Introduction

Complexity as a Pivotal Process of Big History and Evolution

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The title of this ninth issue of our Yearbook is *Complexity in Nature, Society, and Cognition*. Of course, due to the extensiveness of the topic of complexity one can only cover a very small part of it. Nevertheless, we would like to present a short overview on this subject and some of the research in this field.

As is known, megaevolution (in connection with Big History) has been the main subject of our Yearbook. We have considered evolution from different aspects and points of view. Much attention is devoted to the general field of evolutionary studies or, in our term, to 'evolutionistics' (see, *e.g.,* Grinin *et al.* 2011, Grinin, Korotayev, and Rodrigue 2011; Grinin and Korotayev 2013, Grinin and Korotayev 2020).

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Complexity as the Main Concept of Megaevolution and Big History

In fact, evolution can be considered in two aspects, as a part of evolutionary development and as an independent direction of research (in the latter case it will refer to what we have called *the complexity of cognition*; see below). If we ask ourselves what are the most general concepts that can encompass the whole evolution, the whole field of evolutionary studies, there are very few of them. These are the concepts related to evolutionary movement such as *development, change* and *progress.* But they always cause discussions. These are *energy* and *entropy*, and, to a lesser extent, *self-organization* – the concepts covering the most important aspects: energetic and structural ordering. It can be *information*, although the question from what period one can speak of information as an independent aspect of evolution is debatable. We believe that in principle one can talk about information from the very beginning of Big History, but one can distinguish it as an independent line already with the first successes of chemical evolution (Grinin 2020).

But, perhaps, hardly anyone will argue that one of the main concepts of megaevolution and Big History is complexity.

Complexity: Overview

According to many perspectives of traditional sciences, we should not exist. For instance, the second law of thermodynamics of traditional physics appears to limit spontaneous order of matter, much less a complex life. Biologists, however, believe that ecosystems may continue to develop and use more resources, leading to the collapse of the ecosystem, which would result in advanced life being extinct. According to planetary scientists, the relative stability of planets is not great. A solar wind stripping atmospheres, a cooling inner core that weakens magnetic fields and plate tectonics, and instability of rotation can make the environment for advanced complex systems insufficiently stable, leading to insufficient time for them to evolve. The development of both complex life and complex technological civilization (at least so far) has overcome all of these circumstances (so far) on Earth.

Some researchers predicted that the fast development of our civilization would lead to a change of the humanity as a species either as a result of evolution (*e.g.,* Teilhard de Chardin 1987; Vernadsky 1997; see also Fuchs-Kittowski and Krüger 1997) or as a result of the development of human activity on the Earth and in space (*e.g.,* Tsiolkovsky 1964) and accelerated development or growing crisis (*e.g.,* Moiseyev 2000; Kurzweil 2001, 2004, 2005; see also Diakonoff 1999; Ayres 2006).

Over the past few decades, advances in complexity science provided a glimpse of why these barriers had been broken down. In fact, some of these barriers now appear to possibly facilitate the development of complex evolution

(Schneider and Sagan 2006). However, the development occurs only under special circumstances, and only the Earth is known as the place where this has occurred. If the scientists had been given the opportunity to see Earth when it was just forming, it is unlikely they would have predicted such a history.

As a result of the second law of thermodynamics, spontaneous organization is severely hindered in physics.[1] In a closed system, the entropy must always increase, which means that there will always be more disorder and dispersion of energy in the direction of thermal equilibrium. It is evident that there is a force in physics that appears to tend in the opposite direction, namely gravity. Although gravity tends to pull matter together, it does so by heating it. Radiation dissipates heat and allows further collapse, increasing overall entropy while the matter collects to form stars and planets.

