Introduction

Big History's Big Potential

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Big History has been developing very fast indeed. We are currently observing a 'Cambrian explosion' in terms of its popularity and diffusion. Big History courses are taught in the schools and universities of several dozen countries, including China, Korea, the Netherlands, the USA, India, Russia, Japan, Australia, Great Britain, Germany, and many more. The International Big History Association (IBHA) is gaining momentum in its projects and membership. Conferences are beginning to be held regularly (this edited volume has been prepared on the basis of the proceedings of the International Big History Association Inaugural Conference [see below for details]). Hundreds of researchers are involved in studying and teaching Big History.

What is Big History? And why is it becoming so popular? According to the working definition of the IBHA, 'Big History seeks to understand the integrated history of the Cosmos, Earth, Life and Humanity, using the best available empirical evidence and scholarly methods'.

The need to see this process of development holistically, in its origins and growing complexity, is fundamental to what drives not only science but also the human imagination. This shared vision of the grand narrative is one of the most effective ways to conceptualize and integrate our growing knowledge of the Universe, society, and human thought. Moreover, without using 'mega-paradigms' like Big History, scientists working in different fields may run the risk of losing sight of how each other's tireless work connects and contributes to their own.

Scientific specialization and the immense amounts of information contained in the various 'silos' of academia can hinder our capacity for inclusiveness, but, paradoxically, it also amplifies the need for it. Many scientists would like a more integrated vision that sees beyond their meticulous and complicated fields of specialization. One can see the growth of such interest in the framework of individual disciplines, as well as in interdisciplinary research. Yet, while interdisciplinarity is not

a new idea, many disciplines can run the disappointing tendency of only paying lip-service to it. This is not possible in Big History. In a discipline that *starts* by weaving together all the disciplines into a single narrative, interdisciplinary work is not only possible, it is essential. A unification of disciplines, a deep symbiosis of academic cells, will open up research areas that are vital to the development of the twenty-first century thought and culture. As has been mentioned on a number of occasions, the rapidly globalizing world needs global knowledge that explains a unified global system (see Grinin, Korotayev, Carneiro, and Spier 2011; Grinin and Korotayev 2009). Indeed, globalization itself becomes a vehicle for Big History. The very existence of the International Big History Association is proof of that.

Big History ideas did not appear out of nowhere. They have deep roots in human spirituality, philosophy, and science. In the nineteenth and twentieth centuries, there was an explosive growth of scientific knowledge accompanied by a deep differentiation of disciplines. This made borders between scholars and scientists much more rigid, while research specialization grew by an order of magnitude. As Erwin Schrödinger justly noted: '[I]t has become next to impossible for a single mind fully to command more than a small specialized portion of it'. However, he continued, there is 'no other escape from this dilemma (lest our true aim be lost forever) than that some of us should venture to embark on a synthesis of facts and theories' (Schrödinger 1944: 1). As disintegration peaked in the twentieth century, such undertakings were not mentioned as often as they ought to have been. When an interdisciplinary synthesis was mentioned at all, it was seen as a lofty goal, the barest whisper of a dream, rather than an approachable reality.

A very different picture appears if we look further back in the history of human thought. From the very moment of their emergence, grand unified theories of existence tended to become global. Even the Abrahamic theological tradition, that was dominant in the western half of the Afroeurasian world-system in the Late Ancient and Medieval periods, contains a sort of proto-Big History. It presents a unified vision of the Universe's origin, development, and future. In that grand narrative, the Universe has a single point of creation and it develops according to a divine plan. Similarly, classical Indian religious philosophy loosely resembles the principle of the unity of the world through the idea of reincarnation, in a Hindu approximation of the First Law of Thermodynamics. Even the delusions of astrologers and alchemists contained the idea of universal interconnectedness (stars and planets affect human

fates; everything can be transformed into everything else). This is only a fragment of the pre-modern ideas that contained elements of Big History thinking. Many interesting insights on the properties of the Universe can be found in pre-scientific worldviews generated by various human civilizations.

Ancient philosophy even aspired to find the single principle cause for everything that exists.[1] This was done in a very insightful way in the works of the ancient Greeks, who were especially interested in the origins and nature of the Universe. Note that even while Greek (and, more generally, classical) philosophy concentrated on ethical or aesthetic issues, it was still dominated by the idea of the single law of *Logos* that governed the whole Universe, with many different interpretations of it provided by various thinkers. This was reinforced by the concept of a 'cosmic circulation' that also influenced human society. Medieval philosophy inherited the Greek tradition 'to comprehend the universe on the basis of archetypal principles … as well as the inclination to detect clarifying universals in the chaos of the life' (Tarnas 1991: 3–5).

