REVIEWS AND NOTES

FRESH LOOK AT THE GLOBAL HISTORY. A REVIEW OF 'THE 21ST CENTURY SINGULARITY AND GLOBAL FUTURES: A BIG HISTORY PERSPECTIVE'*

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Amazon Books lists seventy-five pages of books associated with the topic, singularity, and these range from a variety of fictional offerings to speculative entries of ambiguous focus to serious works of research scholarship. The edited book by Andrey Korotayev and David LePoire, *The 21st Century Singularity and Global Futures: A Big History Perspective* (2020), is the epitome of this last category of scholarly efforts. It is organized into a series of topics listed in sequence as: An Overview, Historical Megatrends, Models, Future Implications, Epistemology and Ontology, Perspectives and Perceptions, and a closing section, Conclusions. The contributing authors come from a wide range of scholarly backgrounds indicating the diversity of expertise being brought to bear on this timely and pressing topic. These are in no particular order: archeology, history including of course Big History, nuclear physics, systems research, informatics, cognitive science, education, mining science, and pediatrics. Collectively, this group of researchers brings both an eclectic focus and a depth of scholarship that are well adapted to analyze the state of knowledge on what may probably be one of the defining events of the 21st Century.

Dictionary definitions of *singularity* include: from mathematics – a point at which a function becomes infinite; with respect to humanity – a point of dramatic, irreversible change, and generically, a unique event, as in a *singular* event. In the initial section, 'An Overview' (Panov, LePoire, and Korotayev 2020), the topic of singularity is given a carefully described foundation, then reassessed to bring clarity to the reality of singular change, and finally given appropriate conditions under which such a change might occur and also the basis of future possibilities. The second offering in this section by Andrey Korotayev (2020b) is particularly important as it places the notion of singularity within a framework of macroevolutionary regularities. Here the author takes great pains to establish the relationship between differing scales of complex organization with respect to some elegant mathematics showing the commonness of hyperbolic growth, a form of growth characterizing much of the thinking in this volume, to those differing levels of organization, and which has embedded within its structure singularity as an endpoint.

Diversity of opinion is always required for depth of understanding, and the author of the first chapter, Theodore Modis (2020), ultimately suggests that forecasting a sin-

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gularity is 'pure speculation', possibly not a position accepted by other authors in this edition. However, Modis also describes the reality of the pattern of pre-singularity chaos followed by the singularity itself to be followed by further chaos, a pattern, the initial part of which very possibly (most probably) reflects our current world-system condition. The chapter by Modis leads a series of chapters, the first on trends in the context of Big History and hyperbolic evolutionary processes common from biology to technology, followed by a unique chapter by Sergei Tsirel (2020) on Big History and the Singularity as representing metaphors, hypotheses, and predictions. Succeeding this are chapters on informatics, on the end of the singularity, energy flow and its relationship to the upcoming singularity, and a deductive approach logically leading to the singularity as a predictable event.

The chapters by Tsirel (2020a) and by LePoire and Chandrankunnel (2020) merit further comment. Sergei Tsirel establishes a relationship between geological, biological, and societal evolution and in doing so emphasizes a sense of holism that is an underlying theme of the research in this book. Attention is drawn to changes in rates of megaevolutionary processes, the limits to those rates as influencing factors, and also the influence of hierarchical structure on the notion of singularity. David Le Poire and Mathew Chandrankunnel present energy flow as a necessary component of system evolution and the support of system structure. They then clearly bring the reader down to the reality of current system needs; kudos to this genuflection to reality. This chapter also makes a point of noting that increasing energy flow is necessary for the 'evolution of agency'. Agency here refers in a sense to the infrastructures of the system, its necessary information, organization, and complexity all at a minimum for system sustainability.

This largest of sections, Historical Megatrends, is followed by a much shorter section on the models that are applied or can be applied to study of singularities. But sometimes good things come in small packages. The good thing, if it can be expressed as a generic *thing*, is that, although there are only two chapters in this section, the good thing in question is the disparity between the two chapters, one a review of the indications of an impending singularity and the basic models used in the study of singularities, at least as they are understood in a Kurzweillian context, and the other, a unique look by one scholar of his perspective and perception of mathematized Big History trends; the first, by LePoire and Devezas (2020) on the Near-Term Indications and Models of a Singularity, and the second by Graeme D. Snooks (2020) dealing with the reality of a 21st Century Singularity. In the first chapter, Le Poire and Devezas review the mathematics applied to the study of singularities currently and then provide very basic evidence of the consequences of our human behavior that are potentially pushing us toward a singularity. Snooks takes an opposite view, taking great pains to establish a difference between what he believes are misapplied evidence to simple models of limited use. He then explains in great detail the significance of his approach and why it is genuinely revelatory; detailed empirical analysis revealing true trends which can then be applied to (again simple) mathematics, this in turn revealing history's true megatrend, an exponential one, not a hyperbolic one.