However, gravity is not the only way for matter to self-organize. A large thermal gradient can lead to new ways of organizing matter so that entropy can be generated more rapidly in certain systems. This organization is not designed, but rather emerges as a result of fluctuations in the system to try various forms until the system finds the form that best reduces the thermal gradient through self-organization. A simple example is the Benard cells formed when oil is heated on a stove. These spontaneous self-organized systems have been described as the second law of thermodynamics at work (not hindering) the emergence of complexity.

Self-organization is adjustment of the open system due to coordinated interaction of the variety of constituent elements (Haken 1988). In general, it can be considered as one of the phases of evolutionary processes, on the one hand, as the completion of a certain process, as a result of which a certain object or system emerges from a chaotic state, on the other hand, as the beginning of a new evolutionary circle, as a result of which one state is replaced by another, sometimes qualitatively higher one. In other words, the change of states of disorder and order, the destabilization of the new order as a result of emergence of some new factors or processes and the transition to a new order is an important algorithm of evolutionary processes and the growth of complexity. At the same time, such a path can lead after all to a sufficiently lengthy and sustainable system of order. In this case, evolution slows down as systems enter a self-regulatory regime that allows them to preserve their structure. There is no doubt that self-organization and self-regulation are closely related processes. The change of order and disorder, the transformation of the latter into order, and a new breakdown of order before the transition to a new level is an inevitable sequence of many processes and the path to increasing complexity (for more details see Grinin 2013).

[1] It is worth mentioning the discussion on the limits of the second law of thermodynamics in our Yearbook 'Evolyutsiya' (Panov 2010; Khaitun 2010).

The increasing complexity in the cosmos, life, humans, and civilizations has been a major theme of the Big History narrative (Spier 2010). However, there are many questions regarding the driving force, the conditions, and the potential relapse of this trend. What were the most unlikely critical transitions? What would have happened if a critical resource (such as fossil fuel) had not been available to continue using more energy? In light of the fact that the accelerating trend cannot continue, what are the likely or preferably new paths? There are also questions concerning measurements of complexity. Should they be based on characteristics such as energy flow, self-organization, and information processing or should these measurements include their history and individual development (EVO-DEVO), functions, interacting levels, and environmental fit? Various models have been employed to gain insight into their evolutionary dynamics, including general evolutionary models, EVO-DEVO correlate-ons, levels of information processing, dynamic kinetics, self-organizing criticality, and the principle of least action. What is the best way to connect passively driven cosmic complexity with life's agency?

The dynamics of complex systems are as important as their characteristics (Thurner *et al.* 2018). Complex adaptive systems employ processes at multiple time scales to keep the system out of thermal equilibrium. At lower level, metabolic processes keep order and grow. Moreover, it responds to external circumstances in order to learn from them. Finally, evolutionary dynamics may be necessary for the system to remain competitive. In addition to these different scales, the system is usually composed of multiple components (often systems themselves) that interact at multiple spatial and functional scales.

In Big History, there are three types of complex systems: physical systems (equilibrium), physical dissipative systems, and complex adaptive systems. Often, the first is not a truly complex system, but it is often included in a sequence of stages of combination. As an example, two hydrogen atoms and one oxygen atom combine to form water molecules that possess new emergent properties that are important to life.

In complex systems, energy and material are extracted from the environment in order to maintain the system's self-organization. An example of such a system is a chemical reaction-diffusion system, a hurricane, or a tornado. An object that is not in equilibrium uses energy from its environment to maintain its non-equilibrium state, which is called dissipation. When the energy is no longer available (*e.g.*, no reactive chemical being introduced or the heat flow in air or ocean are diminished) the complex system will no longer survive.

The concept of complex adaptive systems (CAS) describes a complex system with the capacity to gather information from its environment, compare it with memories of similar experiences, and then respond accordingly. Life, humans, and society form complex adaptive systems that are monitored and compared with the expected results.

These systems often exhibit emerging properties, panarchical cycles, and self-organized criticality during their dynamics. Erich Jantsch (1980) examined how energy, information, organization, environment, and evolution work in complex systems both during physical cosmic development and during the evolution of life, humans, and civilization on planets like Earth even though the term 'Big History' did not exist at that time. This process follows the traditions of astronomy, geology, biology, anthropology, and civilization history, all of which are taught at all educational levels.

