Introduction

From Big Bang to Galactic Civilizations An Introduction to Big History

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EACH SCIENTIFIC STUDY emerges in its own particular time and marks a new step in the development of human thought.[1] Big History materialized to satisfy the human need for a unified vision of our existence. It came together in the waning decades of the twentieth century, in part, as a reaction to the specialization of scholarship and education that had taken hold around the world. While this specialization had great results, it created barriers that stood in contrast to a growing unity among our global communities. These barriers were increasingly awkward to bridge, and, thus, Big History emerged as a successful new framework.

The Roots of Big History

Much of humanity's recent focus has been on developing tools and concepts within particular disciplines or between a few related ones. As a result of the success of this system, an explosion of knowledge took place in the natural and social sciences, which was then conveyed into world society through education, science, humanities and the arts. Let's consider an example of this interconnected 'chain of knowledge'.

In the 1920s, astronomers Georges Lemaître, Edwin Hubble and their colleagues made the discovery that the universe is not static, as had been assumed for millennia, but was in a general state of expansion, as if begun

in a primordial explosion. By the 1940s, interacting teams of physicists and astronomers speculated on the existence of left-over radiation from this event—the *cosmic microwave background*. This radiation was detected in 1964 and provides the most convincing evidence for the explosive beginning of the universe, which became known as the 'Big Bang'.

First enunciated by physicist Georges Lemaître in 1927 and then named in 1949 by astronomer Fred Hoyle, the 'Big Bang' became popular. It received endorsement from a variety of philosophical traditions: From Pope Pius XII and followers of the Abrahamic religions to those of Buddhist and Hindu faiths, as well as post-modernists, Marxists, neo-Kantians, and others. In popular culture, the Big Bang has appeared in children's literature, novels, TV shows, musical compositions, cinema, and T-shirt logos. Such wide dispersal of one concept of astrophysics testifies to the power of global communication. Any number of other examples could be chosen from other fields.

This kind of intellectual synthesis has taken place since ancient times, whenever humans tried to explain their place in the world. It happened when indigenous peoples used their deep territorial knowledge to craft not only tools and techniques for survival but also when they assembled

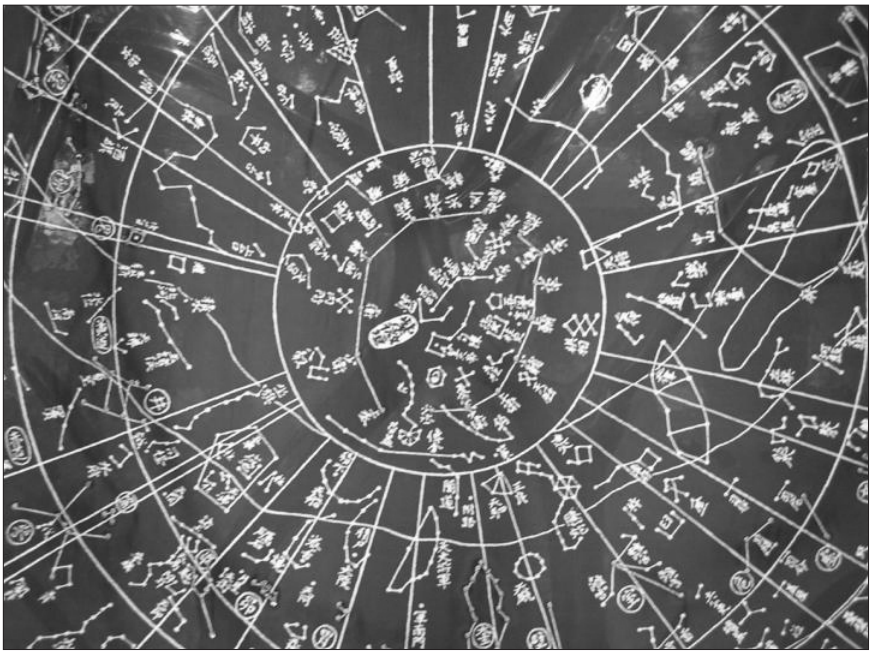


PLATE I.1: A detail from a Chinese astronomical chart, dated 1247 CE. The original is carved in stone and rests in the Confucian temple in Suzhou, Jiangsu Province, China. In sum, it shows 1434 stars and is one of the best existing such charts from this period.

Source: Photograph by Barry Rodrigue from the Beijing Ancient Observatory in 2011.

perspectives reflecting their keen observations. It occurred when Palaeolithic artists painted images on rock walls and it is recognizable in the Axial Age, when Pre-Socratic philosophers in Greece, Mauryan sages in India and Zhou scholars in China advanced holistic cosmologies. This effort to understand our place in the universe led to its most visible expression in technological development.

Much practical inventiveness originated in eastern Eurasia, travelled along the silk routes, was refashioned in Europe and then re-exported to overseas colonies. Innovations included the compass, porcelain, gunpowder, paper, printing and vaccination. It was a two-way street, as when the domestication of potatoes, cocoa and corn spread outwards from the Americas to Oceania, Eurasia and other parts of the world. This cycle of diffusion and adaptation resulted in a synthesis of knowledge that transcended national or ethnic boundaries, becoming the first phase of globalization.

