Introduction

Megaevolution: Multifaceted Research

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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 biological, abiotic, 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. Universal evolution (in connection with the Big History) becomes the main subject of our Yearbook. We strive to arrange each issue in such a way that the line from cosmic evolution to the human future is evident. However, in this case we focus only on the social branch of evolution.

Thus, one can say that the main subject of our Yearbook is megaevolution. Many articles are devoted to the issue of unity of laws, patterns and mechanisms of evolution at all its stages and levels of Big History and megaevolution. It is very important to take into consideration the fact that despite the enormous differences between cosmic, planetary, chemical, biological, and social evolutions, there are many similarities. Unfortunately, few studies of evolutionists are devoted to the analysis of universal similarities, patterns and rules within Big History. This is why we seek to form a common field of study of evolution at different levels, because between all levels and lines of megaevolution there are many similarities, often surprising in so much diversity and at different lev-

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els of complexity. The understanding of these similarities deepens our perception about all stages of megaevolution and Big History and its regularities, and leads us away from the false idea that social evolution in all aspects is different from the evolution of previous levels. In the first section, our key goal is to give our own definitions of evolution which would cover as many variants of evolutionary changes as possible. One should note that in fact none of the important laws and principles, not any of the important rules of evolution, have been 'lost' in the process of transition from lower to higher levels. They were only modified and became more complicated, and there also appeared some new principles and rules (and in retrospect one can see their rudiments at the lowest levels of evolution).

It makes sense to recall our megaevolution scheme that was published in our article in 2020 (see Grinin and Grinin 2020) which was later published in Journal of Big History (*Idem* 2023).

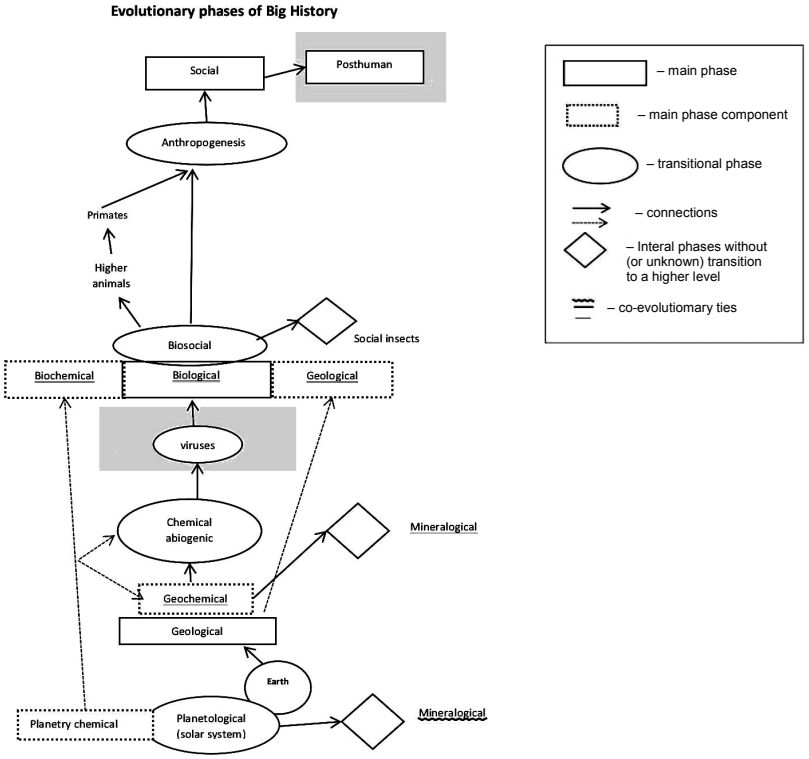

Fig. 1. Phases and lines of Big History with virus and hypothetical posthuman phases

Source: Grinin and Grinin 2023.

However, even our scheme does not fully reflect the complexity of the lines and phases of Big History. We suppose that it is possible to discuss some more transitional, lateral or, even, perhaps, main phases of megaevolution.[*]

But, on the other hand, one should not forget that megaevolution is an incredibly diverse field of study. It is inexhaustible. Our yearbook presents a clear picture of this variety and diversity.

The title of this issue is *Environmental, Demographic, and Political Risks*. Evolutionary trends are explored in various aspects.