There has been a lot of research into these dynamics, as demonstrated by Friston's (2010) proposals for general evolutionary Bayesian models. In this field, it focuses on the interactions of complex adaptive systems (CAS, *e.g.*, a person) with their local environments to learn, survive, and thrive. By predicting (and sensing) the reaction of the environment to its actions, CAS can conduct 'experiments', leading to active learning based on its internal model, rather than acting passively. When the unexpected occurs, we can either alter the model to make it more compatible with reality or change the environment to make it more compatible with the model.

Some findings demonstrate how Big History differs from traditional research. A number of researchers have discussed trends in energy extraction from the environment, storage, and use throughout evolution in relation to energy flow and complex systems (Fox 1988; Niele 2005; Smil 1994; Chaisson 2004). A sequence of ever-larger systems that converge into higher complexity, in ever-decreasing environments is illustrated by Jantsch's diagram. Larger systems evolve through aggregation, first by physical binding, then biological symbiosis, and then direct and loose social networks. Ekstig (2010) examined the relationship between the way system evolution relates to individual development. A number of works (Press and Lightman 1983; Rees 2000; Davies 2007) consider the relationship between the fundamental physical constants and the measures of Big History objects.

Through the introduction of new levels of organization, energy, and information flows, society evolves. As a result, coordination problems, resource extraction issues, and environmental impacts are updated through faster cycles. While larger systems exhibit greater complexity, excessive complexity during a cycle can lead to collapse as a negative marginal rate of return for complexity (Tainter 1996). Unlike other primates such as chimpanzees, early humans developed tools, controlled fire, and developed language and agriculture in small groups which, however, relied on close networks where members knew each other and a theory of the mind, which explained how members interacted with each other. In the next great step of evolution, predominately cultural innovations were responsible for the creation of loose networks through which trade and knowledge exchange took place and skilled planners and collaborators solved larger problems, resulting in greater opportunities for development. One of the earliest forms of centralized decision-making was the chiefdom, which was based on specialization, hierarchies, and centralized decision-making to coordinate a much larger group.

Often, Big History presents data, theories, and histories of what actually occurred but it usually omits the options that were tried, considered, and rejected. A part of this history is dependent on the limited resources and stability of the planet. In order to gain a better understanding of Big History, we must go beyond what happened and how it happened to ask what may have happened or why things might have happened. In addition to understanding the special circumstances of life on Earth, it also helps to evaluate the potential for life to evolve elsewhere. In some instances multiple paths might be tried with only one successful, such as DNA versus RNA, multiple ways to coordinate multiple cells, chimpanzees versus bonobos, and dinosaurs versus mammals. Recently, however, the system has become more integrated into one world system, making it more difficult to attempt multiple paths simultaneously. However, more data has been available recently, allowing for counterfactual speculation. Evolution depends on variation, selection, and reproduction, so what happens when there is just one system? What will the variation look like? Several paths have non-reversible consequences, so we might not succeed at trying different paths sequentially. Our current technological path, for instance, relies on fossil fuels, which prevents other future paths from developing such a valuable source of relatively cheap energy.

Complexity: Connections

This issue continues the discussion of complexity in Big History as previewed below. However, besides the cited material, there are many books that also address this fascinating subject (see Jantsch 1980; Corning 2005; Vidal *et al.* 2010; Meyer-Ortmanns and Thurner 2011; Georgiev *et al.* 2019; LePoire 2015, 2020; Grinin and Grinin 2014; Korotayev and LePoire 2020).

As mentioned before, the sequence of developing complexity on Earth seems to follow a pattern that is highly unlikely. Why is this so, and what would have happened if some condition had not occurred? For example, what if insufficient fossil fuel energy resources prevented the system from moving towards greater complexity? As part of a recent historical transition, David LePoire examines what paths the industrial revolution might have taken without fossil fuels.