The transition from the geocentric (Ptolemaic) to the heliocentric (Copernican) perspective took many centuries notwithstanding all the brilliant conjectures of Giordano Bruno (1548–1600). Discoveries by Johannes Kepler (1571–1630), Galileo Galilei (1564–1642), and Isaac Newton (1643–1727) produced a majestic vision of the Universe. For the first time in history, a more advanced form of Big History thinking was produced – not by the speculations of philosophers or theologians but on the basis of corroborated facts and mathematically formulated laws of Nature. 'Mechanicism' became the dominant paradigm in the western scientific thought (including the social sciences). Thus the formation of a unified scientific worldview was consolidated. 'Natural philosophy', the precursor term for science, investigated everything from the highly cosmological to the deeply sociological and continued to preserve its dominant position in the eighteenth century: the age of the Enlightenment (see Barg 1987; Grinin 2012 for more details).

However, new ideas stressing historical variability soon emerged. Those ideas and discoveries led to a crisis of the dominant scientific paradigm. In geology, Georges-Louis Leclerc, Comte de Buffon, systematized all the known empirical data and analyzed a number of important theo-

[1] In particular, in the classical Indian philosophy one finds the belief in the 'eternal moral order' of the Universe as well as ideas of the collossality of the world space and time, infinity of the Universe comprising millions of such worlds as our Earth (see, *e.g.*, Chatterjee and Datta 1954).

retical issues of the development of the Earth and its surface. He also produced a few insights that turned out to be important for the development of the theory of biological evolution. The hypothesis of the emergence of the Solar System from a gas nebula was first spelled out by philosopher Immanuel Kant and later by mathematician and astronomer Pierre-Simon Laplace in one of the notes to his multivolume *Mécanique Céleste* (1799–1825).

Some of the philosophical roots of evolutionary ideas are very old indeed, and scientifically based evolutionary ideas first emerged in the seventeenth and eighteenth centuries. But the idea of universal evolution only became really influential in the nineteenth century. The first major evolutionary theory in biology was produced by Jean-Baptiste Lamarck (1744–1829), who advocated change via acquired traits. Another no less evolutionary theory was formulated in geology by Charles Lyell (1797–1875) who, in his *Principles of Geology* (1830–1833), refuted the theory of catastrophism.

It is no coincidence that the first narratives beginning to resemble modern Big Histories first emerged around that time. The first real concerted and conscious attempt to unify the story of the physical processes of the Universe to the dynamics of human society was made by Alexander von Humboldt (1769–1859), a Prussian natural philosopher, who set out to write *Kosmos* (1845–1859), but died before he could complete it. Also, Robert Chambers anonymously published the *Vestiges of the Natural History of Creation* in 1844. His book began with the inception of the Universe in a fiery mist and ended with a history of humanity.

In the second half of the nineteenth century, the concept of evolution by natural selection as pioneered by Charles Darwin (1859) and Alfred Russel Wallace (1858) merged with the idea of social progress espoused by Herbert Spencer (1857, 1862, 1896) and became a major influence on western thought. The idea of evolution/progress as a transition from less to more complex systems dramatically transformed the human worldview.[2] It became known that stars and planets, including the Sun and the Earth, are objects that have their origin, history, and end. There was a great deal of indication that revolutionary changes in astronomy were forthcoming.

Two discoveries produced the most important contribution to the emergence of Big History. First, the interpretation of the redshift by

[2] Note that although Spencer paid more attention to biological and social evolution, he treated evolution as a universal process taking place at all possible levels – from microorganisms to galaxies.

Edwin Hubble in the 1920s demonstrated that the Universe is not static and eternal, but is in a general state of expansion, as if it began with a primordial 'explosion'. By the 1940s, interacting teams of physicists and astronomers from around the world speculated on the existence of left-over radiation from this event – cosmic microwave background radiation. This radiation was detected in 1964 by Arno Penzias and Robert Wilson and provides the most convincing observational evidence for the explosive beginning of our Universe, which in the late 1940s George Gamow and Fred Hoyle called the 'Big Bang'. The simple epithet became useful for the theory's supporters. Moreover, the emergence of *historical* evidence for a point of origin of the Universe established a sense of chronology and transformed astrophysics into a historical science. The door firmly swung open for scholars of all shades to produce a universal history, called, to use our own simple epithet, 'Big History'.