As this dynamic exchange of technical knowledge grew, cognitive achievements of classical-era scholars also began to be reconsidered, including the works of Aristotle in Greece, Zhang Heng in China, and Aryabhata in India. Such works were found in the encyclopaedias of China, the libraries of the Islamic empires, the scriptoriums of Europe, and in South Asia's manuscripts. The 'renaissance' that resulted from the reformulation of these ideas from antiquity led to the emergence of modern science.

Although a popular image is that these advances took place in Europe, it was actually a global process. The quickening pace of scientific discoveries began a thousand years ago, proceeding from the work of countless thinkers and practitioners like Abu Ibn al-Haytham and Moses Maimonides in Egypt, Shen Kuo in China, Bhaskaracharya in India, Nicolas Oresme in France, Galileo Galilei in Italy, Johannes Kepler in Germany, Isaac Newton in England, and Seki Takakazu in Japan.

Breakthroughs took place in many fields, from optics to mathematics and astronomy, but the most important result was the development of the scientific method. Expanding global communications generated by trade led to the far-reaching dispersal of these ideas. The result was a majestic new vision of the universe. For the first time in history, a worldview was produced—not by the speculations of philosophers but on the basis of corroborated facts and formulated laws of nature.

The eighteenth and nineteenth centuries saw the growth of insights from biology, geology, chemistry and other observational studies. This synthesis led to larger realizations, such as how our solar system had emerged from a gas nebula.[2] This period also saw the diffusion more accessible forms of encyclopaedias, reflecting Enlightenment goals to amalgamate all knowledge into useful forms for all people. These efforts encouraged others, as when

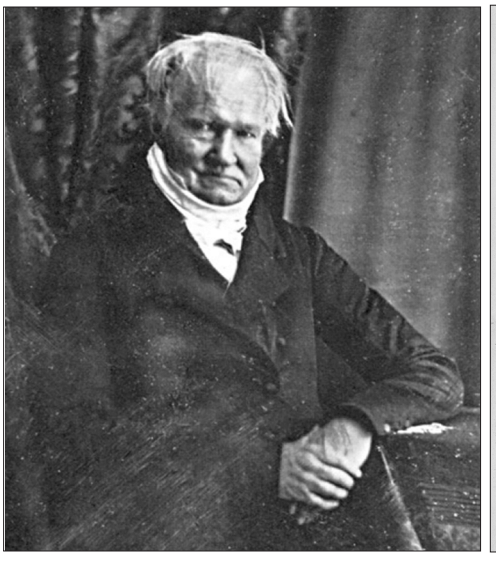
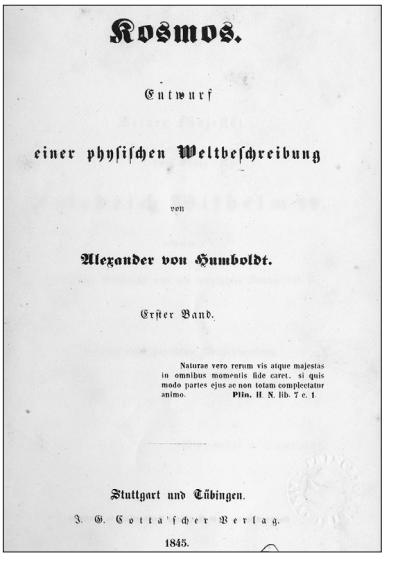


PLATE I.2: Alexander von Humboldt, 1847.
Source: Photograph by Hermann Biow, Wikimedia Commons.


Kosmos.

Entwurf

einer phyſiſchen Weltbeſchreibung

von

Alexander von Humboldt.

Erſter Band.

Naturae vero rerum vis atque majestas in omnibus momentis fide caret, si quis modo partes ejus ac non totam complectatur animo.
Plin. H. N. lib. 7 c. 1.

Stuttgart und Tübingen.
J. G. Cotta'ſcher Verlag.
1845.

PLATE I.3: Title page of Humboldt's *Kosmos: Entwurf einer Physischen Weltbeschreibung*, Vol. 1, Stuttgart: J.G. Cotta Publishing, 1845.

the naturalist Alexander von Humboldt produced his five-volume series, *Kosmos* (1845–62), which is considered a founding event of Big History, because of its integration of cosmology, geology, biology, and humanity.

In speaking of the origins of Big History, it is difficult not to also discuss the emergence of evolutionary thought. Initial efforts appeared in the biological oeuvre of Jean-Baptiste Lamarck and in the geological studies of Charles Lyell, as well as in subsequent works by Alfred Wallace, Herbert Spencer and Charles Darwin. Still later in the century, evolution merged with ideas of social progress to exercise a major influence on civilization.[3]

Nor did philosophical studies lie stagnant. The Hindu scholar, artist and 1913 Nobel Prize winner, Rabindranath Tagore, encouraged global networking of science and philosophy, while Catholic scientists, like palaeontologist Pierre Teilhard de Chardin, not only advanced science but sought to incorporate it into holistic worldviews.