It is a major evolutionary mystery how life developed so rapidly on Earth as soon as the environment became stable enough for it. Various approaches have emphasized energy, information genetics, and organization. The chemical and information pathways common to all cells provide clues. This is addressed by **Leonid E. Grinin** in his paper 'Chemical Evolution in Big History'. The fascinating role of viruses in evolution is explored by Anton L. Grinin. Just as our view of bacteria has been greatly revised in recent years, the author believes that our view of viruses might expand to beneficial roles in ecosystems, health, and evolution. For example, recent evidence has suggested possible new mechanisms for movement of genetic information including from viruses to other organisms.

The ability of humans to form collaborative networks, which include planning, sharing experiences, and communication, is one of their most striking characteristics. Initially, the networks may have been small, consisting of only about 150 individuals. But when it comes to organizing hierarchies in cities and trade, such networks do not scale well. The growth of social connections is an important aspect of complexity and is explored in the paper by **Leonid E. Grinin** and **Andrey V. Korotayev** in their paper 'Chiefdoms: Beyond Time'.

The emergence of scale phenomena in organisms, cities, and companies has been studied by testing hypotheses and identifying patterns (West 2017). The timescales of phenomena in these systems seem to cover a wide range as modeled in the panarchy system first articulated by Hollings and Gunderson for ecosystems but also applied to the cycles of innovation, development, maturity, and revolt seen in civilizations. This important dynamic is explored further by **Antony Harper** by exploring the survivorship curves of civilizations.

The contemplation of how and why systems work has probably been explored since the first civilizations formed with various hierarchies, roles, and specializations. Multiple feedback loops and an entanglement between general systems and individual behaviors make this a difficult task, so it is important to consider other perspectives. **Hans Kuijper** and **Leonid E. Grinin** together with **Anton L. Grinin** consider different ways of gaining insight into these systems. For example, Grinin & Grinin examine how Marx's historical materialism can be interpreted to provide new views as economic activity becomes more information-based, and Kuijper focuses on how systems thinking evolved in China.

In one interpretation of the acceleration of complexity, innovations are used to solve previous problems. However, they eventually result in unintended consequences that should be addressed at ever-faster paces. A revolt may have occurred historically when a group was dismayed by their leaders and when their expectations were not met. This is an important step in the punctuated evolution model of societies. While **Sergey V. Tsirel** explores the historical revolution and religious reformations, the direction of this large evolving system is considered in **George Lawson's** review of *Handbook of New Waves of Revolutions in the 21st Century: The New Waves of Revolutions, and the Causes and Effects of Disruptive Political Change* by Jack Goldstone, Leonid E. Grinin, and Andrey V. Korotayev.

As Hal Linstone pointed out, there must be a balance either the technological innovation rate has to be slowed or the social response rate has to be accelerated (Linstone 1996). Since he wrote in the mid-1990s the pace of technological change seems to be speeding up, resulting in unintended consequences in many areas of social understanding, security, privacy, and technological dependence. In spite of this, social and political responses to global and local issues seem to be hindered. It is important not only to understand the current responses at various levels but also to integrate them into the larger Big History framework in order to avoid frustration that can lead to revolutions. This combination of perspectives might facilitate the collaboration necessary for tackling the challenges of the 21st century.

On Complexity in Cognition and Artificial Intelligence

Humans are thinking creatures. So complexity in cognition increased together with the development of our species and our society. New findings of archaeologists and anthropologists show that such complexity was typical of all species of *Homo,* especially evident among Neanderthals.

The concept of collective learning helps to understand the increasing complexity of human self-consciousness and collective consciousness. In particular, David Christian (2014: 33) notes, 'Once the switch for collective learning was thrown, our ancestors could start building new knowledge, community by community, accumulating local knowledge stores that steered each group in different directions to generate the astonishing cultural variety unique to humans'.