This issue consists of four sections: *Evolutionary Puzzles; Evolutionary Theories and Aspects; Forecasts; Reviews and Notes.*

Section I. Evolutionary Puzzles is devoted to two interesting problems: the influence of the Universe on life span ('How does the Universe Determine How Long We Live?') and whether information structures of the genetic code are an accident or an artifact ('Are the Strange Information Structures of the Genetic Code an Accident or an Artifact?').

According to **David J. LePoire**, the author of the contribution 'How does the Universe Determine How Long We Live?', the question of how the Universe determines how long we live is motivated by the human lifetime as a fundamental unit of time in civilization. Currently we experience unprecedented technological and social change. If too much change happens quicker than a human lifetime, then the changes might not be tested for efficacy in the variety of situations that might arise. Technology that has not been fully tested might lead to instability and chaos in unusual, although expected situations such as global pandemics. In the case of Big History's hyperbolic trend toward a singularity, it determines the maximum rate of change that can be supported in this trend. Previous analysis has demonstrated one perspective that stages occur for every decrease in time to the singularity by a factor of 3. This leads to the determination of the number of stages in the Big History hyperbolic pattern as being the logarithm (base 3) of the ratio of the age of the Universe and the human lifetime. About 50 years ago, the weak anthropic principle was applied to estimate many characteristics of items from atoms to universes. While it provided an approach to determine the mass of 'large' animals on Earth (like humans), it did not find a way to estimate the life of humans based on the fundamental physics parameters. This paper presents one approach that uses techniques covering aspects throughout Big History including the relative strength of electromagnetic and gravitational forces, the size of atoms, evolution-development laws extending into cultural topics, allometric scaling laws of organisms, the rate at which DNA can be reliably copied, and the minimum

[*] About the virus' kingdom transitional phase see Grinin A. 2023, 2025; about the hypothetical posthuman phase see Grinin L. and Grinin A. 2016, 2020, 2021; Grinin, Grinin, and Korotayev 2024.

length of DNA required to support life. An estimate is derived but is based on many uncertain assumptions. This analysis will hopefully be updated as new information and understanding are discovered.

Alexander D. Panov and **Felix P. Philatov** in their article 'Are the Strange Information Structures of the Genetic Code an Accident or an Artifact?' suggest that the universal genetic code has several strange symmetries, the biochemical significance of which remains unclear. In addition, it is possible to construct many numerical signatures, usually related to divisibility by 111, from the weights of the amino acids encoded by the genetic code. It is based on the work of Vladimir Shcherbak and Maxim Makukov (2013), in which many such independent information structures were obtained for the first time. In the current work several new information structures are found, and it is shown that their entire collection naturally divides into five 'information levels', the first two of which are particularly simple and resemble the 'attention signals' known in the practice of searching for signals of extra-terrestrial intelligence in the SETI problem. The method of analysis used in the article differs significantly from the Shcherbak – Makukov approach and is based on the systematic use of the 'simplicity criterion'. The article presents in detail both new and known information signatures of the genetic code and discusses the prospects for resolving the question of the accident or artificial nature of these strange information structures.

Section II. Evolutionary Theories and Aspects examines environmental problems in a broader perspective and in relation to evolutionary theory ('Ecology. Life in the 'Unstable Biosphere'; 'Theory of Evolutionary and Ecological Spaces'), it also explores long-term demographic trends ('Demographic Transformations in the Historical Process in the Light of Technological Development: Theoretical Approach'). The fourth article of this section proposes a new concept, cultural complexus, applicable to the whole spectrum of communities and macro units of analysis employed in historical studies.

The article by **Natalia O. Kovaleva** 'Ecology. Life in the 'Unstable Biosphere' analyzes the modern ecological situation, characterized by an imbalance in the circulation of matter and energy, reduction of the area of active functioning of the biosphere and biodiversity. Biosphere parameters are approaching acceptable limits of changes, the transition through which entails a loss of system stability and its destruction. Humankind, as thousands of years ago, obtains almost all food as a result of the use of soil energy in agriculture and animal husbandry. These circumstances are forcing many countries to expand plowing of land by reducing the area of forests, meadows, and pastures. Meanwhile, the share of arable soils on the planet and the productivity of biocenoses are declining. Replacing natural ecosystems with anthropogenic ones leads to the openness of the cycles of elements, primarily biophilic ones – carbon, nitrogen, phosphorus – and removal of elements from biological cycles,