So, it is apparent that centuries of a basic human desire to understand the nature of existence combined with decades of intensified scientific and scholarly studies to produce the favourable circumstances for the flowering of Big History. Nonetheless, efforts to assemble a comprehensive panorama of the universe and our existence began to decline with the advent of the modern university and departmental studies in the mid-nineteenth century. A result was that the reductionist accumulation of knowledge into strictly demarcated disciplines led to a pervasive distrust of the synthesis of information into a larger meta-narrative.

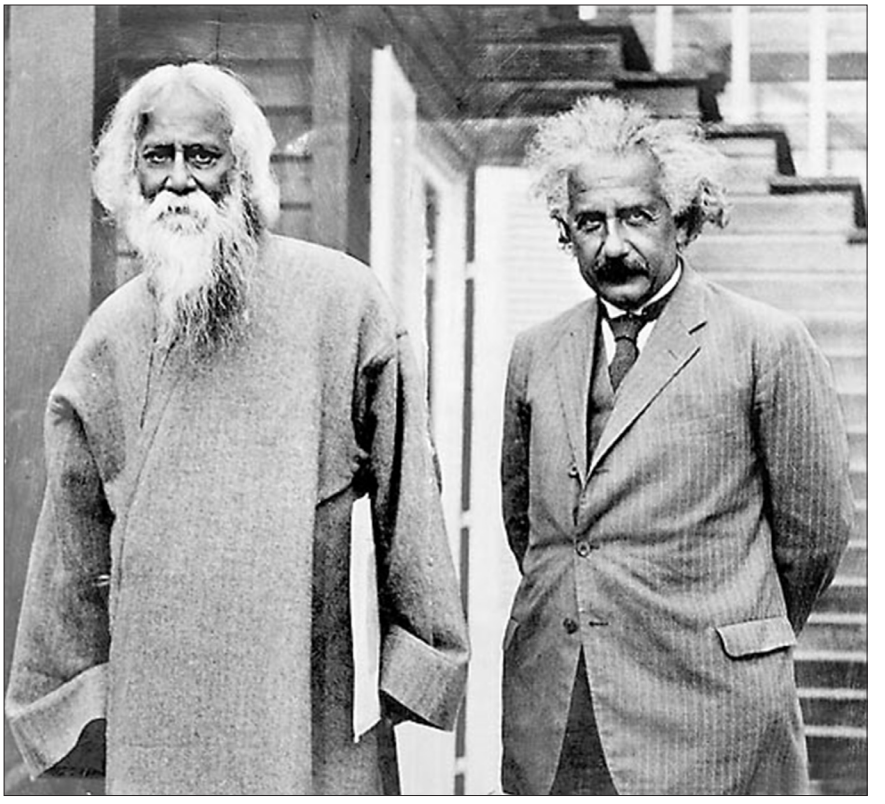


PLATE I.4: Rabindranath Tagore and Albert Einstein in Caputh, Germany, 14 July 1930.
Source: UNESCO.

Despite the limitations of modern university infrastructure, scholars persisted in forming cross-disciplinary studies to match newly generated knowledge. Thus, we see the rise of astro/physics, bio/chemistry and electro/mechanics . . . to name just a few. As a result of the scientific and technological activities of the World War era, in the first half of the twentieth century, the vast assemblage of new data led to the need for even larger intellectual frameworks. In an organic and natural way, globalization and collective knowledge combined and led us to the doorstep of Big History.

From Cross-Disciplines to Big History

A variety of projects designed to bridge national narratives developed as a result of the need for greater international and technological infrastructures in the second half of the twentieth century. People on all sides of the Cold War began to see us as living in 'one world' and sought to make that happen. In 1949, the United Nations Educational, Scientific and Cultural

Organization (UNESCO) established a commission to assemble a global scientific and cultural history. The lofty goal of the resulting *History of the Scientific and Cultural Development of Mankind* was to document all human achievement.[4]

In the 1950s, the Space Race galvanized fresh interdisciplinary efforts, while socio-historical scholarship in the post-colonial world underwent similar revitalization. Soviet scholars developed an integrated pedagogy that came to be called universal history.[5] One of the first books to express this new view of existence was by Soviet astrophysicist Iosif Shklovsky in *Вселенная. Жизнь. Разум* (Universe, Life, Intelligence) in 1962. Four years later, an English-language adaptation was produced with American astrophysicist Carl Sagan, *Intelligent Life in the Universe*. This international cooperation was not accidental, as similar forms of macro-study had also developed in the United States.

From the 1920s through the 1950s, astronomer Harlow Shapley promoted cosmography at the Harvard College Observatory, a study that examined the interlinked nature of stars, Earth, life and humanity. In the 1960s, Carl Sagan offered his rendition of it. And, in 1974, astrophysicists George Field and Eric Chaisson gave a course and produced texts on cosmic evolution. Chaisson especially championed and continued this effort with pedagogy, literature and teaching materials up through the present. Other scientists had likewise moved in this direction around the country, as with G. Siegfried Kutter at Evergreen State College, Tom Bania at Boston University, and Michael Rampino at New York University.[6]

A variety of books and other media expressions that were early formulations of Big History also began to appear at this time, such as astrophysicist Erich Jantsch's text on *The Self-Organizing Universe* in 1980. Some of these works became very popular: Over 500 million people in 60 countries watched Carl Sagan's television series, *Cosmos* (1980), while the book, *A Brief History of Time* (1988), by English astrophysicist Stephen Hawking, sold over 9 million copies.[7]