The emergence of religious myths and religious ideology was an important stage in complexity in cognition and in social consciousness. The birth of science, including the humanities, became no less important, and later much more important, stage. The development of philosophy was also a very important step, but, of course, philosophy is always related to subjective perception, as well as with ideology, which inevitably more or less distorts, presents in a rough outline or oversimplifies reality (in this volume see Grinin and Grinin's article on historical materialism, which shows the pros and cons of this aspect of social consciousness). Finally, the development of complexity in cognition has benefited much from modern sciences. The modern period is the era of informatization, so artificial intelligence started to some extent to show complexity in social awareness.[2] However, it is very dangerous to rely on AI and trust it. This is a new dangerous threat for human civilization (see Grinin, Grinin, and Korotayev 2021).

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[2] Social consciousness is linked to the collective self-awareness and experience of collectively shared social identity (Schlitz *et al.* 2010). Thus, today, our knowledge of the world, our worldview, even the basic foundations of our worldview beliefs are largely based on the capabilities of artificial intelligence. About social consciousness see also Grinin 1997, 2003.

The complexity of society is accelerating. Humankind and the World-System today are extremely complex systems. At the same time, the level of their complexity, unfortunately, does not correspond to our level of complexity in understanding of the ongoing processes. In other words, our social consciousness, as in the past, lags far behind our social existence, the development of which is being driven by the furious pace of technological development (see Grinin, Grinin, and Korotayev 2020), especially in the field of AI. Therefore, the aspect of complexity in cognition acquires not only important academic but also extremely important practical importance, as it raises the question of how to reduce the gap between rapid processes unfolding in reality and our awareness of them.

According to Daniel Bell, the author of the theory of post-industrial society, the changing nature of labor is among the dimensions of post-industrial society. Human life in pre-industrial society was, if using his terminology (a bit paraphrasing it), *a game between man and nature*, *i.e.* interaction between people and natural forces and resources. In industrial society, nature is replaced by an artificial environment (machines). This is a *game between man and machine*. In post-industrial society, in which the service sector becomes the main one, *a game between persons* becomes, according to Bell, the leading one.[3] He also emphasizes that people should learn to live with each other. Unfortunately or fortunately, 'the game between persons' has now greatly reduced its scope. But a new type of game, 'the game between man and artificial intelligence' is rapidly gaining momentum, as a result of which people's live communication is increasingly being replaced by Internet communication. And over time it will quickly be replaced by conversational AI systems, by means of Alice, Alexa or other virtual assistants. This is inevitable. But, to paraphrase D. Bell, 'humans must learn to live with artificial intelligence'. But to do that, we need to curb the aspirations of those forces that want to use AI to enslave society, to 're-flash' our psychology, to substitute our freedom of choice. To learn to live in harmony with AI, we need to develop clear and strict rules for it and make its owners follow them.

Francis Bacon, an English philosopher of the 16th century, noted 'money is a great servant but a bad master'. And this completely reflects the situation with artificial intelligence. Certainly, AI is 'a bad master'. We are moving forward with an increasingly accelerating rate, but always along an uncharted path, by feel, having very little idea of the consequences of our innovations. And this gives rise to concern. 'Humans are changing life on Earth at a tremendous rate, without even realizing it' (Field 2015). But it is high time to start to realize the consequences of each new step forward. Although we have no choice but to

[3] Literally Bell mentioned about game against nature; game against fabricated nature (man-machine relationship); and game between persons (Bell 1973).

move forward, maximum caution, wisdom, prudence, and even some humility before the greatness of the Universe and the world, and a deep respect for the legacy left to us for billions of years of biological evolution, are absolutely necessary along the way. And then our persistence, knowledge and (albeit still weak) ability to predict will allow us to safely reach new heights of human power as well as new levels of complexity and leave descendants capable of preserving them.