By the last decades of the twentieth century, it became clear that the natural sciences contained a clear narrative from the Big Bang to modern day and this unity began to find expression in an increasing number of written works. For the first time it was actually possible for the mainstream to grasp the entire chronology.[3] This began the process of thinking about both natural and human history as part of the unified whole. In 1980, astrophysicist Eric Jantsch wrote *The Self-Organizing Universe* (Jantsch 1980), now sadly out of print, which tied together all universal entities into a collection of processes. It constitutes the first modern unifying Big History. Jantsch did a credible job of examining human history as an extension of cosmic evolution and as just one of many structures operating beyond thermodynamic equilibrium. Jantsch's work constitutes the first attempt to find a common strand or dynamic that streamlines, unites, and underwrites the entire grand narrative. It is thus possible to explore history from the Big Bang to modern day without being weighed down by the scale of the chronology.

Around the same time American-based astrophysicists, geologists, and biologists such as Preston Cloud, Siegfried Kutter, George Field, and Eric Chaisson began writing and teaching courses about the cosmic story. Then, at the end of the 1980s, history and psychology professors like David Christian in Sydney, John Mears in Dallas, and Akop Nazaretyan in Moscow[4] began to craft grand narratives that incorporated

[3] A phenomenon best discussed in David Christian's 'The Evolutionary Epic and the Chronometric Revolution' (2009).

[4] For more details on the Russian Big History tradition see Nazaretyan 2011.

the human story more seamlessly into a larger universal narrative. Fred Spier did the same at Amsterdam and Eindhoven. From here, a Cambrian-style explosion of courses and works has occurred.[5]

Eric Chaisson's *Cosmic Evolution* (2001) defines the unifying theme of Big History as the rise of complexity. Chaisson even proposed a way of objectively measuring this trend. Free energy rate density is the energy per second that flows through an amount of mass. In this way Chaisson empirically established that complexity has been rising in the Universe for 13.8 billion years. The theme of rising complexity was incorporated into David Christian's *Maps of Time* (2004) which further employed it in the human tale. The book also coincided with John and William McNeill's *The Human Web* (2003) and went back further to the beginning of time, for which William McNeill (somewhat superlatively and, one hopes, humorously) compared himself to John the Baptist and David Christian to Jesus of Nazareth for historicizing the natural sciences. Fred Spier, most recently in his book, *Big History and the Future of Humanity* (2010), has emphasized the Goldilocks principle, and how the rise of complexity occurs when conditions like temperature, pressure, and radiation are 'just right' for the rise of complexity to occur. Spier asserts that the rise of complexity combined with energy flows and the Goldilocks principle form the beginnings of an overarching theory of Big History.

The unique approach of Big History, the interdisciplinary genre of history that deals with the grand narrative of 13.8 billion years, has opened up vast research agendas. Or, to engage an evolutionary metaphor, it has triggered a scholarly speciation event where hundreds of new niches have opened up waiting to be filled. The ecological terrain is vast and the numbers that currently populate it are few. The research comes in a variety of forms. We, big historians, must collaborate very closely to pursue this vibrant new field. Our world is immensely diverse and unlimited in its manifestations. However, fundamentally it is one world – that is why it is so important to study those fundamentals.

Hence the International Big History Association was formed on 20 August 2010, at the Geological Observatory at Coldigioco in Italy.

[5] For recent survey of size and of the field see Rodrigue, Stasko 2009; and the canon of seminal works includes but is not confined to Fred Spier's *The Structure of Big History: From the Big Bang until Today* (1996), David Christian's *Maps of Time: An Introduction to Big History* (2004), Eric Chaisson's *Epic of Evolution: Seven Ages of the Cosmos* (2006), Cynthia Stokes Brown's *Big History: From the Big Bang to the Present* (2007), and *Evolution: A Big History Perspective* (Grinin, Korotayev, and Rodrigue 2011).

Subsequently, there was some tireless work involved in arranging the first conference in Grand Rapids, Michigan, in August 2012. Anyone who attended the first conference could not help but feel a little encouraged. We established a fraternity of researchers and educators from every corner of the globe. Numerous presentations were given on a diverse range of projects and we were given demonstrations of Chronozoom and the Big History Project. There is, however, a long road ahead of us as a discipline. One of the most important tasks of big historians in the coming years is to prove that Big History can sustain a wide number of empirically rigorous and truly interdisciplinary research projects. These conference proceedings are a sample made by the IBHA Publications Committee of the excellent work done on the many dynamics of the grand narrative and the best methods of teaching it.