Similarly, in the 1970s, macrosociology, global history and macroeconomics began to coalesce with international studies in order to try to understand the many faces of global development. Economic historian Andre Gunder Frank shifted global studies outside of Cold War frameworks to describe a one-world system, while macrosociologist Immanuel Wallerstein identified the world economy as being composed of interlocking subsystems. This socio-historical work began to merge with larger paradigms, as when economist Graeme Snooks moved his Theory of Global Dynamic Systems beyond the modern era to encompass all of Earth's history, including its physical interactions.[8]

The independent development of such large-scale concepts flowered elsewhere around the world too. In the 1980s, Chinese scholars, including

rocket scientist Qian Xuesen, began to research complexity and published a paper on the 放的复杂巨系统（Open Complex Giant System), which had parallels with macro-historical views in the West, as a meta-synthesis of scientific knowledge.[9] Similar developments emerged in India and led ecologist Vandana Shiva to establish the Research Foundation for Science, Technology and Ecology in 1982. And a movement began in Japan in 1986 in response to proposals to deploy 'star wars' technology into the outer space of Earth. Founded by the international educator, Osamu Nakanishi, it evolved into the Institute for Global and Cosmic Peace and adopted Big History paradigms.[10]

Another manifestation of this interdisciplinarity came in calls for reform to university education. In 1985, American historian John Mears advocated for a general-education curriculum based on what was essentially Big History.[11] Four years later, he crafted a grand narrative and began teaching a course that incorporated human history into larger universal explanations. At that time, in 1989, Australian historian David Christian and Russian historical psychologist Akop Nazaretyan initiated similar curricular innovation.[12]

As David Christian explained, his work started with the question: 'When does history begin?' Receiving different answers from biologists, astronomers, anthropologists and others, he realized that students were getting confused fragments about our origins. So he sought to 'erase' the 'jagged edges' between these studies and make a unified course. In 1991, he coined the term, 'big history', in a whimsical moment, and the name stuck, at least for social scientists. Physical scientists tend to employ 'cosmic evolution', while others retain 'universal history'. There is no single cognomen for the field: we use 'Big History' in our anthology just because it is such a common and popular designation.[13] We also capitalize the name of the field, not because of scholastic egotism but merely to sidestep the banalization of the field when presented in lower-case letters, to wit, 'big history' or 'big historians'—an otherwise pedestrian nomenclature.

Big History has come to fit within a wide variety of educational structures. It is taught at many levels, in many departments, and through general education curriculums. Its popularity is dramatic: universities hold undergraduate classes accommodating hundreds of students and online courses draw students from around the planet. Students have begun to emerge from graduate schools with their masters and doctorate degrees to enter into teaching Big History. A solid core of texts have been translated into many languages and their multiple editions all serve the teaching of Big History.[14]

Not all of this development has been in higher education. Some Big Historians teach in elementary and secondary schools, while others work

in the public and private sectors. For example, 'cosmic education' began to enter Montessori schools in India in the 1940s.[15] Some Big Historians organize workshops and lecture series, while others produce films, websites and computer applications. Students develop social networks that link participants around the world. The creative arts have long held such views, as in the bioregional, geopoetic and eco-art movements, and there is a noticeable blossoming of children's literature. Philosophers participate in Big History, while traditional societies have connected with the scientific community, as in the 1994 founding of the Alaska Native Science Commission.[16]

The promotion of Big History has been assisted by a generation of senior scholars, notably historian William McNeill and geologist Walter Alvarez. The field has received endorsements from public figures, whose advocacy has popularized the field. Software mogul Bill Gates financed several initiatives, including the Big History Project (BHP), an online, high-school curriculum launched in 2014. For one of their activities, Big Historian David Baker wrote a ten-episode series for YouTube's 'Crashcourse', which has two million subscribers.[17]

The first international conference on Big History took place at the International University of Nature, Society and Humanity in Dubna, Russia in November 2005—on the topic of *Big History and Synergetics*. That year, an entire edition of the Russian-based, English-language journal, *Social Evolution and History*, was devoted to Big History and was followed by others. Akop Nazaretyan, light-heartedly summed up the popularity of this study when he restated Marx and Engel's dictum: 'The ghost of Big History is roaming the Earth!'[18]

As a result of the macro-history sessions at the Russian Academy of Sciences' 2009 conference on *Hierarchy and Power in the History of Civilizations*, Barry Rodrigue began assembling a directory of Big History and expanded his correspondence network in order to determine who was working in the field. He found people involved in Big History all around the globe, and the more he searched, the more he found. It became apparent that many scholars had independently developed a Big History perspective because 'it just made sense'. In other words, a global *conjuncture* had taken place, as macro-historical ideas solidified over the course of a half-century. As a result of discovering this critical mass of scholars, the International Big History Association (IBHA) was founded in Coldigioco (Italy) in 2010, and adopted a working definition of their field: 'Big History seeks to understand the integrated history of the cosmos, Earth, life and humanity, using the best available empirical evidence and scholarly methods.'[19]

Soon afterwards, the Eurasian Center for Megahistory and System Forecasting, Moscow, was formed as part of the Russian Academy of

Sciences' Oriental Institute.[20] Most recently, Macquarie University in Sydney (Australia) established their Big History Institute in 2014. Other centres are in the process of forming, while academic outreach has entered into Asia, Africa and South America.

