Big (Universal) History Paradigm: Versions and Approaches

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ABSTRACT

'Big history' – an integral conception of the past since the 'big bang' until today – is a novel subject of cross-disciplinary interest. The concept was construed in the 1980–90s simultaneously in different countries, after relevant premises had matured in the sciences and humanities. Various versions and traditions of big history are considered in this article. Most of the Western authors emphasize the idea of equilibrium and thus reduce cosmic, biological, and social evolution to the mass-energy processes; all mental and spiritual aspects – the informational parameter – are seen as epiphenomena of material structures' complexity that do not play their own role in evolution. In the Russian tradition, down to A. Bogdanov, E. Bauer, I. Prigogine, and E. Jantsch, sustainable non-equilibrium patterns are used. This implies attention to the pan-material sources and the evolution of mental capacities and spiritual culture (as basic anti-entropy instruments), as well as the growing intervention of humans in the material processes on Earth and outside it. The non-equilibrium approach, in the context of modern control and self-organization theories, alters the portrayal of the past and, still more dramatically, the estimation of civilization's potential perspectives.

Two significant events gave rise to this article. One was the publication of D. Christian's monograph *Maps of Time: An Intro-*

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duction to 'Big History' (Christian 2004). The other was the formation of a special Big History section at the Historical Society's 4th biennial conference in June 2004.

Since the early 1990s, Australian-American historian David Christian has been developing an integral conception of the past, in which human history is viewed as a phase in the evolution of the Earth, biosphere, and Metagalaxy. He is an author of the term 'big history', which has subsequently spread in English-language literature (Christian 1991; Spier 1996; Hughes-Warrington 2002). Simultaneously, the equivalent terms 'universal evolutionism', 'universal history' (from 'the Universe'), and 'mega-history' have been adopted in relevant Russian papers (Moiseev 1991; Nazaretyan 1991, 2002, 2004; Fedorovich 2000, 2002; Fedorovich *et al*. (eds.) 2001; Panov 2005).

The inclusion of the big history section in the conference of the Historical Society is also to a considerable extent due to D. Christian's work and authority. Its significance becomes obvious if we recollect that a couple of decades ago Western historians used to treat disdainfully as 'sociology' any research which overlapped a period of one to three generations, while sociologists, in their turn, preferred 'middle level conceptions' and rejected more powerful generalizations as 'philosophy'. Lately, many analysts have expressed rapidly growing interest in panhuman history as a single, coherent story (McNeill and McNeill 2003); in particular, this has been caused by the requirements of global forecasting.

Nevertheless, big history's extreme retrospection is still a point of distrust both in Western and Russian professional historical communities. This attitude arises from the inertia of a monodisciplinary mentality on the one hand, and insufficient development of a methodology to integrate diverse disciplinary patterns, such as astro- and micro-physics, chemistry, geology, biology, paleontology, anthropology, psychology, and historiography, on the other hand. That is why the big history section seems to be a good sign both for the historians (who have thus recognized the telescope as an acceptable research instrument in combination with the

wide-lens objective and the microscope) and for other specialists who are searching for a coherent world picture. So it is distressing that professional philosophers were absent from the section's program, which had wide disciplinary and geographical representation.

It should be noted that a growing number of modern universities include in their curricula big/universal history courses, mostly for the humanities, to give the students a clear idea of the current evolutionary world picture. Rich Western universities usually invite cross-disciplinary groups of up to twenty professors to deliver lectures on the subject. After a general introduction, astrophysicists and astronomers explain the bases of relativity theory, Friedman and post-Friedman models of evolutionary cosmology, and hypotheses of solar system formation. Geologists tell the story of the Earth and the formation of its structures, and biochemists and palaeontologists go on to describe the evolution of the biosphere on geological time-scales. After that, archaeologists and anthropologists expound the evolution of the *Hominidae* family and anthropogenesis. In the final stage, specialists in social history, historical sociology, and political science describe social history; a discussion on global forecasts completes the course.

Here, again, it is a curious fact that psychologists and philosophers, as specialists in mental realities and spiritual culture, are absent. This article will discuss some of the reasons for this. At the same time, the absence of informational and psychological dimensions to such an ambitious world picture has been lately recognized as a shortcoming. It is no mere chance that D. Christian pays essentially more attention to far-from-equilibrium states in his latest book than he did in his previous papers. At the University of Amsterdam, the course is supplemented by a lecture on the psychological dimensions of big history, and to deliver this lecture a teacher from Moscow is invited.

In Russia, very few universities have yet offered similar programs on big/universal history as a part of their standard program ‘Conceptions of Modern Sciences’, as recommended by the Educa-

tion Ministry. In those few that do, the course is taught by a single reader, usually a philosopher who is also qualified as a physicist or biologist.

