The Singularity in Big History: An Overview of Our Recent Book

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Many major transitions are currently underway in demography, energy use, environment, economic convergence, and global interdependence. With so much rapid change, the timescales for decisions are often limited to about five years in the future. It is somewhat paradoxical then that this current rapid change is guiding us to look at very long time-scales. This motivation arises because one explanation of the current rapid change is that it is a continuation of a very long-term trend throughout Big History. Only now when we observe the change trend within our lives do we fully appreciate the consequences and implications. Our recent book 'The 21st Century Singularity and Global Futures. A Big History Perspective' helps understand the basis for this view along with the various deeper explanations as to why it is happening as well as why we can understand it. But beyond just understanding, we attempt to articulate some of the potential issues and implications to help facilitate future scenario development and their considerations. The book first presents a definition of a singularity trend. This is then placed into the context of Big History. The following chapters that analyze evidence in historical mega-trends, suggest potential models, review possible interpretations, develop future scenarios, and raise philosophical questions. This is done with the realization and debate about the analysis limitations and uncertainty.

Keywords: *risks, Singularity, Big History, energy.*

Definition

Many major transitions are currently underway in demography, energy use, environment, economic convergence, and global interdependence. With so much rapid change, the time-scales for decisions are often limited to about five years in the future. It is somewhat paradoxical then that this current rapid change is guiding us to look at very long time-scales. This motivation arises because one explanation of the current rapid change is that it is a continuation of a very long-term trend throughout Big History According to the definition of the International Big History Association, 'Big History seeks to understand the integrated history of the Cosmos, Earth, Life, and Humanity, using the best available empirical evidence and scholarly methods.' There are many standard accounts of Big History (Christian 2004; Brown 2007; Christian, Brown, and Benjamin 2014; Spier 2010). Only now when we observe the change trend within our lives do we fully appreciate the consequences and implications. Our book '*The 21st Century Singularity and Global Futures. A Big History Perspective*' (Korotayev and LePoire 2020) was written to help understand the basis for this view along with various deeper explanations as to why it is happening as well as why we can understand it. But beyond just understanding, we attempt to articulate some of the potential issues and implications to help facilitate future scenario development and their considerations.

The rapid change leading to 'some essential singularity' was articulated early by John von Neumann in the 1950s: 'the ever-accelerating progress of technology and changes in the mode of human life… gives the appearance of approaching some essential singularity in the history of the race beyond which human affairs, as we know them, could not continue' (Ulam 1958). Later Carl Sagan (1977) popularized the cosmic calendar to demonstrate the relatively early slow rates of change with life evolution but accelerating rates of change towards today. While the timescale of many events is somewhat known, some of the major questions in this history are not fully understood, namely, the nature of the Big Bang, the (dark) substance of the Universe, the origin of life, the meaning of consciousness, and the sustainability of technological civilization.

It is important to explore these topics and trends, not just to further understand our origin, but also to put into context our possible future scenarios, to interpret trends and help guide decisions by identifying options and possible consequences. Often civilizations at a smaller scale have failed to be sustainable because of their belief in the continuing expanding trends without regard to their marginal benefits (Tainter 1996).

So, we approach this topic, understanding the limitations of data, interpretation, and trend extrapolation. It is important to remember that the megatrend towards a singularity does not mean that the singularity will happen but instead there might be some limitations and changes in the trend. In this book we have various perspectives from those interpreting the continuing pattern as towards a technological singularity, a bounded logistic pattern, or no pattern at all (Modis 2020).

A Big History Context

To place the accelerating trend of complexity in the context of Big History we need to distinguish the two forms (arms) of megaevolution so far in the Universe. The first arm of megaevolution is the decelerating development of physical matter and energy into galaxies, stars, and planets from the initial Big Bang. The second one is the accelerating rate of complexity evolution in the form of life, humans, and civilizations, which is the main concern of our book (see Fig. 1). This increasing complexity requires additional information to overcome the second law of thermodynamics tendency towards thermal equilibrium (death). Instead it marches further from this natural equilibrium towards a stable disequilibrium (Nazaretyan 2005) maintained by a constant flow of energy under information control. This concept of complexity correlates with various definitions of complexity in mathematics, such as the minimum length of the text describing its structure.

Both arms proceed from combining two existing structures to form a new emergent structure. This process is known as aromorphosis (Grinin, Markov, and Korotayev 2011). Between these jumps of structure, there is a rather smooth evolutionary process. A complex system cannot arise 'from scratch'; such a system is always the result of combinations of systems of the previous level of evolution. Evolution is not engaged in strategic planning and preliminary calculation of its aromorphoses, it works only with the material that it already has at hand and can immediately use.