Why We Need Big History

So the question arises, what does this all portend? Since the movement, as well as its area of scholarship, reflects a human trend of wider, more inclusive awareness, we see Big History as a field of cooperative endeavour that will continue to expand with exciting possibilities.

The compartmentalization of knowledge into a number of isolated fields that reached its peak in the twentieth century was not consistently present in the history of human thought. Indeed, one would rather tend to see the aspiration for universal understanding as the more dominant trend. As physicist Erwin Schrödinger noted: 'We have inherited from our forefathers the keen longing for unified, all-embracing knowledge. The very name given to the highest institutions of learning [*universities*] reminds us, that from antiquity to and throughout many centuries the universal aspect has been the only one to be given full credit.'[21] We believe that the aspiration for a syncretic worldview, for the comprehension of the whole history of this immense globe, was always (and will be) inherent in humans.

The need to see this process of development holistically—in its genesis and growing complexity—is a fundamental characteristic of scientific and human cognition. The increase 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 scientists and scholars who desire to see beyond their specialization. One can also watch the success of such interest within individual disciplines, as well as in interdisciplinary research. The rapidly globalizing world needs global knowledge and global generalizations.[22] Globalization itself becomes a vehicle for Big History's expansion of awareness.

Humankind is generating knowledge at an enormous rate; the volume of knowledge is too colossal to fit into the head of one person. This implies that the enlarging deficit of knowledge-synthesis is a problem for not only scientists but for any one person. As Schrödinger again 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'.[23] With

the emergence of Big History, one could observe the formation of a whole intellectual movement working on this task.

What do we call this process? It certainly is an expression of globalization, but it also represents something larger. In some respects, Big History is a process of *mutualisation*, since it results in heightened awareness of the fragile, mutual dependence between human and non-human worlds, between organic and inorganic regimes, as well as between microscopic and macroscopic levels—on Earth and beyond.[24]

So it makes sense to represent the history of the universe 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 things came to be. That is why the ideas of universal history never died, whereas the idea of Big History (under various names) emerged almost simultaneously and independently in different countries.

Anthology

You hold in your hands the first volume (of a three volume anthology) titled, *Our Place in the Universe: An Introduction to Big History*. The second volume is about Big History education and understanding around the world, while the third volume presents ways in which Big History functions, especially in relationship to the cosmos, life, society and our future. Big History has engaged several important themes, including the development of collective knowledge and the rise of the Anthropocene epoch. Each of these themes are respectively discussed in the introductions for Volume II and Volume III of our anthology.

This anthology has been assembled with the cooperation of people from all walks of life. It features authors from every region of our planet. It is an interdisciplinary effort. Indeed, the very emergence of an anthology indicates that a given scientific discipline has achieved a considerable degree of development and recognition.

While various authors present views of related themes, they offer different emphases. We see agreement, complementarity and opposition . . . this is a work of process. As editors, we came to appreciate how different traditions of essays exist around the world, not just as to style and language but in presentation as well. The four sections in this volume highlight overviews and trends of Big History today. Many of the articles in each section connect to articles in other sections and volumes, a process that illustrates the dynamic nature of the field.

- *Big History as a History of the Universe* analyses the development of views about the universe that led to the emergence of the mega-process of Big History, as well as its possibilities, goals, and tasks.

- *Big History as a Philosophy and Methodology* analyses some of the concepts, theories and trends that are relevant for Big History as a whole.
- *Big History as an Active Outlook* illustrates the diversity of applications of Big History, especially in relationship to human social life.
- *Big History in the Life of People* brings together papers that employ the concept of 'little big histories'—the focused and holistic studies of special topics.

Each of us has been trained to think in terms of disciplines, not only in the university, but through our jobs and in our daily lives. Big History provides us with a way to not only enrich those experiences but to transcend them. It can be perplexing to contemplate ourselves as part of a global community, let alone part of a galaxy, universe or multiverse.[25] To employ a metaphor, Big History is like a set of bridges. It seeks to explain existence, based on the most current scholarly thinking, by permitting passage between the islands in the fragmented archipelago of our intellectual landscape.

Big History brings together constantly updated information from the scientific disciplines, merges it with the reflective realms of philosophy and the humanities, and then reconfigures it through the expressive arts and technology. It also provides a connection between the past, present, and future. These bridges allow us to see the panorama of the past, consider humanity's place in the present, and speculate on how such issues might affect our daily lives and those of our descendants.

The authors of the articles in this anthology have made that intellectual journey, describing their individual experiences and knowledge within the context of Big History. They demonstrate how the framework of Big History can be used at multiple levels and diverse cultures. Thus, in a very real way, this anthology serves as a guidebook for the application of Big History to human thought.

Notes

1. Examples of what we survey in this introduction are detailed in the chapters of our anthology and in Barry Rodrigue's essay, '"Big History": The Study of All Existence'. This essay is an on-going historiography that is updated and maintained online at http://www.bighistorycenter.org.
2. Pierre-Simon Laplace proposed his nebular hypothesis in 1796. Earlier ideas about our cosmic origins had been expressed by philosophers Emanuel Swedenborg (1734) and Immanuel Kant (1755), astronomer William Herschel (1786) and others (about Herschel, see the chapter by Robert Carneiro in Volume III of our anthology).