Certainly, this 'universalism' of the enthusiasts (Russian universities are not rich and independent enough to afford bringing together a group of professors for one course) limits the amount of detail that can be discussed. Still, the positive aspect is that it requires higher attention to the methods of interdisciplinary synthesis.

THE CONSTRUCTS OF WORLD, GLOBAL, AND BIG HISTORY

The medieval historians were, in the expression of J. Le Goff (1977), 'great provincials'. Each one used to describe the events he observed as the centre of human history, and had no reason to reflect on the differences between the stories of separate civilizations.

Geographic discoveries, colonial conquests, geologists' and archaeologists' findings, and especially the new outlook essentially broadened the Europeans' space and time horizons. The formation of nations, nation states, and ideologies resulted in discrimination and conceptual confrontation between local histories. In the eighteenth and nineteenth centuries, together with national histories, the conception of 'world history' appeared, which rested on the idea of panhuman progressive development. In the current versions of it there are various divisions into periods, always ascending from prehistory (the Palaeolithic) to modern history.

Originally, the concept was distinctly Eurocentric, which in the nineteenth and, especially, the twentieth centuries was strongly criticized by adherents of the 'civilization approach' (such as N. Danilevski, O. Spengler, and early A. Toynbee), and, later, 'historical particularists', 'post-modernists', and religious and national fundamentalists. Together with the Eurocentric ideology, the idea of panhuman history was denied, and O. Spengler (1980) even proposed to consider 'humankind' as merely a zoological concept.

In the twenty-first century, the world-historian's standpoint is not yet shared by all historians or sociologists. Still, archaeological, anthropological, and historiographical discoveries in the previous century disavowed the two key arguments put forward by N. Danilevski and O. Spengler: that there had been no progression in the development of regional civilizations, and there had been no meaningful events for all of humankind (that is, they were meant only for this or that separate civilization). As there is abundant testimony for the mainstream of human history and prehistory[1], in a scientific (unlike ideological) discussion one may question certain interpretations but not world history as a subject matter.

Moreover, in the first half of the twentieth century, the profound mutual influence of geological, biotic, and social processes was revealed. As a result, a novel cross-disciplinary field took shape – 'global history': the planetary story seen as the successive formation, evolution, and interaction of the structures in which first biota and then society became the leading agents.

Russian biochemist V. Vernadsky and French anthropologist P. Teilhard de Chardin as well as philosopher E. Le Rouis were among the discoverers of global history. They proved that human history was a phase in the evolution of the Earth, which culminated (or will culminate) in the 'Noosphere' – the sphere of maximum intellectual control over planetary processes. The global history approach has been developed further in more recent works (Golubev 1992; Snooks 1996, 1998, 2002). In particular, G. D. Snooks has developed and applied a general dynamic theory of life and human society.

It is curious that, in the 1930s, V. Vernadsky (1978) did not pass over the question of whether the evolutionary standpoint could be extrapolated beyond the Earth and the solar system, but his answer was undoubtedly negative. Not being a specialist in theoretical physics, he ignored relativist cosmological models; like most of his contemporaries, he shared the idea that the Universe was stationary, isotropic, and infinite in space and time. That idea, which descended from Giordano Bruno, obviously contrasted with

universal evolution: eternity cannot have a history! Since the Russian scientist did not see an alternative to the Brunian cosmic picture, he had to recognize that the evolutionary processes on the Earth were nothing but an ordinary local fluctuation which was doomed to dissolve with time into the infinite Universe, like an ocean wave. As for the Universe on the whole, he argued, it had always been and would always remain exactly as we find it.

Before V. Vernadsky, many outstanding thinkers (F. Bacon, J. Condorcet, C. Fourier, F. Engels, and others) had been racking their brains over the problem of concordance between the philosophy of progress and a naturalist account of reality. All of them, more or less explicitly, came to the same discouraging conclusion: no infinite perspective for life and spirit is thinkable if the destinies of the Earth and the Sun are limited. At the best, it was assumed that eternal matter was regularly producing splashes like the evolution of Earth at various points in cosmic space, but any continuation of or progression between those local stories was excluded.

Only the most unreserved German and Russian 'cosmists' – G. Fichte, A. von Humboldt, N. Fedorov, and K. Tsyolkovsky – who were the laughing stock of their contemporaries, dared argue that intelligence would lead its bearer outside his home planet, and influence of the Earth civilization would expand far into boundless cosmic space, which would guarantee the infinite progress.