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The present volume is the ninth issue of the 'Evolution' Yearbook.

Our Yearbooks are designed to present to its readers the widest possible spectrum of subjects and issues: from universal evolutionism to the analysis of particular evolutionary regularities in the development of the Universe, cosmos, stars and planets, the Earth, chemical, biological, and social systems, culture, cognition, language, *etc.* The main objective of our Yearbook is the creation of a unified interdisciplinary field of research, within which scientists specializing in different disciplines could work within the framework of unified or similar paradigms, using common terminology and searching for common rules, tendencies and regularities.

This issue consists of four sections. ***Section I. Complexity in Evolution*** consists of three contributions and opens up with the article by **David J. LePoire** ('Tickling the Dragon's Tail of Complexity: How Complexity Might Develop after an Inflection Point of a Singularity Trend'). The rate of technological change seems to be continually accelerating. However, innovation in a limited specific area often seems to demonstrate similar acceleration before an inflection leads a slower rate of change towards a technology maturation phase. Will the trend of the global technological society also follow this path to slowing down? If so, will the resulting societal organization simplify or continue to rise in complexity? In the past, rising energy flow seemed to be required to facilitate the increased complexity. Will this relationship continue? This paper explores historical analogues and context for indications of how a general inflection (slowing down) might occur along with its implications for energy usage, environment, inequality, and demographics. These analogues include previous, current, or potential technological development paths. One technique is to perform analysis of alternate histories where energy limits were realized at different times (*e.g.*, if there was no oil to fuel the technology acceleration in the 19th and 20th centuries). One theme is that complexity is often concentrated in material and information processing, for example in components for transportation such as solar cells, battery storage, smart grids, and self-driving cars. However, simplification is most likely to be realized as reduced organizational and individual stress resulting from the slower rate of change. For example, large stresses occur due to technological changes contributing to indirect costs of obsolescence, short-term investment decisions, issues with inadequate testing before deployment, and requiring analysis of many optional uncertain technology paths to identify efficient long-term solutions.

According to **Leonid E. Grinin**, the author of the contribution 'Chemical Evolution in Big History', there is insufficient research on the course of chemical evolution within the framework of the study of both Big History and evolution. The lack of attention to chemical evolution is all the more disappointing since it is a very important part of megaevolution and Big History, which at some of its stages even act as the leading line (in particular, in the formation of pre-life on the Earth five billion years ago).

The paper presents a brief history of chemical evolution: from the formation of the first atoms in the Universe to abiogenesis on the Earth, that is, the stage of pre-life and the formation of prerequisites for the emergence of the first living organisms. The history of chemical evolution before life's origin can be divided into three stages: the formation of atoms (pre-evolution); history before the start of the abiogenic phase on the Earth; and abiogenic chemical evolution. However, the author aims to elaborate a more detailed periodization of chemical evolution before life's origin.

One should also pay attention to the important feature of chemical evolution which distinguishes it from other lines of evolution, namely, its co-evolutionary nature. The author demonstrates that chemical evolution at all its stages acted as a part of a co-evolutionary tandem: first, as a part of cosmic and stellar-galactic evolution, then as a part of planetary evolution since it is on planets (where temperature parameters are much more comfortable for chemical reactions) that a new qualitative stage in the development of chemical evolution begins. Finally, on the Earth, it developed first as a part of geochemical evolution, and then as a part of biochemical evolution, and this development continues until now.

Anton L. Grinin in his paper 'Viruses and Evolution: The Role of Viruses in Big History' considers the role of viruses within Big History as an important field in understanding the process of evolution; however it is not yet extensively studied. This is due both to the fact that viruses, being microscopic infectious agents, have left limited physical traces in the geological record, and because there is no clear agreement on the place of viruses in evolution. The article aims to explore the role of viruses in the context of evolutionary development within the framework of Big History. It provides an overview of current perspectives and challenges associated with understanding the position of viruses in the broader narrative of evolutionary history.