3. Alfred Wallace, *Man's Place in the Universe*, McClure, Phillips & Company, 1903; Charles Darwin, *The Origin of Species by Means of Natural Selection*, New York: Gramercy Books, 1859. Although Spencer paid more attention to biological and social evolution, he treated evolution as a universal process taking place at all levels—from microorganisms to galaxies. Herbert Spencer, *First Principles*, London: Williams & Norgate, 1862.
4. United Nations Educational, Scientific and Cultural Organization (UNESCO), 'International Commission for a History of the Scientific and Cultural Development of Mankind', <http://atom.archives.unesco.org/international-commission-for-history-of-scientific-and-cultural-development-of-mankind-2;isad>.
5. Leonid Grinin, Alexander Markov and Andrey Korotayev, eds., *Evolution: Cosmic, Biological, Social*, Moscow: LKI, 2009, pp. 44–5. Also, see Akop Nazaretyan's chapter in Volume I of our anthology.
6. Eric Chaisson, Syllabus, Astronomy 8, Cosmic Evolution, Harvard University, Cambridge, Massachusetts, Fall 1975; idem, 'The Scenario of Cosmic Evolution', *Harvard Magazine*, November–December 1977; idem, 'The Broadest View of the Biggest Picture', *Harvard Magazine*, January–February 1982; idem, 'The Old Man in the Corner', *Harvard Magazine*, *c*.1998; idem, 'Teaching the Epic of Evolution', Journey of the Universe Conference, School of Forestry & Environmental Studies, Yale University, New Haven, Connecticut, 24–6 March 2011, p.1, <http://www.journeyoftheuniverse.org/conference-at-yale/>; idem, 'Cosmic Evolution—More than Big History by another Name', in *Evolution: A Big History Perspective*, ed. Leonid Grinin, Andrey Korotayev and Barry Rodrigue, 2011, pp. 39–40; idem, Medford, Massachusetts, personal communications (e-mail), to Barry Rodrigue, Lewiston, Maine, 29–30 June 2010; idem, Barry Rodrigue, Joseph Voros and David Baker, 22 January 2015; idem, 4 February 2015. Harvard Magazine, 'This Issue', *Harvard Magazine*, November–December 1977, p. 4; George Field, Gerrit Verschuur and Cyril Ponnamperuma, *Cosmic Evolution: An Introduction to Astronomy*, Boston: Houghton Mifflin, 1978; George Field and Richard Hirsh, Interview by Richard Hirsh, Smithsonian Astrophysical Observatory, Cambridge, Massachusetts, 14 July 1980; G. Siegfried Kutter, 'Big History: A Personal Perspective', in *Evolution*, ed. Grinin, Korotayev and Rodrigue, 2011, pp. 102–3; Thomas Bania, Boston, Massachusetts, e-mails to Barry Rodrigue, Bath, Maine, 12 February and 31 March 2014. See Michael Rampino's entry in Barry Rodrigue, 'A Big History Directory: An Update, 2011', pp. 15–16, <http://www.bighistorycenter.org>.
7. Preston Cloud, *Cosmos, Earth and Man: A Short History of the Universe*, New Haven: Yale University Press, 1978; Hubert Reeves, *Patience in the Blue: Cosmic Evolution*, Paris: Éditions du Seuil, 1981; Eric Chaisson, *Cosmic Dawn: The Origins of Matter and Life*, Boston: Little Brown, 1981; Antonio Vélez, *El Hombre: Herencia y Conducta*, Medellín: Editorial Universidad de Antioquia, 1986; Isaac Asimov, *Beginnings: The Story of Origins—of Mankind, Life, the Earth, the Universe*, New York: Walker, 1987; Wikipedia 2010: 'Carl Sagan'; 'A Brief History of Time'.

