an external agency (*deus ex machina*) that will 'take care of us' has continued. There are many examples illustrating the flawed consequences of such faith, examples that demonstrate how unquestioning faith in a higher power – be they god or computers – has resulted in serious consequences for our species and our planet. The related belief that particular groups of humanity have been chosen to fulfil a pre-ordained 'mission' is just as prevalent and just as dangerous, perhaps nowhere more obvious today than in central Eurasia. This problem of misunderstanding the world around us and acting in unintentionally lethal ways is perhaps one of the most mortal conundrums we face today.

**Akop P. Nazaretyan** (‘Mega-Evolution and Big History’) maintains that Big History – an integral conception of the past from the Big Bang until today – is a relatively novel subject of cross-disciplinary interest. The concept was construed in the 1980s–1990s simultaneously in different countries, after relevant premises had matured in the Sciences and Humanities. Various versions and traditions of Big History are considered in the article. Special attention is paid to the comparison between the Russian and the Western approach to Big History. Most Western authors emphasize the idea of equilibrium, and thus reduce cosmic, biological and social evolution to mass-energy processes. As a result, the informational parameter, involving mental and spiritual aspects, are seen as epiphenomena derived from the increasing complexity of material structures – epiphenomena that do not play their own role in evolution (on this subject, see David Hookes' article in this issue). In the Russian tradition, sustainable non-equilibrium patterns are more frequently used. This implies attention to panmaterial sources, including the evolution of mental capacities and spiritual culture (as basic anti-entropy instruments), as well as to humans' growing intervention in the material processes on Earth and outside of it. The non-equilibrium approach, in the context of modern control and self-organization theories, alters the portrayal of the past, and still more dramatically, the estimation of civilization's potential.

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***Section 2 (‘Big History's Trends and Phases’)*** looks at particular aspects of Big History, such as analogies between biological and social evolution, information as a defining aspect of cosmic evolution, and exo-humanitarian connections in our meta-galaxy. Contributions to this section analyze major phases of Big History (cosmic, geological, biological, social) including some possible forecasts. The detection of separate trends, and analysis of evolutionary mechanisms allow for a more comprehensive understanding of the general principles and mechanisms of Big History. This is very important for the development of a general Big History paradigm.

**G. Siegfried Kutter** (‘Big History: A Personal Perspective’) gives a personal perspective on the history of the Universe, from the Big Bang to the origin of life on Earth, and life's evolution towards the enormous diversity that we witness today. His perspective is based in part on writing the college-level text, *The Universe and Life*, published in 1987, which influenced the creation of the multi-disciplinary field of Big History. Kutter begins by describing the circumstances that motivated him in the mid-1970s to start writing *The Universe and Life.* He continues by giving a brief, updated summary of the text's content about physical and biological evolution, asking, ‘Where do We Go from Here?’, and discusses the philosophical and pedagogical challenges that he confronted.

These are issues that characterize Big History as well. He concludes by commenting on some of Big History's unique challenges, due to the field's broad, multi-disciplinary nature, and suggests that we consider these as an opportunity to jointly move the field forward.

One of the articles of this section, the contribution by **Tom Gehrels** ('The Chandra Multiverse') extends the already colossal time horizons of Big History in a truly fantastic way. While reading this article, it is difficult to avoid exclaiming something like: 'This is a really BIG history!' Of course, this is a hypothesis, with which many might not agree. But this is a very bold hypothesis that extends the Big History horizon by many orders of magnitude. According to Gehrels, equations of Planck and Chandrasekhar lead to the conclusion that our universe is a member of a quantized system of universes, which he calls the 'Chandra Multiverse'. It is a trial-and-error evolutionary system. All universes have the same critical mass and finely tuned physics that our universe has. The origin and demise of our universe is described. In our astronomical environment, everything ages and decays; even the proton may have a limited half-life. The decay products of all the universes expand into the inter-universal medium (IUM), clouds form in the IUM, from which new universes are started. When the density at the center of our proto-universe cloud reached proton density, then photons, protons and neutrons were re-energized. A Photon Burst marks the beginning of our universe at $10^{-6}$ sec ($10^{37}$ Planck times) later than a Big Bang, and the evolution of forces, sub-atomic particles and finely tuned physics occurs in the Chandra Multiverse. This theory of the multiverse also makes identification of dark energy and dark matter possible.