STRUCTURE AND SECTIONS

Big History brings together constantly updated information from the scientific disciplines and merges it with the contemplative realms of philosophy and the humanities. It also provides a connection between the past, present, and future. Big History is a colossal and extremely heterogeneous field of research encompassing all the forms of existence and all timescales. Unsurprisingly, Big History may be presented in very different aspects and facets. One way of dividing it is 1) methodology and the theory of knowledge, 2) ontological aspects, and 3) pedagogy. This volume is consequently structured in the following way:

– Section 1. Understanding and Explaining Big History in which Big History is explored in terms of methodology, theories of knowledge, as well as showcasing the personal approach of scholars to Big History.

– Section 2. Big History's Phases, Regularities, and Dimensions is connected with ontological aspects. A mental dissection of the whole into its parts is one of the most important tools of scientific cognition.

– Section 3. Teaching Big History explores the nature of teaching Big History as well as profiling a number of educational methods.

The first section of the volume stresses the unity of Big History. The second section comprises the articles that could clarify Big History's main trends and laws. The third section shows how that scholarly knowledge is transformed to the benefit of future generations. Naturally, in a field as interwoven as Big History, there is some overlap in the ideas and arguments contained in all three of these sections.

1. Understanding and Explaining Big History

David Christian's *Swimming Upstream: Universal Darwinism and Human History* shows how the patterns in cosmic, quantum, and biological evolution are connected to cultural evolution, especially in relation to his concept of Collective Learning. David Baker's *Standing on the Shoulders of Giants: Collective Learning as a Key Concept in Big History* presents research on the evolutionary history of Collective Learning in hominines, its role in the history of agrarian civilizations, and explains how this form of Universal Darwinism is deeply connected to the wider rise of complexity in the Universe. Lowell Gustafson's highly entertaining *From Particles to Politics* bestows a new perspective on the entire grand narrative through the lens of a political scientist and with the use of political metaphors for a variety of physical processes, showing the 'body politic' of everything from atoms to apes. Esther Quaedackers' *To See the World in a Building: A Little Big History of Tiananmen* explores how the history of one single thing can reflect back the many physical processes of Big History and how Little Big Histories can be used as a fertile research agenda for scholars of any discipline. Esther Quaedackers invented Little Big Histories in 2007 and the concept has since been adopted by the Big History Project and also forms the basis for each episode of H2's *Big History* series. Sun Yue's *Chinese Traditions and Big History* outlines some of the challenges for Big History in the world's most populous nation and also compares some of the key features of cosmic evolution to strikingly similar ones found in traditional Chinese philosophy. Ken Gilbert's *The Universal Breakthroughs of Big History: Developing an Unified Theory* explores how the concept of 'thresholds', as seen through a Gouldian framework, could potentially lead to an overarching theory of Big History that unites cosmology, biology, and human history. Ekaterina Sazhienko's *Future of Global Civilization: Commentary of Big Historians* compiles data from interviews with various people connected to Big History about the prospects for humanity and the future of complexity. The work touches on opinions of big historians about many areas of the grand narrative and uses them to take on the brave, if idealistic, task of figuring out what should be done to address the most crippling problems of the twenty-first century.

2. Big History's Phases, Regularities, and Dimensions

Leonid Grinin's *The Star-Galaxy Era of Big History in the Light of Universal Evolutionary Principles* is an in-depth view of how Universal Darwinism operates in the stelliferous section of the grand narrative. A startling