I am reminded here of Scott Page's admonition (Page 2017) to construct as many models of a given process/phenomenon as is (reasonably) possible, first, because all

models are wrong as a function of their incompleteness (Were models complete, they would not be models but the real thing!), and, second, because models coming from different mental perspectives may reveal different consequences of whatever is being modeled. Model incompleteness, *i.e.* the limitations of models, requires an understanding of their incompleteness cum limitations in order to further understand model functions and the appropriate model application. In light of this, both chapters should be read with the understanding that although oppositional, they both have the potential to reveal very useful information. (For a good, brief review of model limitations, see Chapter 1 of Richard Levins' (1968) *Evolution in Changing Environments*.)

In the following section on Future Implications there are eight chapters ranging in focus from Big History and its attendant singularity as a road map to humanity's future, to the establishment of a global brain post-singularity, to what post-singular development might be like. There are three that bear further comment and a recurrent theme that requires emphasis. To this theme first.

In the chapters of Bohan (2020) and Nazaretyan (2020; see also Nazaretyan 2017) there is strong reference to the role of Big History in education, first as an evidence-based model of historical change through time and as a preparator of sentient humans for the future. Embedded within this model of change over time is the notion of singularities. Akop Nazaretyan goes so far as to suggest a curriculum adapted to the needs of future generations post-singularity; Bohan suggests that transhumanism will be a function of the upcoming singularity and that Big History provides a plan in which to prepare for and be part of this post-singular future. Taking this a step further, Nazaretyan then suggests that his curriculum become global and do so in an incipient fashion by linking what he calls 'clubs' and universities. Learning is of course a mode of adaptation, especially to changing environments, and the establishment of a global brain a la Cadell Last's (2020) chapter.

The rate of technological change throughout history has accelerated, in many respects due to the positive feedback created by establishing a given technological paradigm. The Gutenberg printing press established a medium by which information could be spread in the western world at least much more rapidly and to a much broader audience. The current technological revolution is no different. In their chapter, 'Dynamics of the Current Technological Growth Rate and the Forthcoming Singularity', Grinin, Grinin, and Korotayev (2020) address rates of technological change within the context of developing theory, measurement of rates of change, and forecasts for the near future. With regard to theory, their presentation is both qualitative and quantitative, the latter being a mathematical structure. It should be noted that the mathematics in question distill to a simple hyperbolic relationship, one shared by a number of other research efforts in this chapter. The four production principles, hunter-gatherer, agrarian, industrial, and post-industrial or scientific-cybernetic production principle are described with the intent of establishing a context within which the approaching singularity can be understood. Following this blend of historical and mathematical analysis it is pointed out that rates of change will themselves change as the global population ages and develops what is called the Japanese Disease by the authors. They predict that the post-singularity future

will result in a more managed society; one that does not consume per se for consumptions sake.

Sergei Tsirel's (2020b) offering of the challenges that post-singularity technology will bring to humanity ends with an interesting model of a transitional economic structure in which the top 10 per cent of global society, the elites of science, politics, and economics will in a sense run the show. The next 50 per cent of post-Singularity humanity will be comprised of service occupations, including but not limited to education; the bottom 40 per cent, possibly not unlike the unnecessary people of the early Industrial Revolution, will perform jobs that could and will be easily roboticised. However, this social and economic structure will collapse in the face of a cybernetic and nanobiotechnology wave, in other words genetic modifications of the sort that are debated about currently with regard to their ethical and biological effects.

In a final chapter in this section, Alexander Panov (2020) gives the broadest and deepest predictions of what a post-singular world will be like. Scale invariance is the initial focus of the chapter and Panov gives credit to Snooks as a predecessor of scale invariance as it applies to Big History. However, Panov's scale invariance applies to phase changes as opposed to a log-linear array of the events of history. [Note here that the chapter of Widdowson (2020) and the final chapter by Korotayev (2020a) provide potential resolution to this problem of exponential versus hyperbolic growth as characteristic of Big History processes.] He then suggests a crisis in science is developing, as scientific pursuit will shift from discovery to application, and he also suggests that scientific pursuit in combination with a disembodied AI will be the new means of discovery. This in turn will allow post-singular humanity to meet what might be called *Homo sapiens*'s manifest destiny, a destiny that involves migration and colonization as part of their modus operandi. As such, Panov suggests that SETI level communication will become a possibility opening the door to new human vistas.