**Walter Alvarez, Alessandro Montanari and David Shimabukuro** ('*Ex Libro Lapidum Historia Mundi:* Reading History Written in Rocks') indicate that, in the emerging conception of Big History, the largely contemporaneous regimes of Earth and life occupy the middle ground between cosmos and humanity. As part of the bridging of disciplinary boundaries, historians and astronomers will need to learn how geologists and paleontologists read history written in rocks. This was the goal of a workshop held at the Geological Observatory of Coldigioco, in the Marche Region of Italy in August 2010, that led to the founding of the International Big History Association. The Observatory is in a part of the Apennine Mountains that has extensive outcrops of deep-water or 'pelagic' limestones, which carry the best record of Earth history, covering an interval of about 200 million years. Especially in the remarkable outcrops at Gubbio, geologists and paleontologists have recovered records of the evolution of microfossils, the reversals of the Earth's magnetic field, the giant impact that caused the mass extinction in which the dinosaurs perished, and have dated parts of this record with volcanic ash layers that give numerical ages. The integrative stratigraphy obtained from the Italian pelagic limestones has been very impor-

tant for the development of the geologic time scale, and new developments in cyclostratigraphy hold the promise of dating these rocks back to about 100 million years ago, with a resolution of about 1,000 years.

**Leonid E. Grinin, Andrey V. Korotayev and Alexander V. Markov** ('Biological and Social Phases of Big History: Similarities and Differences of Evolutionary Principles and Mechanisms') demonstrate that the comparison of biological and social macroevolution is a very important issue; this issue, however, has been studied insufficiently. Yet, its analysis suggests new, promising possibilities to deepen our understanding of the course, trends, mechanisms and peculiarities of the biological and social phases of Big History. Even though there are very important differences between biological and social macroevolution, it appears possible to identify a number of fundamental similarities. At least three fundamental sets of factors determining those similarities can be singled out. First of all, we are dealing with very complex non-equilibrium (but rather stable) systems whose principles of functioning and evolution are described by General Systems Theory, as well as by a number of cybernetic principles and laws. Secondly, we do not deal with isolated systems but rather with complex interactions between both biological and societal organisms and their external environments. Thirdly, there is a direct 'genetic' link between the two types of macroevolution and their mutual influences. This article analyzes similarities and differences between two phases of Big History at various levels and in various aspects. It compares biological and social organisms, mechanisms of evolutionary selection, transitions to qualitatively new states, processes of key information transmission, and fixation of acquired characteristics. It also considers a number of preadaptations that contributed to the transformation of the Big History biological phase into its social phase; it also analyzes some lines of such a transformation.

This article is the continuation of the authors' contribution to the previous issue of the Almanac. It appears appropriate at this point to remind our readers the basic ideas of the authors' first article. According to them, it appears reasonable to consider biological and social macroevolution as a single macroevolutionary process to at least some extent. This implies the necessity to comprehend general laws and regularities describing this general process. An important notion that may contribute to our understanding of the differences and similarities of these two types of macroevolution is the term *social aromorphosis.* This term was developed as a counterpart to the notion of biological aromorphosis, which is well established within Russian evolutionary biology. Grinin, Korotayev, and Markov regard social aromorphosis as a rare qualitative macro-change that increases in a very significant way complexity, adaptability and mutual influence of social systems, and thus opens up new possibilities for social macrodevelopment. In their contribution, they discuss a number of regularities that

describe biological and social macroevolution by employing the notions of social and biological aromorphosis, including such regularities as rules of 'module evolution' (or the evolutionary 'block assemblage'), 'payment for arogenic progress', *etc.*

**David Hookes** ('The Evolution of Information Systems: From the Big Bang to the Era of Globalisation') shows the importance of the evolution of information systems for the emergence of life and the trajectory of human history. It locates this development in the widest possible context, that is, the history of the Universe as a whole. One can view the development of the Universe from the Big Bang to the present social existence of our species as a series of revolutionary/evolutionary stages, with each stage associated with the development of a new information system. The present form of globalization is made possible, in part, by the development of modern Information and Communications Technology (ICT). In this context, the change in character of the working class is examined. It is argued that information workers are the dominant category in advanced economies, and that one of their sub-groups, the knowledge workers, can play an especially important role in resolving the crises of both the socio-economic system and the physical environment.

**Alexander D. Panov** ('Post-singular Evolution and Post-singular Civilizations') discusses how the ability of the world civilization to overcome a singularity border (a system crisis) determines important aspects of that civilization during an intensive, post-singular phase of development. A number of features of a post-singular civilization can stimulate its 'strong communicativeness', which is a prerequisite for the formation of a 'galactic cultural field'. Post-singular civilizations – carriers of the cultural field – are considered as potential partners in interstellar communication and in our own potential future.

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There then follows ***'Essays on Big History' (Section 3)*** that considers literature, art and poetry, as well as the teaching of children and personal views of the world – all through the prism of Big History. This is an exciting assemblage of thinking from around the world on what promises to be the defining paradigm for the survival and continued evolution of our global civilization. It is very important to show the connection between Big History and various aspects of human life, such as poetry and ecology, art and architecture. It is even more important to develop methods of Big History teaching so that it can be understood by children and adolescents – our next generations.