Still, even the 'cosmists' extended their evolutionary outlook only to the future but not to the past: the pre-human cosmos remained outside history. As to 'respectable' science, up to the twentieth century the only reason to assume a universal mega-trend could rest on the second law of thermodynamics. Its rational corollary was that, if the world was a single whole, it had to be continually degrading with time from the maximum organization toward absolute entropy. The heat death theory in physics harmonized with the biological theory of catastrophes argued by the father of palaeontology J. Cuvier and his pupils: new living forms cannot spontaneously emerge, and their original diversity on Earth has successively decreased because of geological and cosmic cata-

clysms. The conceptions of social and spiritual decay constituted the roof over this theoretical building, but it had been raised long before the building's walls and groundwork appeared.

While the idea of a descending trend had powerful alternatives in nineteenth-century sociology and biology (A. Comte, H. Spencer, C. Darwin, K. Marx, for example), against heat death theory physics could only offer the thesis that the infinite Universe was an open system and, therefore, free from thermodynamic laws, *ergo*, from history. However, the empirical data that testified to the consecutive evolution of life and society, and the relevant conceptual conclusions, presented a strong contrast with the thermodynamic generalizations; as one physicist put it, ‘Clausius and Darwin cannot be both right’ (quoted in Prigogine 1981).

The concept of big/universal history, which covers evolution from the Big bang to current society, appeared in the 1980–90s. At least two crucial achievements of the twentieth-century science served as premises for the concept.

First, relativist evolutionary cosmological models had been mathematically deduced, received indirect empirical support (for example, redshift effect, cosmic background radiation), and were commonly accepted. Historical method penetrated deeply into physics and chemistry: all material objects from nucleons to galaxies proved to be temporal products of a certain evolutionary stage and had their histories, pre-histories, and naturally restrained futures.

Second, a set of natural mechanisms had been discovered by which open material systems could spontaneously move away from equilibrium within their habitat, and, by using the environment's resources to work against entropy, sustain their non-equilibrium condition. Patterns of self-organization became a subject of interest in the sciences and humanities.

All the above revealed that we can trace distinctive progressive vectors, or mega-trends, which enter into social (including spiritual), biological, geological, and cosmo-physical histories as a single continuous process. Moreover, although no direct contradic-

tions of the laws of physical irreversibility have been found, the orientation of the mega-trends conflicts with the classical paradigm of natural science. E. Chaisson (2001) describes this as two 'arrows of time' – the thermodynamic and the cosmological arrows.

Indeed, available data allow us to observe evolution retrospectively, from quark-gluon plasma to star clusters and organic molecules; from the Proterozoic cyanobacteria to the higher vertebrates and the most complicated ecosystems of Pleistocene, and from *Homo habilis* with pebble chips to the post-industrial civilization. Thus, as far back as our retrospective view can reach, the Universe-Metagalaxy has been successively evolving from the more probable states (or 'natural' ones, from the 'entropy' point of view) to the less probable ('unnatural') states.

True, the cone of evolution has been tapering off. Most matter in the Universe (the so-called *dark matter*) has avoided evolutionary transformations and remained apart from atomic structures. A tiny portion of the atomic structures has formed organic molecules. Living matter has apparently emerged in extremely rare and limited parts of cosmic space, and only one of the millions of biological families on the Earth has reached the social stage. Thus, we may agree with E. Chaisson (2001) and D. Christian (2004) that complexity and rarity go together. Still, the appearance of a qualitatively higher structure imparts a novel faculty to the Universe as a single whole. As A. Einstein once noted, the state of the Universe is altered by a mouse just looking at it.

These new qualities are pregnant with further development. Hence, an opposite trend to the cone extension can be traced from a certain stage of evolution: the field of the mind's influence has been growing (human activity has become a geological power and is now spreading outside the Earth), and there are no essential reasons to see limits to its ulterior expansion (see below).

Recently, Moscow physicist A. Panov (2005) claimed to have added a new trait to the picture. Having confronted the time intervals between the qualitative leaps in the evolution of the Earth, nature and society (the author used the Geochronological Table

and the records of global human-induced crises and revolutionary breaks since the Lower Palaeolithic [Nazaretyan 2003]), he found that the spans successively decreased in the course of 4.5 billion years in conformity with a simple algorithmic formula. This result, reported to the State Astronomic Institute (November 2003) was recognized as a scientific discovery by the participants of the seminar. Unknown to Panov, the political economist G. D. Snooks, in *The Dynamic Society* (Snooks 1996: 80), had already formulated this algorithm as $y=(3^{t-1})$, where y is biomass and t is time. This algorithm reflects his discovery that over the past 3,800 million years, each great transformation of life forms occurred three times as rapidly as its predecessor. This can be represented in diagrammatical terms as an exponential curve that approaches the vertical. I have called this the 'Snooks-Panov vertical'. This discovery by Snooks and Panov offers complementary evidence for the unity of the universal history, and a new context for global forecasts.