Also included in this last section are chapters by Leonid Grinin and Anton Grinin (2020) on the Cybernetic Singularity, the aforementioned chapter by Cadell Last (2020) on the Global Brain, an emergent phenomenon of our developing global interconnectedness, and a chapter by David Baker (2020) addressing the energetic consequences of increasing complexity, the end point of which Baker proposes not annihilation but possibly a 'Big Save' contra a 'Big Freeze' or 'Big Rip', due in fact to that increasing complexity.

Understanding the basis of knowledge of the research and how to access that knowledge related to the reality of the 21st Century Singularity are the bases of the penultimate section of this book. Six chapters are briefly reviewed.

The first chapter, 'Big History by Mathematics: Information, Energy, and the Singularity', by Claudio Maccone (2020) is not for the mathematically faint of heart, even though the authors assures readers that relatively simple mathematics are the core of his assertion in the article, i.e. $m_o \ln m_o \sim ts$, where m_o = the number of species alive today, and ts = time elapsed. They are; their derivation is not, admitted so by the author, who took ten years to develop his Evo-SETI Theory of which the previous equation is an end point. Even so, the author does a masterful job of relating what he labels Geometric Brownian Motion (GBM) to his Peak Locus Theorem and Shannon Entropy, using a *b*-

lognormal distribution, also of the author's creation, to develop his Evo-SETI Theory. There are some cautionary notes of a mathematical nature to be aware of. First, entropy is used as a measure of the evolved level of a given species; adaptation per se is not considered. Mass extinctions are considered to be wholly stochastic events, however, with respect to at least the middle three mass extinctions, the Devonian, Permo-Triassic, and Triassic, all associated with the breakup of Pangea, in retrospect, prediction, or rather postdiction, might be possible. One more concern, the author's assertion that there are 4000 extant genera +/– 1000 (p. 483) does not come near what systematists suggest as the number of extant genera today, i.e. > 500,000, not something that a reader should turn a blind eye to. Even so, whether the reader reads this chapter in detail of simply glosses over the more technical mathematics, Maccone has derived a potentially fundamental relationship between life on earth as represented by the number of extant species at any given time and the amount of time elapsed to that specific time; no mean feat.

The remaining five offerings are led by a thoroughly analytical resolution of the disparity between the data of Modis and Panov and a resolution of Panov's model with that of Korotayev. This analysis by Widdowson (2020), canalized by perception and perspective (Taken from the title of this chapter.), reaches the conclusion that Big History, although he does not use this term, is a series of logistics with inflection points leading to a successor logistic embedded within an overall logistic process. Malkov (2020) then shows that while hyperbolic patterns of growth may be common between biological and social systems, it is the rate or mode of change that is shared between those systems and not any commonness of a shared singularity. In Dobrolyubov's (2020) chapter the author accepts the general pattern of hyperbolic growth but questions the rate of change near the singularity point, recalling that Korotayev suggests a logistic pattern actually holds. With this in mind, Dobrolyubov goes on to develop a simple mathematical model that predicts a singularity specifically at 3930 CE. The contribution of John Torday (2020) is that evolution is the driver of Big History, and goes on to describe our niche constructing behavior as driving to the singularity. Underlying Torday's position if the imprint of the singularity/big bang, and the fact that evolutionary mechanisms originated from that point and are embedded within Big History. A final chapter by Andrey Korotayev (2020a) reviews the possibility of perception playing a role in the use of mathematics to identify the time of the upcoming singularity and clearly shows that the hyperbolic growth pattern is real. A brief section, 'Conclusion' (LePoire, Korotayev 2020), terminates the book and is a very even-handed summary of the problem of the singularity, the range of conclusions about the singularity, and a firm admission that there is much to learn.

In closing this review, I wish to salute all the scholars who have contributed to this remarkably diverse set of research, thoughtful speculation, and insight. Further, the chapters included within this book were clearly written for academic specialists; however, all of this book is accessible to the informed general public. This is a remarkable feat in that, from this reviewer's perspective, the entire populace of the planet will be affected by the continuing rush of technology and the effects of that rush on economics, politics, and culture, and to have some source of near-term analysis of the potential for

the singularity available to an audience beyond a particular academic circle is academic openness at its best.

NOTES

[*] Korotayev, A. V., LePoire, D. (Eds.). The 21st century Singularity and global futures. A Big History perspective. Springer, Cham, 2020. 620 p. ISBN 978-3-030-33729-2. URL: https://doi.org/10.1007/978-3-030-33730-8.

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