**Nigel C. Hughes** ('The Change We can Believe in: Ten Facts about the Evolution of the Earth-Life System and their Relevance to Current Global Environmental Change') emphasizes that what we believe about the past of the Earth, for the first time in human history, has direct implications for our future. If we are

to make responsible choices about global environmental change, we must understand what Earth history says about how the planet and its inhabitants have coevolved, and be able to relate these insights to our current conditions. The Big History movement is an important bridge between scientific understanding of this past, varied views of humanity's place in Earth history, and practical environmental issues that affect our daily lives. If Big History is to gain serious traction, the movement must emphasize the linking of lessons from the past to the choices we must make as a global society today. This article presents ten facets of Earth history that contextualize some current issues concerning global change and species extinction within a Big History perspective. Hughes argues that, although extinction has played an important role in shaping the evolutionary history of life and although we are here partly because of it, the fact that almost all species that have ever lived are extinct cautions against a passive response to global climate and environmental change.

**Jos Werkhoven** ('Once upon a Time… There was a Story to be Told...') was a teacher for more than thirty years. The article starts with the story of a teacher: the story of everything! For a while, we follow the story in the classroom. But it is a 'long, very long story'. So we leave the classroom and he writes about his approach to telling this story of Big History to children of the age of 6+. He calls his story 'questioning' – questioning of space and time. He helps the children with three frameworks, which is the core of the article. For the framework of space, he uses the concept of the *Powers of Ten*, which was developed by Kees Boeke. For time, he uses a framework that he himself developed: *The Lines of Life*, a set of four timelines for use in primary school. For questioning, he uses the material for sentence analysis developed by Dr. Maria Montessori.

**Erika K. H. Gronek** ('And Then There Was You…: A Children's Story of Science and Emotion') describes the background to the writing of the children's book, *And Then There Was You...* In addition, the multiple layers of the story that go beyond a child's initial comprehension are deconstructed. The book in question hits upon many of the themes of the Big History movement in academia.

The objective of the article by **Paula Metallo** ('Brain Stretching: Art and Big History') is to express the ways that Art can serve as a means to describe patterns and encourage openness to 'stretching' the brain. Such a process helps us comprehend inter-connectivity and shows how Big History can help to implement a whole-picture, interdisciplinary approach to learning. She quotes author Richard Shelton, who wrote twenty-five years ago: 'Somebody must integrate and synthesize what we know about ourselves and the world in order to prevent social, cultural, and even personal fragmentation'.

**Gary Lawless** ('Big History and Bioregions') demonstrates that Bioregionalism and Big History are part of the new way of looking at our homes and the Cosmos that is unfolding around our planet Earth today. Bioregionalism is Big History in action. This essay shares some views about Big History by a bio-

regionalist poet from his home in Maine, relating them to other bioregional poets like Gary Snyder in California and Nanao Sakaki in Japan.

**Esther Quaedackers** ('A Little Big History of Tiananmen') aims at demonstrating the usefulness of studying small-scale subjects such as Tiananmen, or the Gate of Heavenly Peace, in Beijing – from a Big History perspective. By studying such a 'little big history', previously overlooked yet fundamental explanations for why people built the gate the way they did can be found. These explanations are useful in their own right and may also be used to deepen our understanding of more traditional explanations of why Tiananmen was built the way it was.

**Roland Saekow** ('From Concept to Reality: Developing a Zoomable Timeline for Big History') emphasizes that Big History is proving to be an excellent framework for designing undergraduate synthesis courses. A serious problem in teaching such courses is how to convey the vast stretches of time – from the Big Bang, 13.7 billion years ago, to the present, as well as how to clarify the wildly different time scales of cosmic history, Earth and life history, human pre-history and modern human history. Inspired by a series of printed timelines that had been created by Professor Walter Alvarez at the University of California Berkeley, a time visualization tool called 'ChronoZoom' was developed by Saekow and Alvarez through a collaborative effort between their Department of Earth & Planetary Science and Microsoft Research. Work on the second version of ChronoZoom is presently underway with the hope that it will be among the first in a new generation of tools to enhance the study of Big History.

Finally, **James Tierney** ('Two Themes Inherent in Big History') ties together the Big History components of collective learning and complexity-building within the long term perspective of the evolution of the Universe and the shorter term perspective of human culture. Since human culture is at the leading edge of complexity-building, it is appropriate to wonder where that process is taking us and whether there are ways by which it might be influenced. Tierney suggests that the pace of cultural evolution is significant in terms of the heavy investment in war technology over the past 10 thousand years, while the more leisurely and cooperative pace of human development from 35 thousand years ago may hold better lessons for human sustainability.