8. Andre Gunder Frank, *World Accumulation, 1492–1789*, London: Macmillan Press, 1978; Immanuel Wallerstein, *The Politics of the World Economy: The States, the Movements and the Civilizations*, Cambridge: Cambridge University Press, 1984; Institute of Global Dynamic Systems (IGDS), <http://sites.google.com/site/institutegds/>; Rodrigue, 'A Big History Directory', p. 18.
9. Xuesen Qian, Jingyuan Yu and Ruwei Dai, 'A New Discipline of Science—The Study of Open Complex Giant System and Its Methodology', *Chinese Journal of Nature*, vol. 13, no. 1, 1990. Xuesen Qian, 'The Open Complex Giant System', *Pattern Recognition and Artificial Intelligence*, vol. 4, no. l, 1991; See Yue Sun's chapter in Volume I of our anthology.
10. The Institute for Global and Cosmic Peace learned of Big History through the efforts of Professor Nakanishi's student, Nobuo Tsujimura. Nakanishi et al., *Big History and the 21st Century's International Order*, Yokohama: Institute for Global and Cosmic Peace, 2014.
11. John Mears, 'Evolutionary Process: An Organizing Principle for General Education', *The Journal of General Education*, vol. 37, no. 4, 1986; idem, Western History Association Conference, Incline Village, Nevada (USA), personal communication with Barry Rodrigue, 14 October 2010.
12. Rodrigue, 'A Big History Directory', pp. 3, 7, 16–17.
13. David Christian, 'The Case for "Big History"', *Journal of World History*, vol. 2, no. 2, 1991; David Christian and William McNeill, *An Introduction to 'Big History'*, 2008, <http://www.youtube.com/watch?v=lBCvpIK7g8U>; Fred Spier, 'The Small History of the Big History Course at the University of Amsterdam', *World History Connected*, vol. 2, no. 2, 2005, <http://worldhistoryconnected.press.illinois.edu/2.2/spier.html> .
14. Alex Moddejonge, *The Biggest Story Ever Told: On the Historiographic Origins of Big History*, California State University at San Marcos, Thesis, M.A. in History, 9 May 2012; Fred Spier, Amsterdam, e-mail to Barry Rodrigue, Lewiston, Maine, 14 August 2011. For a synopsis of Big History courses and literature, see Barry Rodrigue, 'A Big History Directory'; idem, 'A Big History Bibliography', *Big History Center*, 2015, <http://www.bighistorycenter.org>, accessed 1 January 2015. Some citations of notable works in Big History follow. Fred Spier, *The Structure of Big History: From the Big Bang until Today*, Amsterdam: Amsterdam University Press, 1996; 'The Small History of the Big History Course at the University of Amsterdam', *Big History and the Future of Humanity*, Oxford: Wiley-Blackwell, 2010; repr. 2014; Akop Nazaretyan, *Intelligence in the Universe: Sources, Formation, and Prospects*, Moscow: Core Publishers, 1991; idem, *Civilizational Crises in a Big History Context*, Moscow: Per Se, 2001; David Christian, *Maps of Time: An Introduction to 'Big History'*, Berkeley: University of California Press, 2004; idem, *Big History: The Big Bang, Life on Earth, and the Rise of Humanity* (DVD), Chantilly: The Teaching Company, 2008; Cynthia Brown, *Big History: From the Big Bang to the Present*, New York: The New Press, 2007; David Christian, Cynthia Stokes Brown and Craig Benjamin, *Big History: Between Nothing and Everything*, New York: McGraw Hill Education, 2014; Walter Alvarez and Roland Saekow, *Chronozoom*, Berkeley: Earth and Planetary Science,

University of California, 2010, <http://research.microsoft.com/en-us/projects/chronozoom/>; Eric Chaisson, *Cosmic Evolution: The Rise of Complexity in Nature*, Cambridge: Harvard University Press, 2001; idem, *Epic of Evolution: Seven Ages of the Cosmos*, New York: Columbia University Press, 2006; idem, *Cosmic Evolution: From Big Bang to Humankind*, Cambridge: Harvard University, 2008, <http://www.cfa.harvard.edu/~ejchaisson/cosmic_evolution/docs/splash.html>; Eric Chaisson and Dana Berry, *The Arrow of Time: A Linear Rendering of Forward Time*, Cambridge: Harvard University Press, 2007, <http://www.cfa.harvard.edu/~ejchaisson/cosmic_evolution/docs/fr_1/fr_1_intro_movies.html>; Osamu Nakanishi et al., 2014; Liu Xincheng, Yue Sun and Yue Xiukun, eds., *Big History and Global History*, Beijing: China Social Sciences Press, 2013; Guangbi Dong and Kunyu Tian, *The Origin of the Heaven and Earth–Natural Evolution and the Birth of Life*, Harbin: Northeast Forestry University Press, 1996; Shili Ma, *Outline of World History*, vols. 1–2, Shanghai: People's Press, 1999; Liuzhu Huang, 'On Sima Qian's Ideas of "Big History"', *Journal of Humane Studies*, vol. 3, 1997, pp. 72–5; 'A Note on the "Crisis of History Study"', *Random Thoughts on Traditional Chinese History and Culture*, Xi'an: Sanqin Press, 2005, pp. 185–94.

15. Jos and Anne-Marie Werkhoven, private communication (e-mail), to Barry Rodrigue, 26 May 2015; Maria Montessori, *To Educate the Human Potential*, Amesterdam: Netherlands Montessori Association, 1998, p. 15.
16. Examples of alternative and creative expressions of Big History are in Barry Rodrigue, 'A Big History Directory' and 'A Big History Bibliography', as well as the following references. Australian/Indian novelist Greg Roberts independently assembled his form of Big History, which he calls 'Resolution Theory'. Gregory Roberts *Shantaram*, New York: St. Martin's Press, 2003; pp. 705–9; idem, Geneva, Switzerland, personal communication (e-mail) to Barry Rodrigue, Bath, Maine, 4 April 2012. I would like to thank Michael Dix for noting this connection between Mr. Roberts' work and Big History. Italian geologist Alessandro Montanari and composer/sound technician Gabriele Rossetti documented the Earth's history in their geo-musical production, *Dances with the Earth*. Gabriele Rossetti and Alessandro Montanari, *Dances with the Earth*: Ancona: Depositi Ed.iali Fagnani, 2001; Gary Lawless, 'Big History and Bioregions', in *Evolution: A Big History Perspective*, ed. Leonid Grinin, Andrey Korotayev and Barry Rodrigue, Volgograd: Uchitel, 2011, p. 267; Gary Lawless, Brunswick, Maine, e-mail to Robert King, Incline Village, Nevada, 31 October 2010; Alaska Native Science Commission, <http://www.nativescience.org/>, 2014; Rich Blundell, 'Shakespeare in the Cave', second conference, International Big History Association, Dominican University of California, San Rafael, California, 8 August 2014, <https://www.youtube.com/watch?v=VoisuLgCDr0&feature=youtube_gdata_player>.
17. David Christian and William McNeill, *An Introduction to 'Big History'*, 2008 <http://www.youtube.com/watch?v=lBCpIK7g8U>; Walter Alvarez, *T. rex and the Crater of Doom*, Princeton: Princeton University Press, 1997; idem, *The Mountains of Saint Francis*, New York: W.W. Norton & Company, 2009;

