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Big History and Astrobiology

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Book Review

Introduction to the Special Issue on *Expanding Worldviews: Astrobiology, Big History, and the Social and Intellectual Benefits of the Cosmic Perspective*

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Big history and astrobiology are two relatively new academic disciplines, the former aiming to integrate human history with the wider history of the universe, and the latter searching for life elsewhere in that universe. Despite differences in emphasis, these two disciplines share much in common, especially their interdisciplinarity and the cosmic and evolutionary perspectives that they both engender. To explore these relationships, and to investigate their wider societal implications, a one-day meeting on the theme of 'Expanding Worldviews: Astrobiology, Big History, and the Social and Intellectual Benefits of the Cosmic Perspective' was held on 19 July 2018 under the auspices of the Humanities Research Centre at the Australian National University.[1]

This special issue of the *Journal of Big History* contains the peer-reviewed versions of seven papers presented at that meeting (i.e. those by Elise Bohan, David Christian, Ian Crawford, Chris Hamer, Charley Lineweaver, Mark Lupisella and John Stewart), together with three additional papers (by Charley Lineweaver & Aditya Chopra, Fred Spier, and Joseph Voros) that were inspired by the theme of the meeting. The participants at the meeting also contributed to original research through interdisciplinary discussion and intellectual synthesis. This is reflected in the diverse range of content and styles of the published papers. Whereas some of these papers present the results of original research, others are more subjective and offer personal reflections and/or original interpretations of previously published work. Taken together, they provide a broad, if eclectic, overview of the interactions of big history and astrobiology and their wider implications for society.

Acknowledgements

I thank all the authors for contributing to this special issue of the Journal of Big History. I also thank the Humanities Research Centre at the Australian National University, and especially Professor Will Christie and Ms Penny Brew, for hosting the meeting on which it is based. I would also like to thank the editor of *JBH*, Professor Lowell Gustafson, for offering to host these papers, and the anonymous reviewers who offered very useful suggestions.

1. For a published summary of the meeting, see: Crawford, I.A., "Big History and the Cosmic Perspective," *Astronomy and Geophysics* 59, 5.33-5.36 (2018). Available on-line at: https://www.researchgate.net/publication/327766260_Big_History_and_the_Cosmic_Perspective

"The keen longing for unified, all-embracing knowledge": Big History, Cosmic Evolution, and New Research Agendas[1]

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Abstract: This article offers an interpretation of recent attempts at the unification of knowledge. It argues that today's scholarly world is aberrant. It is splintered into distinct scholarly disciplines to such an extent that universities and research institutes have lost what Erwin Schrödinger called "the keen longing for unified, all-embracing knowledge." In contrast, most earlier human societies have valued the search for an underlying unity to human knowledge, a unity that was both conceptual and narrative, and often took the form of "origin stories". Unifying knowledge on the basis of modern science was also one of the central projects for the Enlightenment and for many nineteenth century thinkers. But at the beginning of the twentieth century, in every country in the world, knowledge was broken up into disciplines, to such an extent that most educators and researchers lost sight of the ancient hope of seeking an underlying unity to all knowledge. The essay describes the fragmentation of knowledge in the twentieth century and discusses reasons for that sea-change in the modern knowledge system. But it also argues that the period of extreme disciplinarity, in which the disciplines blocked the free flow of ideas between disciplines, may prove short-lived. The emerging transdisciplinary fields of "Big History" or "Cosmic Evolution" may herald a general scholarly return to a more balanced relationship between detailed research and the quest for large, unifying frameworks.[2] This paper ends by speculating about how a return to the project of unifying knowledge may transform education, research agendas, and the institutions within which they take place.[3]

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Charles Darwin:
From my early youth I have had the strongest desire to understand or explain whatever I observed — that is, to group all facts under some general laws. [*Autobiography*]

Erwin Schrödinger:
We have inherited from our forefathers the keen longing for unified, all-embracing knowledge. The very name given to the highest institutions of learning reminds us, that from antiquity and throughout many centuries the universal aspect has been the only one to be given full credit.[4]
[*What is Life?*]

Introduction:

The epigraphs capture the central claim of this essay: that good education and research depend on a balance between detail and generality, between sharply-focused research, and the unifying intellectual frameworks that help us make sense of, and find meaning in, detailed research.

When Darwin wrote, the need for such a balance was well understood, and his own career offers a spectacular example of the extraordinary synergies that can be generated by connecting detailed research to deep, unifying ideas. Schrödinger wrote just after World War II, when scholars in most fields had

abandoned the search for unifying ideas. His comment is a plea to re-establish a lost balance.