A virus is defined as 'any of a large group of submicroscopic infectious agents that are usually regarded as non-living extremely complex molecules'. The term 'agents' is commonly used in virology due to the difficulty in finding a universal term to describe these unique entities. A virus is not an organism, in our usual sense of the definition, nor is it a chemical compound since viruses have an overly complex structure and behavior that sets them apart. In the field of evolution, viruses pose a perplexing puzzle piece that does not neatly fit into the larger picture.

Undeniably, viruses are the most pervasive entities on Earth. However, despite their ubiquitous presence, only a little over 6,000 virus species have been comprehensively described in the existing body of knowledge.

In the paper, the author observes evolution and the origin of viruses, including regressive, protobiont hypotheses, as well as the symbiotic theory, which, according to some researchers, was the factor that led to the three cellular domains of life that we know today.

The paper also delves into a fascinating aspect of evolution: the unique position of viruses, which exist on the edge of disorder, displaying high instability and at the same time remarkable adaptability. This raises the question of whether viruses can be considered alive or not, leading to an intriguing debate. We also explore the question of whether viruses can be classified as parasites, which may seem simple at first glance but in fact it is a complex and contradictory topic.

The author discusses the role of viruses from an energetic perspective, recognizing their significance in information and energy dynamics within ecosystems. Viruses exert a substantial influence on energy flows in intricate ecological systems. The paper considers viruses from the perspective of information evolution, because in some respects viruses can be regarded as pure information particles. The author also argues that viruses can be considered as basic information agents that transmit genetic information and are thus the basic molecular tool of evolution. Moreover, this tool is beginning to be used by humans for the genetic alteration of many organisms, including ourselves.

It is important that viruses will no longer be considered only as dangerous pathogens, since infectious viruses make up only a small part of their genus. We argue that breakthroughs in virology in the coming decades could be no less important as a breakthrough in understanding the nature of bacteria, both pathogenic and beneficial.

The paper also examines viruses as a complex self-regulating system drawing comparisons to other complex systems such as computer viruses, cancer, and languages. It emphasizes the remarkable similarities between these systems and explores possible explanations for these similarities.

Section II. Social Evolution contains one contribution 'Chiefdoms: Beyond Time' by **Leonid E. Grinin** and **Andrey V. Korotayev** which is devoted to the analysis of chiefdom, which is a very ancient form of political organization. Its features can be found in various formal and informal organizations of modern times (including in societies where tribalism is strong, criminal networks, clandestine and terrorist organizations, *etc.*). A comparison has been made between chiefdoms of previous epochs and modern chiefdom-like structures. The authors show that there are many similarities between the ancient and present eras in this aspect.

Section III. Civilizations and Ideology consists of four contributions. **Antony Harper** in his article 'A Survivorship Pattern of Civilizations and Its Consequences' suggests that using the data of Kemp, agrarian civilizations are considered as members of a single cohort and their pattern of survivorship is derived from these data. Models of survivorship from the disciplines of demography and population biology are used as standards of comparison, and it is shown that civilizations represented in this data set exhibit a Type II survivorship pattern. This result is then briefly compared with the work of Sandberg who demonstrated that civilizations per se do not age. The consequences of these parallel results are then investigated, and the implications of these results are considered within the context of the early 21st century and humanity's future in this century.

According to **Hans Kuijper** in his paper 'The Foundation of Chinese Systems Thinking', whoever wants to know the fruits should never lose eye of the tree bearing them. In other words, the development of systems thinking cannot be understood without taking their cultural context into consideration. This also holds for the development of both Western and Chinese systems thinking. As the Chinese culture fundamentally differs from the Western one, ideas of the nature, variety and history of system thinking in China and the West can thus not be the same. Even Xuesen Qian (1911–2009), father of the 'metasynthesis' system approach, and Jifa Gu, originator of the 'wuli-shili-renli (WSR)' system approach, seem to be unaware of the cultural ground of their intellectual products.