Trends

First the data are collected and analyzed. Surprisingly, much data seem to fit a relatively simple model, along with a high-level explanation (Korotayev 2020). The idea that in the near future we should expect 'the Singularity' has become quite popular recently, primarily thanks to the activities of Google technical director in the field of machine training Raymond Kurzweil and his book *The Singularity is Near* (Kurzweil 2012). It is shown that the mathematical analysis of the series of events, which starts with the emergence of our Galaxy and ends with the decoding of the DNA code, is indeed ideally described by an extremely simple mathematical function with a singularity approximately in 2029. This is similar to the earlier independent analysis by the Russian physicist Alexander Panov (2020). This function is also similar to the equation discovered in 1960 by Heinz von Foerster concerning the dynamics of the world population. All this indicates the existence of global macroevolutionary patterns covering the period of a few billion years, which can be surprisingly accurately described by extremely simple mathematical functions. However, there seems to be no reason to expect a continuation of this trend to an unprecedented acceleration of technological development near the time of the trends' Singularity. Instead, it is reasonable to interpret this point as an indication of an inflection point, after which the pace of global evolution will begin to systematically slowdown in the long term.

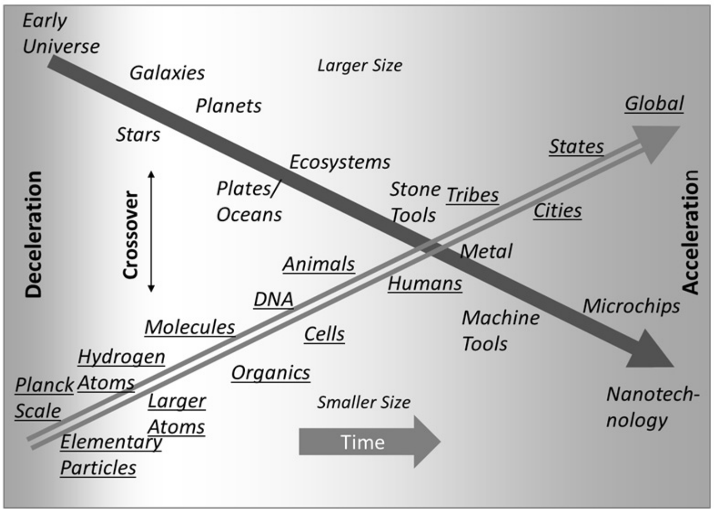

Fig. 1. Megaevolutionary processes in the Big History perspective. The arm starting at the bottom left shows increasing complexity. The other arm is the enabling system (natural or technological environment) in which it evolved. As the size of the increasingly complex objects grow, the smaller the system or tool involved. The first arm is the decelerating rate of events after the Big Bang up to the formation of planets. The second arm is the evolution of life, humans, and civilization. The line showing the construction of larger atoms (nuclei) by supernovae is a critical step leading to planets which enable the second arm to develop and accelerate

Other potential historical trends are discussed that include integrating long-range topics such as geology and biology as well as the potential for the trends' end with the complexity of developing Artificial Intelligence. If viewed as a complex adaptive system, there are expected to be patterns in related aspects such as energy flow and information (Chaisson 2001). The impact of human perception is raised to question the reality of these trends. However, the trend seems to facilitate understanding of these long time scales.

Models

Next, we consider potential models at various levels of abstraction. While the simplest, most mathematical, and abstract model is the modified exponential growth with collective learning leading to a hyperbolic form as presented in Fig. 2 (Korotayev 2020), there are many other aspects to consider. These aspects include the analogies to physical and social systems, more detail in the dynamics, questions about stochastic effects, and patterns that may continue beyond the unique singularity (or inflection time).

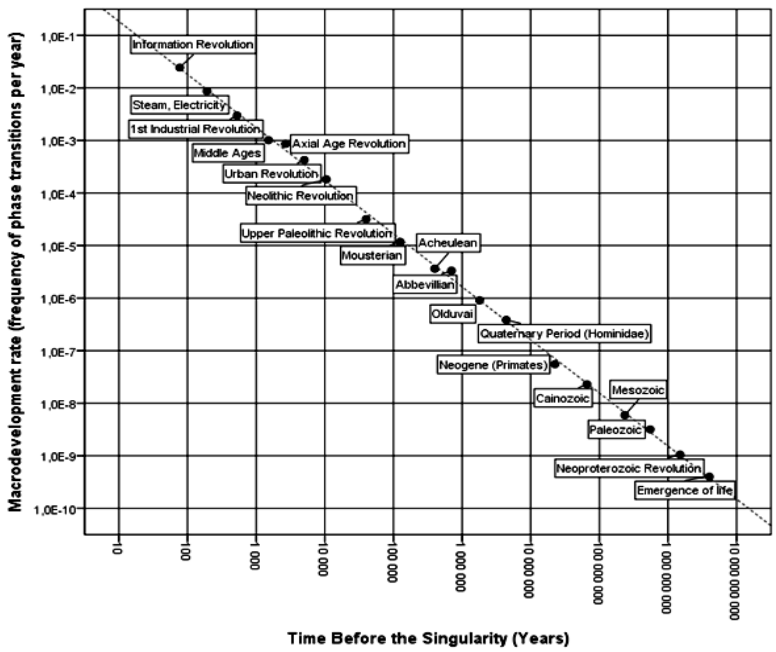

Fig. 2. Scatterplot of the phase transition points from Panov's list with the fitted power-law regression line (double logarithmic scale) – for the Singularity date identified as 2027 CE with the least squares method.