Today, we still live in an unbalanced scholarly world in which research normally means sharply focussed enquiry within the boundaries of particular disciplines. In such a world, research that tries to link ideas across many disciplines looks extreme, and (a bit like extreme sports) it can seem over-ambitious and unrealistic. But such projects seem extreme today only because of the emergence, early in the twentieth century, of structures that partitioned teaching and research between distinct scholarly disciplines. That change was so swift and so decisive that today few scholars show any interest in the unifying projects that were once the complement to all detailed research.

Coherent worlds of Knowledge before the twentieth century

So complete was the disappearance of the ancient quest for intellectual unity and harmony, that it can come as a shock to realize how important such unifying projects were for much of human intellectual history, and how recently they lost their centrality in most fields of scholarship.

Almost all human societies have constructed origin stories or creation myths: large, inter-linked collections of stories that summarize a community's best understanding of how things came to be as they are, by harmonizing many different types of knowledge.[5] Whether in small-scale societies with ancient oral traditions built up over many generations, or in societies with writing and institutionalized religious traditions, origin stories were powerful because they summed over a society's core understandings of reality. Origin stories shaped identities because they told you who you were, what you were part of, what roles you could play, and what roles you should play, so they usually structured how young people were educated.[6] As Marie-Louise von Franz argues, Creation Myths: "… refer to the most basic problems of human life, for they are concerned with the ultimate meaning, not only of our existence, but of the existence of the whole cosmos."[7] To take one random illustration, the thought world of Isaac Newton was framed from childhood to old age by the origin stories embedded within Christianity, and Newton's science flourished within these unifying stories. He thought of God as the "first cause", and once described the Universe as "the Sensorium of a Being incorporeal, living, and intelligent."[8]

It is important to avoid the common error of assuming that unifying projects must suppress diversity and dissidence. This was never true. Origin stories were always capacious enough to allow for disagreement. Isaac Newton, though a devout Christian, opposed the doctrine of the Trinity and was, technically (and discreetly) an "Arian", a denier of Christ's divinity.[9] Similar tensions existed within all origin stories, and all religious and philosophical traditions. Indeed, as with modern scientific paradigms, it was the sharing of fundamental ideas that gave salience and significance to differences in interpretation, and sometimes made them worth fighting over. Modern descriptions of all "grand narratives" or unifying projects as necessarily monolithic and unchanging are simplistic caricatures.[10]

As modern science emerged, it re-directed the quest for intellectual harmony and unity. The pioneers of modern science, and the major thinkers of the Enlightenment era, aspired to a new understanding of reality, and origin stories that would be based not on tradition, faith or authority, but on Reason and empirical research. "[W]e in effect propose a compleat system of the sciences," wrote David Hume, "built on a foundation almost entirely new, and the only one upon which they can stand with any security."[11] Science, they believed, would set new standards for reliable knowledge, and release humanity from naïve trust in faith or authority. "Enlightenment," wrote Immanuel Kant, "is man's release from his self-incurred tutelage [literally, Unmündigkeit, or "minority"]… [his]

inability to make use of his understanding without direction from another. … Sapere aude! 'Have courage to use your own reason!'- that is the motto of enlightenment."[12] Most Enlightenment thinkers were convinced that a better and more coherent understanding of reality would advance the progress of humanity as a whole.[13]

It is possible to identify two overlapping colours or qualities to the Enlightenment's unifying project, and it may be that the same two colours can be identified in all origin stories.[14] The first approach emphasises historical or narrative coherence, so it tends to take the form of stories or histories. It assembles diverse types of knowledge, like so many coloured tiles or pixels, into coherent accounts of how things came to be. Such narratives can be found at the heart of most religious traditions. The second approach can also yield large unifying narratives, but its primary emphasis is on conceptual unity, on the search for networks of ideas that are locked together tightly enough to provide a foundation for most of knowledge. Traditionally, this approach has shaped much theological, philosophical and mathematical thought, and today it can be found in unifying ideas such as General Relativity or Quantum Physics. The two approaches have always overlapped and reinforced each other. Thus, all the world religions contain large stories linked to logically rigorous foundational systems of ideas about how the Universe works.