number of similarities occur at this level, resembling both biological and cultural evolution and governing the life and death of stars – without which further evolutionary processes and the rise of complexity would be impossible. Andrey Korotayev and Alexander Markov's *Mathematical Modeling of Biological and Social Phases of Big History* explores how macropatterns of evolution are similar at both the biological and social phases, and goes even further to explain how these processes can be charted and effectively described by mathematical models. Ken Baskin's *The Dynamics of Evolution: What Complexity Theory Suggests for Big History's Approach to Biological and Cultural Evolution* examines complexity dynamics through the lens of cultural evolution and punctuated equilibrium. Abel Alves' *The Animals of the Spanish Empire: Humans and Other Animals in Big History* is a historian's take on the similarities between animal and human behavior, contrasting the realms of biology and human history, that also tests the hypothesis that humans are 'chimpanzees who would be ants'. It is a remarkable take on conventionally human history and a fresh insight into our relationship with nature. Craig Benjamin's *Big History, Collective Learning and the Silk Roads* explores how in the era of agrarian civilizations human societies across Afroeurasia did not live in isolation. From the rise of the first states to the age of exploration, collective learning operated along the silk roads, spurring along human innovations and connecting the continents of Africa, Europe, and Asia into the largest of the 'world systems'. Barry Rodrigue's *Retrofitting the Future* takes an archaeological look at how technologies devised by humans in the earliest agrarian villages and states can inform our own technological development today. Joseph Voros' brilliant *Galactic-Scale Macro-engineering: Looking for Signs of Other Intelligent Species, as an Exercise in Hope for Our Own* deals with the most daunting of all Big History periods: the future. A respected physicist and futurist, the author looks at possible avenues for the further rise of culturally-generated complexity, how civilizations could harness the power of stars and even galaxies, and the telltale signs that such large scale complexity would exhibit in the night's sky.

3. Teaching Big History

Michael and D'Neil Duffy's *Big History and Elementary Education* discusses methods on how Big History can be extended from university and high school curricula to be taught to elementary students, particularly in a Montessori framework. They have devised a course progression through which young minds can travel through all the thresholds of the grand narrative. Tracy Sullivan's *Big History and the Secondary Classroom:*

A Twenty-First Century Approach to Interdisciplinarity? involves the experience the author has had teaching Big History to high school students and also developing the Big History Project. She uses her knowledge to explore pedagogical questions about how modern educators all over the world will define and improve their curricula in the rest of this century. Cynthia Stokes Brown's *Constructing a Survey Big History Course* takes her experiences in teaching Big History at a university level and gives some careful and direct advice to university lecturers who are considering setting up a course of their own. John Fowler's *Cosmology, Mythology, and the Timeline of Light* explores how to best capture the imaginations of 11 and 12 year old elementary students to impart on them an all-encompassing knowledge of the long story of existence from the Big Bang to modern day. Lastly, Jonathon Cleland Host's *Big History Beads: A Flexible Pedagogical Method* demonstrates a fun way that students of many ages can further reinforce their education of Big History by some simple but clever mnemonic devices.

THE FUTURE OF THE IBHA

Big History has already come a long way, and these proceedings are but a small sliver of proof that this new field already has minds churning with a thousand different ideas about how we understand and interpret the Universe. It is our hope that further work will be done in the near future, on a mounting scale, with an ever-widening network of collaborators. As a young discipline, we have enjoyed advantages in our early years that other young disciplines do not. The historical study of the Universe has a highly interdisciplinary and mind-blowing quality to its founding principles that embraces and inspires scholars from every background. Scientists, historians, philosophers, and more, can find a place in our ranks. And many who have heard of Big History have eagerly jumped at the chance to do so. We also benefit from the wholehearted support of prestigious and well-respected public figures like Bill Gates and Walter Alvarez.

We also enjoy the advantage of timing. At no point was a discipline that explored the connections between the natural and social sciences more relevant than now. At no time was a discipline that told the inhabitants of all nations across the globe their common story more important than in an age when travel is swift and communications are instantaneous. And never before in human history have we been so conscious of our potential in the cosmic story of rising complexity and so conscious of the perils threatening to reduce that potential to ruins and

ashes. The timing is not a coincidence. We are currently in the middle of a cultural revolution unprecedented in the times of all our forbearers. We should not be surprised that people from many different backgrounds and nations should at once have risen up and called for a grand historical epic that unites us all.

But each member of the IBHA needs to get the word out about Big History. Too few people have yet heard of this genre, much less the full story of humanity, life, and the Universe. We need to foster a network of researchers from the sciences and humanities. Physicists, geologists, biologists, historians, philosophers, and more, need to be encouraged to pursue interdisciplinary research projects in Big History. We need support, positions, and funding for graduate students who will be the researchers and educators of Big History in the future. We need to establish an academic journal to provide incentive for more scientists and scholars to spend their time doing Big History research. We need to create large, funded, research hubs in America, Europe, Australia, and anywhere else that a university will take us, to bring together people from various disciplines to work jointly on the questions of cosmic evolution. Much depends on the reader of this volume to do his or her part in these early days, so that the words 'Big History' will one day immediately leap to mind when people talk of the cultural legacy of the twenty-first century.

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