Debate continues whether the rate of change at the singularity will further accelerate, slowdown, or demonstrate other behavior (*e.g.*, flattening, collapse). Very basic questions about this historical trend concern the causes such as mathematical conditions of growth and factors like energy, environment, and information. Further details include determination of indications of the singularity's behavior (*e.g.*, time, number, type) and the pattern of substructure (*e.g.*, timing, transition characteristics) leading up to the singularity. Finally, possible extensions to the pattern are considered in cosmological history, near-term transition to sustainability, and construction of potential far-future scenarios and implications.

Future Implications

Potential future implications, scenarios, and actions are developed and presented. Future implications include effects of more integrated cyber and human (*i.e.*, cyborg) systems, initiatives like the Global Brain project and applications of new fundamental technologies, especially to medicine. Scenarios often include the potential for the rate of change to slow down due to increasing complexities or ageing due to demographic trends. Identified actions include educational awareness, greater international collaborative efforts, and application of strategic foresight. Insightful implications of a slowdown after a singularity might be the relative speed at which other similar civilizations progress. This leads to another possible hint at the resolution of the Fermi Paradox.

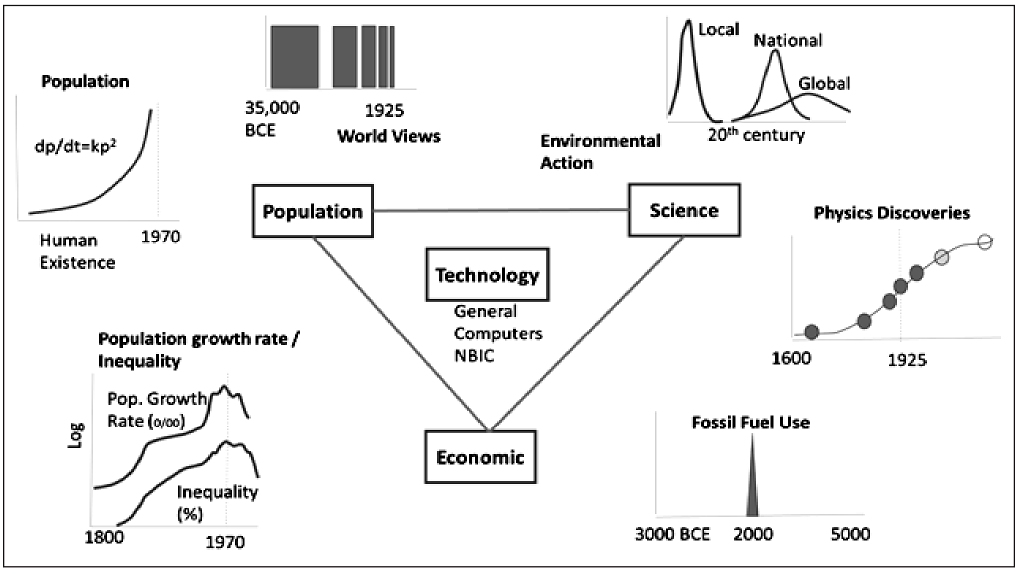

Fig. 3. Showing some of the topics and modelling approaches from demography, economics, and science all centered around technology. These include (from upper left, clockwise) population growth, worldview changes, environmental interest, science discoveries, depletion of fossil fuels, and correlations of population growth and inequality

Epistemology

The chapters of this part of the book seek to answer such questions as: Why can we know this trend? How is this related to our evolution of worldviews? How much is the matter of perception relevant? Can we divide the hyperbolic acceleration into major phases and logistic nested progress?

Conclusion

Every part of the book presents a brief summary of the findings and integrates them into a current perspective of approaches, issues, research gaps, implications, and controversies. The approaches include the way each of the trends were constructed and analyzed along with the critique and attempts at resolution as presented in other chapters. Research gaps were identified in many chapters including collection and validation of data, for example, energy flow throughout history. Implications are identified throughout the book including the way history is viewed, the way potential future scenarios are constructed and analyzed, and the potential for SETI efforts.

In general, it is shown that the study of the twenty-first-century Singularity allows detecting a number of sufficiently rigorous global macroevolutionary regularities (describing the evolution of complexity on our planet over a few billions of years), which can be surprisingly accurately described by extremely simple mathematical functions.

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