To give it a sharp graphic form, the pivotal evolution mega-trend may be drawn as a consecutive distancing or digression from the natural (the most probable) state. Still more grotesquely, over the whole distance of our retrospective view (about 13–15 billion years), the world has been getting stranger and stranger, and both our own existence and the actual state of civilization on this planet are manifestations of a world getting stranger.

In fact, this conclusion is nothing but an empirical generalization deduced by simply comparing evidence from different disciplines. In spite of human free choice, wrong actions, countless social fractures, and civilization cycles, a bird's eye view of world history reveals its progressive ascent, which continues the previous mega-trends. The central question is why evolution has gone in such an odd direction, and here a wide range of conceptual versions is possible.

THE VERSIONS OF BIG HISTORY

There is a temptation to explain the paradoxical mega-trend of universal evolution (digression from the natural state) by an assump-

tion of an *a priori* program aimed at the final state. As soon as we assume this, the most acute questions, beginning with 'why?', are removed and replaced by relatively elementary ones like 'what for?' and 'how?'

A vivid example of a teleological argument in modern cosmology is the 'strong anthropic principle'. This implies that the very precise balance of universal physical constants that made possible the emergence of living cells (and humans) is due to an artificial composition of the initial parameters in the giant laboratory, which is our Metagalaxy. In F. Hoyle's words, 'a sound interpretation of facts allows us to presume that in physics, as well as in chemistry and biology, a Super-Intellect has experimented' (quoted in Davies 1982).

In biology, we find a similar argument represented by the nomogenesis and ortogenesis theories. To emphasize essential idea of these theories, the outstanding Russian biologist L. Berg (1977) said, quoting from his predecessor, another enthusiast of nomogenesis, K. Bar: 'The final goal of the whole animal world is the human species'.

The same teleological idea was metaphorically expressed in K. Marx's words that 'the physiology of humans is the key to the physiology of monkeys'; this has still deeper roots in sociology. Almost all of the progressivist theories from the eighteenth to the twentieth century implied a belief that the historical process was a successive ascent toward an ideal model. This argument generated severe criticism from the opponents. In the early twentieth century, Russian Orthodox philosopher N. Berdyaev (1990) advanced the strongest anti-progress argument: the idea is immoral, he wrote, for it represents all previous generations as nothing but foot-steps on the way to the final aim (and thus deprives them of self-value) and the future generation of lucky ones as 'the vampires reveling on the graves of their ancestors'.

Classic and modern philosophy still includes a greater number of teleological doctrines than other disciplines do. However, they all look too exotic for the university big history courses and, as far

as I know, are hardly even mentioned; what apparently prevail are *a posteriori* interpretations. In this case, the authors tend to deduce evolutionary effects as a consequence of actual interactions, so that their sequence within a certain mega-trend is recognized as a *problem*, which expects a scientific solution.

However, *a posteriori* versions are not homogeneous either. To see the difference, we should consider the recent story of the question. If we abstract from peoples' legends, religious and philosophical doctrines concerning the beginning and the end of the world, then E. Jantsch's *The Self-Organizing Universe* (1980) seems to be the first work that could unconditionally be referred to as a paper on big history. Jantsch later emigrated from Austria to the USA. His brilliant book, dedicated to I. Prigogine, was published in German and in English, but drew small interest both in West Europe or in America. Soon after that, he committed suicide (indeed, personalities living a hard life often write optimistic texts, and vice versa: psychologists call this ‘compensation’). In my many contacts with Western colleagues, I was surprised to discover that none of them had even heard of E. Jantsch. So, a decade later, the subject of big history subject had to be construed anew.

The Self-Organizing Universe could have sunk into oblivion if it were not for one accidental circumstance: although the book was never published in Russian, it had a stronger impact on Russian (Soviet) readers than on Europeans or Americans. To explain this fact, we must remember that, in the 1910s, the Russian physician and philosopher, and one of the fathers of system theory, A. Bogdanov had paid attention to *non-equilibrium* systems (Bogdanov 1996), whereas systems thinking in Western Europe (L. von Bertalanffy, W. R. Ashby, and others) emphasized exclusively the idea of equilibrium. In the 1930s, the Soviet biophysicist E. Bauer first used the concept ‘sustainable non-equilibrium’ (Bauer 1935), which was developed by the Belgian I. Prigogine (who could read Russian) and was philosophically adopted by E. Jantsch. Therefore, this productive concept was more familiar to Russian scholars

than to their Western colleagues who still used equilibrium patterns for constructing big history in the 1990s.

This suggests why big history courses in Western universities have mostly ignored its psychological dimensions. In I. Prigogine's words, ‘equilibrium is blind’, and only non-equilibrium gives a system vision. To sustain a far-from-equilibrium condition, an organism is working against the environment's coercive force. This work requires free energy to be extracted from other systems. So, in order to tap energy continually from outside and escape becoming itself a source of energy for its enemies, the organism needs *information*: it has to orientate itself in the environment, forecast events, and organize its activity in conformity with the situation's dynamic; that is, it must construct anticipative world models.