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So, you hold in your hands an almanac that has been assembled with the cooperation of local, regional and international organizations. It features editors and authors from different parts of the planet. It is a concept that builds bridges over the antiquated fortifications of the Cold War. It is an interdisciplinary and international effort. And now it transcends the boundaries of 'mere' global existence: Big History.

This very publication is an example of the process – in Marshall McLuhan's words: 'The medium is the message'. Think about it… Many of the ideas expressed in this edition are derived from thoughts that – until recently – have been sequestered behind artificial barriers of ideology, language, class and profession. We are on the threshold of a new era of advancement.

There is a certain point at which evolution leads to revolution. This certainly was the case when our universe coalesced, when blue-green bacteria created an oxygen-rich atmosphere on Earth, when hominids developed symbolic logic that could be communicated through generations, and when human society deployed carbon-combustion engines throughout the world. Although none of these evolutionary steps inevitably led to the next stage, each evolutionary step did lead to a revolutionary stage of activity. We are at a point where there is the need for yet another evolutionary revolution, this time in the realm of scholarship and pedagogy. We embrace the challenge and welcome you to our new world!

## Technical Note

Many of the articles are accompanied by photographs and images that cannot be inserted into the printed edition of the Almanac *Evolution* for technical reasons. Following the example of journals, such as *Nature* and *Science,* as well as other paper-published volumes, we provide an online edition of the Almanac at its website (www.socionauki.ru/almanac/evolution_en/evol_2_en/). There, you can find full texts, together with all the photographs and images sent by the authors. Some figures and diagrams mentioned in the articles, but which are available only in the online version, have linked references to the online publication.

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## References

**Ashby W. R. 1958.** General Systems Theory as a New Discipline. *General Systems* 3: 1–6.

**Bratton S. 1983.** The Ecotheology of James Watt. *Environmental Ethics* 5(3): 225–236.

**Chambers R. 1844.** *Vestiges of the Natural History of Creation*. London: J. Churchill.

**Christian D., and McNeill W. H. 2008.** *An Introduction to 'Big History' with David Christian and William H. McNeill*. URL: www. youtube.com/watch?v=lBCvpIK7g8U.

**Fukuyama F. 1989.** The End of History? *The National Interest* 16: 3–18.

**Grinin L. E., Carneiro R. L., Korotayev A. V., and Spier F. 2011.** Introduction. Evolutionary Megaparadigms: Potential, Problems, Perspectives. *Evolution: Cosmic, Bi-*

*ological, and Social* / Ed. by L. E. Grinin, R. L. Carneiro, A. V. Korotayev, and F. Spier, pp. 5–29. Volgograd: Uchitel.

**Grinin L. E., and Korotayev A. V. 2009.** *Social Macroevolution. Genesis and Transformations of the World-System.* Moscow: KomKniga/URSS. *In Russian* (Гринин Л. Е., Коротаев А. В. *Социальная макроэволюция: Генезис и трансформации Мир-Системы.* М.: ЛИБРОКОМ).

**Grinin L. E., Markov A. V., and Korotayev A. V. 2011.** Biological and Social Aromorphoses: A Comparison between Two Forms of Macroevolution. *Evolution: Cosmic, Biological, and Social* / Ed. by L. E. Grinin, R. L. Carneiro, A. V. Korotayev, and F. Spier, pp. 162–211. Volgograd: Uchitel.

**Henderson L. 1913.** *Fitness of the Environment*. New York: Macmillan.

**Philips A. 1998.** *20 Mishaps that Might have Started Accidental Nuclear War.* The Nuclear Age Peace Foundation, Santa Barbara, California (USA), NuclearFiles.org. URL: http://www.nuclearfiles.org/menu/key-issues/nuclear-weapons/issues/accidents/20-mishaps-maybe-caused-nuclear-war.htm. Date accessed: 01.2011.

**Rodrigue B., and Stasko D. 2011.** Changing the Future with the Past: Global Enlightenment through Big History. *Journal of Globalization Studies* 1(2): 30–47.

**Shapley H. 1930.** *Flights from Chaos.* New York: McGraw-Hill.

**Shelton R. 1985.** Introduction. *Art and Geology* / R. D. Abbey, pp. i–xii. Layton, UT: G. Smith.

**Shklovskii I. S., and Sagan C. 1966.** *Intelligent Life in the Universe*. San Francisco, CA: Holden-Day.

**Von Bertalanffy L. 1968.** *General System Theory*. New York: Braziller.

**Whitehead A. N. 1925.** *Science and the Modern World*. New York: Macmillan.