which in turn reduces the stability of the biosphere as a whole. Urbanization which implies a loss of highly fertile agricultural land, deforestation, and a significant reduction in biological diversity, has a serious impact on the global ecology. The author considers the problems of negative anthropogenic impact both within the framework of the global crisis and within the framework of local crisis conditions. The article analyzes the experience of implementing global and local measures aimed at minimization or elimination of the anthropogenic damage to the environment, as well as available theoretical and methodological scientific research from various countries aimed at solving the identified problems. The author outlines priorities in resolving those problems in the framework of the development of a science-based strategy for sustainable development as well as suggests measures to improve the environment and rehabilitate contaminated territories. The next few decades will be of decisive importance for the formation and implementation of a new global agenda aimed at ensuring the survival of the humankind.

Leonid E. Grinin and **Anton L. Grinin** in their contribution 'Demographic Transformations in the Historical Process in the Light of Technological Development: Theoretical Approach' maintain that the analysis of the demographic component and the demographic dimension of historical process has unfortunately not been sufficiently studied in the social sciences. The demographic development of humankind is even more rarely studied in its close connection with technological development. However, this is an extremely important aspect that can not only explain essential dimensions of the development, but also provide a basis for explaining current processes and forecasting our futures. Moreover, in many respects, it is an integral aspect of analysis, because it focuses on people, the population, that is the main subject of society and humanity. Accordingly, the changes in demographic parameters (both quantitative and qualitative) have an impact on the entire social system, from technology to ideology as well as on the World System as a whole. Population growth is undoubtedly the major driving force of the development of society. The most important subsystem of society, which constitutes its material basis, combines population and production. The link between demography and production is seemingly obvious, since, on the one hand, production determines population growth opportunities and, on the other hand, population size affects the production and other opportunities of a society. However, this relationship is far from simple. Moreover, it is also non-linear, and besides, the correlation between the demographic and production components of societies changes significantly over the course of the historical process. It is also not always so easy to explain strong fluctuations and transformations in population dynamics.

In the present study, the authors provide an analysis of the demographic development of humankind in its close connection with technological development, including the 21st-century trends. This work aims to provide a theoretical

framework for the correlation between the development of production and technology, on the one hand, and demographic transformations, on the other, during the historical process, and to describe all major demographic transformations during human history. The work describes the historical types of population reproduction (TPR) and the reasons for their change. All this makes it possible to make a forecast about the vectors and main features of the coming demographic transformation in the 21st century.

This article describes theoretical approaches and models of the connection between production revolutions (Agrarian, Industrial and Cybernetic) and the largest demographic transformations. It also reflects important points influencing population growth and its limitations. It is shown that the production revolution and the development of the production principle cycle in general change the type of population reproduction, and together they provide the most powerful impulse for the qualitative reorganization of the entire social structure and social relations and further world-system configurations. The authors conclude that every production revolution is followed by a fundamental change in demography. And conversely, population growth causes such changes in society and intersocietal relations, communications and diffusion of innovations that it greatly accelerates technological development. However, there are many nuances and external inconsistencies in this correlation that require explanation.

Boris M. Kondorsky in his article 'Theory of Evolutionary and Ecological Spaces' suggests that for the past 30–40 years, there have been no breakthrough ideas in the field of the theory of biological evolution that could lead it out of a deadlock in which it has been for so long. Apparently, in this case some non-traditional approaches are required.

The author of the article proceeds from the commonality of certain basic regularities underlying the so-called forms of matter motion (hereinafter referred to as the FMMs), i.e. physical, geological, biological, and social ones, and has already attempted to make a parallel comparison of the basic patterns of biological, social, and linguistic evolutions (Kondorsky 2014a, 2014b, 2021, 2022). For a better understanding of the problems of biological evolution raised in the article, homologous events and patterns of social evolution will be constantly mentioned in this work. One should emphasize that the author will speak precisely about homologous events, as it is of a particular importance. Thus, one can speak of the homology of phenomena and structures between individual FMMs.

The philosophical approach to comprehending and understanding the processes of biological evolution is hardly innovative (Zakharov A. 2005; Lyubarsky 1996; Pozdnyakov 2017). The researchers in this field also use terminology and theoretical constructs related to the theory of language (Vasilieva 2001). Moreover, linguists themselves drew attention to the similarity of biological and linguistic evolution back in the mid-19th century.