Without this purposeful and highly sensitive anti-entropy activity, neither long-term far-from-equilibrium conditions, nor the sequential building up of living matter's degrees of non-equilibrium would be possible. Therefore, competition for matter and energy resources has served as an immutable motive for the perfection of modelling procedures, so that the special weight of information versus matter-energy has been increasing with time; on the social stage, the mind itself has become more and more the determinant cause of activity and evolution.

So, since we want to get rid of teleology, or the assumption of the drive to evolution, we must still assume living matter's drive to sustain highly improbable far-from-equilibrium conditions, which is similar to the Bergsonian *élan vital*. To avoid the French philosopher's dualism, we must also seek the evolutionary premises of living organisms' immanent faculty.

To the extent that Western big historians have used equilibrium patterns, they have tended to confine themselves to the matter-energy constituents of interactions and put aside the information aspect. In this case, the history and prehistory of subjectivity, of mental, and spiritual processes are viewed as exclusively epiphenomena of material structures' complexity that do not play a role in evolution. Thus the psycho-physical problem raised by R. Des-

cartes is simply removed. Meanwhile, since the formulation of mathematical theories of communication and control, and N. Weiner (1950) definitely indicated that information was neither matter nor energy, the problem has been transferred from the purely philosophical to the scientific sphere.

Accordingly, after the basic question of the methodology of big history (teleological versus causal approach) is solved in favour of *a posteriori* arguments, the attitude to the last constituent in the triad 'matter – energy – information' comes to the fore. Properly, the question is whether information is a significant factor in evolutionary processes, or whether the two basic physical categories, matter and energy, are, in principle, necessary and sufficient for exhaustive description.

In the strict physicalist version, the evolutionary mega-trends are nothing but an irreversible growth of the entropy of the aggregate Universe, and the emergence of qualitatively higher organizations like life and society serve to accelerate destructive processes where and if this is possible (Huzen 2000). A moderate physicalist view, which is more popular among scientists, insofar as it denies a creative role to intellectual agents also leads us to the conclusion that the prospect of civilization is strictly constrained by natural laws (see Nazaretyan 2004).

It is no accident that world historian and cross-disciplinarian D. Christian categorically follows the professional astrophysicists' usual estimation of the distant future. Entities as complex as modern human society, he suggests, arise close to the limit of our Universe's capacity to generate complexity, and, if this is so, we cannot expect dramatic further development. After the end of the Universe's youthful period, stars will flicker out and die, the Universe will get colder and colder as it ages, and there will be no more energy to conjure up or to sustain such miracles as living and thinking matter. It would appear that this textbook physical scenario is a slightly modified wording of the heat death theory.

In Russia, 'cosmist' philosophy influence remains so strong that even among the most qualified astrophysicists and mathemati-

cians we find those who reject this naturalist scenario and connect the potential future of the Metagalaxy with the increasing intervention of civilization (Novikov 1988; Linde 1990; Lefevre 1996). However, not only Russian physicists have come up with similar suggestions. For instance, the eminent American specialist in quantum theory D. Deutsch, who seems never to have heard of the 'cosmist' philosophers, clearly expressed the same idea (Deutsch 1998): the future story of the Universe depends on the future story of intelligence, which will sequentially enhance its control over cosmic space as well as actually dominate the Earth's biosphere.

Although this suggestion looks amazing *prima facie*, it seems reasonable as we observe the relevant trend over previous billions of years. Looking back, first at the millennia of social history, we may note how virtual events like novel ideas and values; religious and philosophical doctrines; poetic, artistic, and musical images; and technological and scientific findings have had, via human activities, a stronger and stronger impact on the natural processes on the Earth. Ultimately, their far-reaching effects surpassed those of spontaneous geological and climatic cataclysms, full of blind power.

Going back far beyond human history, we again find out that the growing capacity of living matter to use energy flows is related to its growing cleverness, although it is less obvious in this case. To argue this point, V. Vernadsky has used the concept of a 'coefficient of cephalization' – the anatomic correlate for the intelligence quotient of vertebrate species. If we take modern fauna's aggregative index as 1, the index for the Miocene (25 myrs ago) would be 0.5, and for the beginning of the Cenozoic (67 myrs ago) – 0.25, and so on. The great Russian evolutionist did not read the words by N. Weiner mentioned above (they were written after Vernadsky's death in 1945), but he too was puzzled by the numerous facts that demonstrated the independent role of information: how can the mind that is surely not a form of energy regulate material processes?