William Gates and Charles Rose, 'Bill Gates about Big History', YouTube, 2009, <http://www.youtube.com/watch?v=lyQiS-QGRc8&feature=related>. Endorsements for Big History have spanned the political spectrum from Nixon White House counsel John Dean to Bill Clinton's vice president, Al Gore. John Dean, 'Looking for Great "Big History" Books', *FindLaw*, 2009, <http://writ.news.findlaw.com/dean/20090807.html>; Albert Gore, *The Future: Six Drivers of Global Change*, New York: Random House, 2013; Big History Project, <https://www.bighistoryproject.com/portal>; David Baker, 'Crashcourses: Big History', *YouTube*, <https://www.youtube.com/playlist? is t=PL8dPuuaLjXtMczXZUmjb3mZSU1Roxnrey>.

18. *Social Evolution and History: Exploring the Horizons of Big History*, vol. 4, no.1, Graeme Snooks (guest editor), Volgograd: Uchitel Publishing, 2005; Leonid Grinin et al., ed., *Evolution: Cosmic, Biological, and Social*, Volgograd: Uchitel Publishing, 2011; idem, *Evolution: Big History Perspectives*, Volgograd: Uchitel Publishing, 2011; Akop Nazaretyan, Quoted in Fred Spier, Review: 'The Ghost of Big History is Roaming the Earth', *History and Theory*, vol. 44, no. 2, 2005, p. 264.
19. Barry Rodrigue proposed the formation of an association of Big History in August 2010, during a workshop at the Coldigioco Geological Observatory in the Apennine Mountains of Italy. Discussion of such a society had gone on for years, but the documentation of practitioners around the world made it apparent that there was a critical mass sufficient to make such a group viable. Walter Alvarez and Alessandro Montanari had convened this workshop to expose Big Historians to a more detailed study of earth sciences. The Big Historians who met at Coldigioco founded the IBHA on 20 August 2010 and became its first board of directors: David Christian of Macquarie University in Sydney (Australia), Walter Alvarez of the University of California at Berkeley (USA), Craig Benjamin of Grand Valley State University in Michigan (USA), Cynthia Stokes Brown of Dominican University in California (USA), Fred Spier of the University of Amsterdam (Netherlands), Lowell Gustafson of Villanova University in Pennsylvania (USA), and Barry Rodrigue of the University of Southern Maine (USA). Other instrumental participants were Alessando Montanari and Paula Metallo (directors of the Coldigioco Geological Observatory), Milly Alvarez, Penelope Markle, Pamela Benjamin, Gina Giandomenico, Daron Green and Michael Dix. Rodrigue chaired the first meeting.
20. The Eurasian Center for Megahistory and System Forecasting is coordinated by Akop Nazaretyan, Leonid Grinin and Andrey Korotayev.
21. Erwin Schrödinger, *What is Life? The Physical Aspect of the Living Cell*, Cambridge: Cambridge University Press, 1944, p. 1.
22. Leonid Grinin et al., 'Evolutionary Megaparadigms: Potential, Problems, Perspectives', *Evolution: Cosmic, Biological, and Social*, ed. Leonid Grinin et al., Volgograd: Uchitel Publishing, 2011, pp. 5–29; Leonid Grinin and Andrey Korotayev, *Social Macroevolution: Genesis and Transformation of the World-System*, Moscow: LKI/URSS, 2009.

23. Schrödinger, *What is Life?*, p. 1.
24. This mutual aspect has especially been elucidated in Russia, Japan and China. Barry Rodrigue links his concept of *mutualisation* to those proposed by Russian geographer Peter Kropotkin, as in his classic study, *Mutual Aid*. Barry Rodrigue and G. Siegfried Kutter, '"Big History": The Study of All Existence', Big History Center, 2012, 2014, <http://www.bighistorycenter.org>, p. 5; Peter Kropotkin, *Mutual Aid: A Factor of Evolution*, London: William Heinemann, 1902.
25. NASA chief scientist Ellen Stofan stated on 7 April 2015: 'I think we're going to have definitive evidence within 20 to 30 years.' Mike Wall, 'Signs of Alien Life Will Be Found by 2025, NASA's Chief Scientist Predicts', *Space.com*, 7 April 2005. URL: (http://www.space.com/29041-alien-life-evidence-by-2025-nasa.html).