In the article, the author attempts to explain the cultural-philosophical foundation of Chinese systems thinking, because China seems to fully understand the significance of systems science. The conclusion will be that (a) the Chinese, experts in playing Go, have been systems thinkers from the very outset and (b) Western systems thinkers could learn something of great importance from them. The conclusion will be that (a) the Chinese have been systems thinkers from the very outset and (b) Western systems thinkers of all kinds could learn a lot from them.

The article by **Leonid E. Grinin** and **Andrey V. Korotayev** 'The Reflection on Historical Materialism: Does the Concept Have a Future?' examines academic and intellectual merits of the central part of Marxism – historical materialism. The authors argue that historical materialism has many valuable findings and conclusions and analyze some of them, showing that they together with its methodology can be helpful for social scientist and for a historian theorizing and aspiring for broad analogues. New explanations for this phenomenon are given as the restrictions of the existing model of historical materialism are revealed. A peculiar attention is paid to Marx's conclusion that the changing developmental level of productive forces inevitably leads to changes in all other spheres of societal life; moreover, these changes do not happen automatically and immediately but through the resolution of structural and systemic crisis in a society. The article presents a survey on the history of the Western studies within historical materialism framework starting from the end of the 19^{th} century at the general background of the ups and downs of the Western Marxism and its crisis after the collapse of socialism. The authors show the waves of the Western Marxists' attenuating and increasing interest in historical materialism. The latter to a certain extent should be considered as a program for scientific research which is far from its realization. The authors also make a conclusion that today one can hardly work within the framework of historical materialism conception since many of its postulates should be revised. It is very important that historical materialism can affect social science mainly in an indirect way through a creative acquiring and interpretation of its method, approaches, and partially of its categories and discourse and with integration other concepts. Within social science some directions are discussed which can be combined with some ideas of historical materialism. On the other hand, today the fate of historical materialism and Marxism is defined by a certain paradox: its influence increases along with the merge with other theories, therefore they, nevertheless, continue to exist. Since it has become a part of the general intellectual legacy, one can figuratively speak about its genetic drift.

Sergey V. Tsirel in his article 'Revolutionary Ideologies. Revolution and Religious Reformation' investigates ideological aspects of revolutions, including the role of an ideology in revolutions and its connection with the other components, driving forces, factors and courses of revolutions.

Revolutions do not only imply political and social changes, they also involve ideological and cultural changes. In our opinion there is a deep connection between the Reformation of monotheistic religions (primarily Abrahamic religions) caused by the growth of literacy and knowledge of the world, leading to the rejection of traditional forms of ritualism and dual faith (that mixed the monotheistic religions with traditional paganism and its vestiges). In Russia in the early 20^{th} century it took a form of search for equality/justice and transition from unreformed orthodox beliefs to Bolshevik atheistic beliefs. Later, Reformation processes swept the Muslim world.

The main conditions for the creation of revolutionary situations include not only the delegitimization of the existing regime, but also the existence of an alternative or, more precisely, the ideas of the existence of an alternative to the current regime. The role of ideologies is different in different cases. In some cases, the key ideological factor is not another ideology or another political ideal, but the very illegitimacy, inadequacy and injustice of the existing regime.

But quite often are opposite cases, when a new ideology, a new moral, religious or political ideal, which the existing power does not satisfy, becomes the leading factor of deligitimization. And it is this disparity in the protesters' view that explains its weakness, failure, inability and unwillingness to organize life the way protestors would prefer.

Section IV. Reviews and Essays contains two contributions: a review by **George Lawson** of *Handbook of New Waves of Revolutions in the 21st Century: The New Waves of Revolutions, and the Causes and Effects of Disruptive Political Change* by Jack Goldstone, Leonid Grinin, and Andrey Korotayev (Springer, 2022); and the essay by **Noha Tarek** 'My Cosmic Story: The Dark Energy'.

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