We will consider some of the responses to this question. As to the *growing* capacity of mindful regulation, modern psychology offers some suggestions about the relevant mechanism. As gestalt-psychological experiments have shown, the parameters of the objective situation, which are *uncontrollable constants* within an accepted mental pattern, prove to be *controllable variables* as soon as we find a conceptual meta-system, that is, the one that reflects broader causal links. Having assumed our world is infinitely complicated, no absolutely control-proof faculties in it should be imposed theoretically, and no correctly formulated technical problem should be recognized as radically solution-proof.

In fact, the whole story of social technologies shows that any cardinal problem has been practically solved as evolution required it. Most technical achievements in the twentieth century were theoretically forbidden by the natural laws as understood in the nineteenth century, and the outstanding thinkers explicitly formulated worthy interdictions more than once. Although not a law of classical physics has been dramatically disavowed, multiple additions, modified definitions, and specifications have made possible quite a different conceptual and technological reality. Looking farther back at human history, or at the evolution of pre-human biological 'technologies' (for example, living matter's expansion from the sea onto the land, the conquest of the air by the vertebrates), we find a slower but essentially similar succession.

So, the post-physicalist view of big history's empirical evidence supplements the evolutionary picture with a new determinant. If there is a relation between structural complexity and the amount of energy consumed (which has been brilliantly shown by the American physicist E. Chaisson (2001): the more complex the order is, the denser the energy flows that pass through it), then this is because complex systems get cleverer and thus perfect their control capacities. The relationship between a system's capacity for energy control and the volume of its information model has been singled out as one of the fundamental laws of nature by the Russian system theorists (Druzhinin and Kontorov 1976; Nazaretyan 1991).

Besides, it has been shown that, as soon as we include the information-control parameter, the *futuribles* (potential futures) of civilization, as well as those of the Metagalaxy, look radically different. This should be related to the perspectives of further developing the mind. The cosmic Universe cannot always remain free from the intellectual influence exerted by Earth's civilization (if it survives) or some other planet's civilizations, which manage to survive longer. This raises specific problems (including ethical ones) for the distant future that are discussed in relevant literature but are beyond the subject of this article.

Current experience shows that the discrepancies between the adherents of the *a posteriori* approach assume a scientific discussion of and confrontation with the explanatory power of the patterns. And the differences between the *a posteriori* and the *a priori* (teleological; theological) approaches are mainly the subject of philosophy, which, being concerned with 'eternal' questions, cannot solve such questions by the scientific method. Since post-classical, model-oriented epistemology (unlike truth-oriented one) excludes final and exhaustive solutions, gaps in any theoretical worldview may be filled by an appeal to the purposeful (and thus anthropomorphic) Actor. This mocking phantom is perpetually soaring over science and evolving together with it from the Biblical Creator to the Watch-Maker and, further, to the Computer Engineer, Extra-Planetary, even Extra-Galactic, Intellect, and so on, and creating complementary impulses to scientific and philosophical reflection.

Nevertheless, as we have mentioned, modern scientific method accepts a telic approach to the extent that it is introduced in the context of actual interactions (drive to preservation). Taking this into account, we will conclude the article by quickly outlining one of the synthetic patterns that help us interpret big history's mega-trends.

BIG HISTORY, CYBERNETICS, AND SELF-ORGANIZATION THEORY

The mutual relation of causal and telic mentalities has had its own faraway and fanciful story, and it has essentially influenced both official ideologies and ordinary worldviews in various epochs (Nazaretyan 1991). Non-classical science implies a new synthesis

of the two opposite approaches that is embodied particularly in the interdisciplinary patterns concerning cybernetic system theory and synergetics[2].

In cybernetics, the initial kind of tasks for the interacting systems is not an eventual final condition but conservation of the parameters of all outer and inner structures. The combination of the two basic faculties – the immanent activity of matter and the physical conservation laws – is manifested in the struggle of organization forms (A. Bogdanov), or *competition of controls* for the preservation of the current movement condition by each of the interacting agents.

Some of the patterns of classical physics, such as the variational principles, Le Chatelier's principle, and Onsager's law, conform organically to the metaphor of regulation, control, telic causality, and competition. Ultimately, as the Russian physicist N. Moiseev (1986) has put it, from this point of view, 'any inert matter law... is in fact a mechanism of selection of real movements'.

The cybernetic and ecological metaphors bring together the questions beginning with 'why?', 'how?', and 'what for?' Molecular biologists are aware that ferment synthesis at any particular moment is regulated by the cell's actual needs. Geologists apply telic functions to describe mathematically the processes of the landscape. Having asked for what purpose nature needs several kinds of neutrino, or lambda-hyperons, theoretical physicists refer to system dependencies. The search for the 'lacking elements' – that is, those required for the Metagalaxy stability – has more than once led to important discoveries. Simultaneously, ideas based on categories like control, self-organization, competition, and selection (of forms or movement conditions) have demonstrated the profound continuity between inert and living matter, and the evolutionary roots of the apparently aim-oriented behaviour of living organisms.