An integral part of a theory that can be recognized as developed is a set of axioms – basic postulates or initial concepts and principles, i.e. provisions that do not require any proof (Ravkin and Efimov 2006). The author did not set out an objective to analyze the literature on the issues of biological evolution. The idea is to present the main points of the proposed concept using relevant examples.

According to **Ernesto Domínguez López** in his paper 'Cultural Complexus and Evolution Conceptual Contributions to a General Theory of Historical Evolution', the development of a general theory of historical evolution requires the development of strong conceptual frameworks. The article proposes a new concept, cultural complexus, applicable to the whole spectrum of communities and macro units of analysis employed in historical studies. The core of the definition stems from general systems theory and complexity. From that perspective, the paper explores the problem of diversity-unity in human societies and the problem of scale, and finds that the concept proposed provides a framework to accommodate all the variants within a coherent description. The article presents a definition of evolution consistent with the conceptual framework introduces three key principles and a model for the change of configuration (evolution) of the complexus. This development implies an answer to the question of determinism, proposes a law of increasing complexity and points to an explanation of the observed acceleration of change.

Section III. Forecasts consists of one article, but it is an important topic due to the rise of the African continent, whose influence on the future of our World-System will continually grow. The article 'Sociodemographic Risks of Armed Civil Conflicts in Sub-Saharan Africa: Modelling Future Scenarios' by **Andrey V. Korotayev, Vadim V. Ustyuzhanin, Julia V. Zinkina, Jameelah M. Musieva,** and **Leonid E. Grinin** presents forecasts for the emergence of large-scale political and demographic collapses and for the economic growth of some countries in Sub-Saharan Africa where the likelihood of armed civil conflicts and population impoverishment is the highest in the coming decades.

The study develops mathematical models to forecast: (1) risks of large-scale armed civil conflicts with population size, median age, and education as the main explanatory variables; and (2) economic growth with the same explanatory variables and risks of conflicts added. The models include interactions between explanatory variables. We estimate inertial, pessimistic and optimistic scenarios for four large Sahel countries. The inertial scenario is an 'as is' scenario based on the assumption of an unchanged continuation of the current rates of modernization processes (including the diffusion of formal education and fertility transition) and corresponds to the reference scenario by IHME. The pessimistic scenario implies a stall in modernization processes (including fertility stall) and corresponds to the IHME scenario of delayed achievement of the sustainable development goals (SDGs). The optimistic scenario presumes fast achievement of SDGs and corresponds to the IHME scenario of full achievement of SDGs.

Sahel could become a particularly disadvantaged region. The four countries of this region are characterized by: (1) negligible differences between inertial and pessimistic scenarios; (2) extremely high risks of full-scale civil wars in the near future; and (3) prospects of reaching the current level of middle-income countries not earlier than by the end of the century, even under the optimistic scenario.

In the last section of the article, the authors give a brief summary of our vision and some forecasts regarding 1) the prospects for the development of the African continent in the future due to its rapid development and increasing role in the World System; 2) geopolitical rivalry between the leading powers in Africa now and in the future; 3) directions and opportunities for the development of Russian-African relations (including in connection with the NWO).

The main way of mitigating the risks of sociodemographic collapses is rapid progress towards achieving the SDGs in the very near future, which seems impossible without the support of the world community.

Section IV. Reviews and Notes consists of three rather interesting contributions which analyze the most important issues of our time and extrapolate them into the future until the end of this century: a review by **Antony Harper** of *Handbook of Revolutions in the 21st Century: The New Waves of Revolutions, and the Causes and Effects of Disruptive Political Change* by Jack A. Goldstone, Leonid Grinin, and Andrey Korotayev (Springer, 2022); a review by **Leonid E. Grinin, Sergey Yu. Malkov,** and **Andrey V. Korotayev** of *Reconsidering the Limits to Growth. A Report to the Russian Association of the Club of Rome* by Victor A. Sadovnichy, Askar A. Akaev, Ilya V. Ilyin, Sergey Yu. Malkov, Leonid E. Grinin, and Andrey V. Korotayev (Springer, 2023); and a review by **Andrea Komlosy** of *Cybernetic Revolution and Global Aging. Humankind on the Way to Cybernetic Society, or the Next Hundred Years* by Leonid Grinin, Anton Grinin and Andrey Korotayev (Springer, 2024).

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