In particular, cybernetic system theory first emphasized the functional essence of material *reflection*. As the Russian chemist and philosopher Y. Zhdanov (1983) has shown, 'self-preservation

against the outside coercions is an essential function of reflection as an immanent material faculty'. Therefore, this philosophical category is similar to the interdisciplinary category of *modelling* as an instrument of control.

Provided all the interaction agents have comparable capacities of reflection and control, the outcome is a kind of 'compromise of coercions'. Still, even in this case, equilibrium conditions are only a virtual aspect (like a perfect gas or a geometric point) of fundamentally non-linear processes.

Since self-organization effects have been discovered, we can better understand how a highly improbable far-from-equilibrium state emerges spontaneously. At the same time, the combination of self-organization and control patterns make it clearer why a non-equilibrium condition is preferable and is purposefully defended by complex systems. From there, we see why feedback and modelling mechanisms have been progressively improving together with structures' complexity and behaviour capacities; after all, why and how the role of reflection in joint causalities has been successively growing for billions of years (Nazaretyan 1991, 2004).

In the 1940s, E. Schrödinger showed that anti-entropy work can be done only by means of 'order consumption' from outside – that is, at the cost of the increasing entropy of other systems (Schrödinger 1955). When there are abundant environments, open non-equilibrium systems increase the volume of their anti-entropy work and expand as much as they can. Sooner or later, this exhausts the available resources and, as a result, there follows a specific crisis in system-environment relations.

In ecology the crises of this type are called *endo-exogenous*. The system – an individual, a population, or a human society – runs against the unfavourable environmental transformations provoked by its own activity. Endo-exogenous crises, including all the anthropogenic (technogenic) crises, play a special role in evolution. As previous anti-entropy mechanisms become counterproductive – being fraught with catastrophic entropy growth – a bifurcation phase develops. If migration is impossible, there are only two fur-

ther possibilities. Either the system turns back to equilibrium – that is, degrades – (this is called a *simple attractor* in synergetics), or diverges from that owing to the development of advanced anti-entropy mechanisms. This last possibility is usually caused by higher inner diversity and structural complexity, and a more dynamic world model with higher resolving power and sensible feedback.

The new non-equilibrium response to crisis is known as a *strange attractor*. It looks like a 'quasi-aim' situation, as far as the actual task of self-preservation has turned with directionality to a phase transition (a qualitative leap); a highly developed society can give this crisis-coping scenario a form of deliberate projects for technological, organizational, and psychological reconstruction. Retrospectively, the sequence of successful actual solutions (each time accompanied by many dramatic collapses) over a long temporal distance is lined up as the mainstream of biological and social progress.

Self-organization patterns in anthropology include the evolution of spiritual culture, which has usually been mediated by anthropogenic crises as well, when seen in the big history context. It has been shown, for example, that instrumental intelligence, like any other anti-entropy organ, in certain evolutionary conditions led the early hominids into lethal danger: the Olduvai artifacts have once and for all broken the ethological balance between animals' natural weapons and instinctive intra-species aggression-inhibition (Lorenz 1981). In this new, unnatural situation, in which the proportion of deadly intra-group conflicts became incompatible with existence, very few *Homo habilis* groups (or maybe a single one) could survive. Confronting archaeological, anthropological, and neuropsychological data bring us to the conclusion that their survival was due to specific neurotic faculties. Necrophobia (dread of the deceased) seems to be the first artificial factor that balanced the killing power of extra-natural weapons: it restrained intra-group aggression and was displayed in the care for deceased, sick, and crippled conspecifics. So, the groups affected by necrophobia

(which implied higher mental ability, suggestibility, and unnaturally developed imagination) were the ones to create proto-culture and to start a new evolutionary spiral with a different selection mechanism (Nazaretyan 2002).

From that time, the existence of hominids, including *Homo sapiens*, has not had a natural background and was to a great extent enhanced by cultural regulation and technological power. Disparities in the development of the instrumental and self-regulative hypostases of culture caused outbursts of ecological and/or geopolitical aggression, which have most often resulted in the destruction of society. The mechanism by which internally sustainable social systems are selected and unbalanced ones discarded has so far permitted the preservation of humankind. As special calculations show, although the killing power of weapons and demographic densities have been growing continuously for millennia, the ratio of victims of social violence to population has been decreasing rather irregularly (Nazaretyan 2003, 2004).

These calculations (and some other ones) are made to check a corollary of the hypothesis which arises from quite different empirical evidence, namely, the history of anthropogenic catastrophes and the resulting cultural revolutions since the Palaeolithic. Summing up diverse information from cultural anthropology, history, historical psychology, and current ecology concerning anthropogenic crises, we have suggested that there was a regular relation between the three variables: technological potential, cultural regulation quality, and society's internal sustainability. *The law of techno-humanitarian balance* states that *the higher is the power of production and war technologies, the more refined are the means of behaviour-regulation required for the self-preservation of the society.*

The formal version of the hypothesis (Nazaretyan 2003, 2004) demonstrates that more powerful technologies increase a social system's sustainability against external fluctuations and, at the same time, make it more vulnerable internally (less fool-proof), if the technological advance is not balanced by well-proportioned cultural aggression-retention. The law explains causally both the

sudden collapses of flourishing societies and the breakthroughs of humanity into new historical epochs (which often look still more mysterious). Following this, we can better observe the progression of panhuman history, in spite of successive and dramatic replacements of leading cultures and continents. We see how one after another social organisms have fallen into evolutionary deadlocks, but humanity as a whole has always managed to find a cardinal way out. This was achieved by successive and irreversible leaps forward that commonly included: technological innovations, the increasing information volume of social and individual minds, the complexity of social structures, and the improvement of cultural values[3].

In earlier papers, seven wide-ranging anthropogenic crises and the resultant crucial revolutions since the Lower Palaeolithic have been considered. Every constructive solution led into the next growth phase of the social system's non-equilibrium intensification of society-nature and intra-social artificial mediations, and, on the whole, the distancing of society and its natural environment (the society-nature system) from the natural (wild) condition. This becomes clearer when we contrast, for example, gathering and hunting with agriculture and cattle-breeding (the Neolithic revolution), or farming with industry (the industrial revolution), or industry with computer production (the information revolution). Each of these revolutions broadened and deepened the human species' ecological niche, produced new demographic growth, new opportunities, ambitions, and consumer demands, and thus the way to the subsequent anthropogenic crisis began.

In synergetic (or mathematical chaos theory) terms, human history is the story of one self-similar system, which exists on the scale of a million or so years and has been successively transforming itself to conserve its sustainability (Christian 1991, 2004). Having assumed that the nucleus of those salutary transformations is intellectual, we may see the universal roots of human intelligence and morality without appealing to God's Providence. What we call biological or social progress is neither an eternal purpose (a divine program) nor a movement from the worse to the better, but *a*

means of self-preservation by which a complex far-from-equilibrium system responds to the challenges of reduced sustainability, and, on the whole, a chain of successful adaptations to the effects of the activity of non-equilibrium systems (against the background of prevailing failures).

Thus, the informational parameter of world development brings with it a relevant moral (self-regulation) aspect at a certain evolutionary stage. Taking a bird's eye view of world history, especially of its turning points, in a big history context helps us to develop reliable scenarios for the future and distinguish between forecasts and projects that are realistic and those that are utopian. Hence, the prospects of planetary civilization in the twenty-first or bifurcation century are concerned either with a global fracture or with a coming drastic digression from the natural state spiral. This conclusion, which is based on long-term historical observations and analysis of the relevant mechanisms, discredits many 'back to nature' claims and projects. The creativity of the mind gives civilization unlimited potential for advancement, and the mind's inner imbalance rather than natural laws may turn with lethal menace on civilization both in the near and distant future.

NOTES

[1] We have singled out five mainstreams of consecutive global transformations over the millennia*: increases in world population, in technological power, in organizational complexity, and in mental information capacity*, and *evolution of cultural regulation mechanisms*. The first three vectors are inferred as empirical generalizations that can easily be illustrated with figures. The forth and the fifth vectors require particular arguments (Nazaretyan 2003, 2004).

[2] The last term is not accepted everywhere and, therefore, it requires explanation. Self-organization patterns were called *synergetic* in Germany (by H. Huken), *non-equilibrium thermodynamic* or *theory of dissipative structures* in Belgium (by I. Prigogine), *theory of autopoesis* in Chile (by U. Maturana), *dynamic chaos theory* in USA (by M. Feigenbaum), and *non-linear dynamic* in Russia (by S. Kurdumov). The linguistic diversity and competition for priority must not conceal the fact that these are various readings of a single scientific paradigm.

[3] The techno-humanitarian balance hypothesis is consonant with L. Kohlberg's idea of correlation between humankind's intellectual and moral

development (Kohlberg 1984), which is still a subject of criticism, even by social evolutionists. In fact, Kohlberg applies to social history the classical evidence of J. Piaget and his followers concerning individual development, and the conflict-enculturation hypothesis of anthropologists: the downward course of violence with increasing age has been revealed both in Western and primitive cultures (Chick 1998; Moroe *et al*. 2000).

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