The search for a science-based origin story flourished in Europe from the early eighteenth century. The search for conceptual unification drove the great intellectual systems of the nineteenth century, those of Hegel, Comte, Marx, Spenser and many others, though most of these systems also generated grand historical narratives. The emphasis on narrative unity shaped the natural histories of Buffon or the Universal histories of Voltaire, as well as nineteenth century universal histories, such as Alexander von Humboldt's multi-volume Kosmos, or Robert Chambers' Vestiges of the Natural History of Creation, which would have a profound influence on Charles Darwin.[15] The deep desire to keep in touch with the underlying unity of life and the universe also drove much of the Romantic reaction against what many saw as the arid scientism and the extreme focus on detail of some scientific thought.

The quest for intellectual unity still flourished in the late nineteenth century, in both its conceptual and narrative forms. While James Clerk Maxwell showed that electricity and magnetism were different expressions of the same underlying force, the historian, Leopold von Ranke (often thought of as the primary exemplar of small-scaled historical research) warned against "the danger of losing sight of the universal, of the type of knowledge everyone desires. For history is not simply an academic subject: the knowledge of the history of mankind should be a common property of humanity …."[16]

The Fragmented Knowledge World of the twentieth century

Early in the twentieth century, the unifying project vanished like a ghost at dawn. And it vanished so completely that, a century later, it is easy to forget how normal such projects once seemed. Two decades into the twentieth century, most scholarship and research was conducted within the well-policed borders of particular scholarly disciplines, and fewer and fewer scholars were willing or able to look for harmonizing concepts or stories that crossed multiple disciplines.[17] Those that tried, such as H.G. Wells, were widely regarded as dilettantes, and had little impact on the academy. Suddenly, except in areas such as Physics, where unifying paradigm ideas such as General Relativity flourished, interdisciplinary research and scholarship began to seem extravagant, wasteful and unnecessary: a quaint intellectual hangover from an era in which scholars had not yet grasped their impossibility.

For most of the twentieth century, scholars and researchers inhabited an intellectual world whose borders were as well patrolled as those of modern nation states. An influential 1972 OECD report on interdisciplinarity noted the exclusivity and competitiveness of these new intellectual statelets. Each discipline, it argued, consisted of: "A specific body of teachable knowledge with its own background of education, training, procedures, methods and content areas," and its own well-defined territories, interests, rituals and leaders, so that they often functioned like "autonomous fiefdoms".[18]

The idea of distinct scholarly disciplines is old, of course, as old as the first attempts to describe and certify specialist knowledge and skills. But in the narrower sense referred to here, "disciplines" emerged in the late nineteenth century, along with modern research universities.[19] German universities pioneered today's combination of research and teaching within well-defined discipline borders. But the model was soon copied elsewhere, and, in the early twentieth century it spread throughout the world.

> By the end of the nineteenth century a worldwide revolution in practice was beginning, …. The desire to emulate German universities led to the modern university in one country after another. Disciplines developed in association with licensing regulations or their de facto surrogates, and disciplinary organizations developed to define portions of academic turf. By 1910 the modern disciplines, and the modern research university, had been defined.[20]

In many ways, the turn towards extreme disciplinarity was a success. The disciplines provided containers for research agendas that might otherwise have grown unmanageably. Within those safe spaces, research flourished throughout the twentieth century.

But the achievements came at a cost. Discipline-based research flourished, a bit like potted plants, because it was confined. Where thought threatened to sprawl unmanageably, the disciplines pruned over-reaching branches and root systems, creating the intellectual equivalent of a bonsai garden. As Fred Spier puts it: "In the real world, everything has remained connected with everything else. As a result of the ongoing 'disciplinification' of universities, however, this important insight, familiar enough to Alexander von Humboldt, was lost."[21] Modern education blinkered the educated, creating the world of mutually uncomprehending scholarly tribes that C.P. Snow lamented in his famous 1959 Rede lecture on "The Two Cultures". In 1963, Snow wrote:

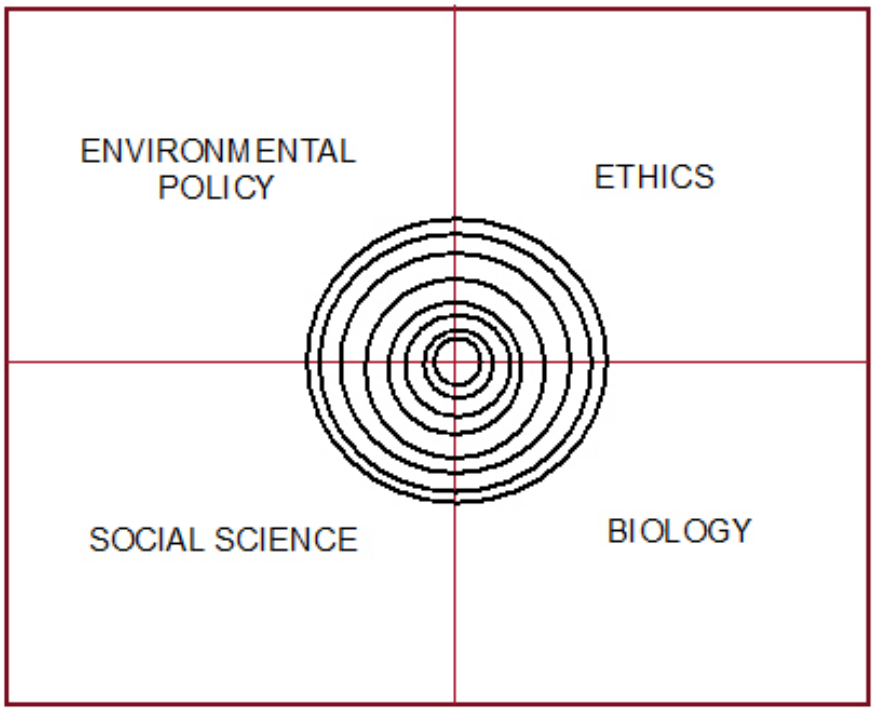
> Persons educated with the greatest intensity we know can no longer communicate with each other on the plane of their major intellectual concern. This is serious for our creative, intellectual and, above all, our normal life. It is leading us to interpret the past wrongly, to misjudge the present, and to deny our hopes of the future. It is making it difficult or impossible for us to take good action.[22]

In such a world, as Martin Kemp wrote: "a gulf of understanding has opened up by the time students enter university."[23]

The problem is not so much the existence of disciplines, as the fact that the disciplines have tended to block the free movement of ideas. In 1998, E.O. Wilson argued that the borders between disciplines were blocking fundamental research in many areas. The success of research within disciplines was creating more and more dead zones between disciplines, where new questions accumulated only to be ignored by discipline-based researchers, until they withered in an academic no-man's land of extreme aridity. Wilson used a diagram to make the point.

Here, each quadrant represents a distinct research world, with its own rules, its own criteria for good research, its own funding mechanisms, journals, and

Why Consilience is difficult:
a diagram adapted from E.O. Wilson, *Consilience*, p. 8



measures of prestige and success. But, he wrote, close to the borders between disciplines, "we find ourselves in an increasingly unstable and disorienting region. The ring closest to the intersection, where most real-world problems exist, is the one in which fundamental analysis is most needed."[24] Though vibrant and productive within their boundaries, the disciplines were creating intellectual dead zones at their borders. Insert into Wilson's diagram other disciplines such as Anthropology, Neuroscience, History, and Primatology and you find, in the dead zone at their borders, the most fundamental question of all for the Humanities: what is it that defines our own species and explains why we are so unusual?

What explains this sudden fragmentation of knowledge that both empowered and limited education and research for a century? Increasing government management of education and research, driven by the increased role of governments during the world wars, encouraged a focus on specific problems and a high degree of institutional compartmentalization. But two other powerful forces were also at work: the spectacular increase in new information in the 19th century; and scepticism about the failure of earlier attempts at intellectual unification.

Today, it is easy to forget how terrifying and destabilizing was the tsunami of new knowledge created by the earthquake of industrialization. In a famous passage in the Communist Manifesto, Marx and Engels wrote: "All fixed, fast-frozen relations, with their train of ancient and venerable prejudices and opinions, are swept away, all new-formed ones become antiquated before they can ossify. All that is solid melts into air, all that is holy is profaned,…" No universal systems or stories seemed robust enough to survive unscathed in a world of such intellectual turmoil, none of the ancient religious or philosophical systems, and not even the more modern systems of the great Enlightenment thinkers. The disciplines provided intellectual shelters from the hurricane of new knowledge.

The second reason for abandoning the unifying projects of the Enlightenment was that none of these projects really worked. The success of Newton's system was not matched in history or sociology or even in the sciences, and early in the twentieth century Einstein showed that even Newton's physics

needed adjusting. Besides, the French Revolutionary Terror, and the bloody history of the nineteenth century undermined the Enlightenment's intellectual optimism, by showing that Reason, science and new types of knowledge could serve oppression as well as progress. Scepticism was magnified by the world wars of the early twentieth century and the rise of totalitarian systems sustained by science and claiming to be built on Reason. One of the most influential modern critiques of Enlightenment thought, Horkheimer and Adorno's Dialectic of Enlightenment, was written in the shadow of the Nazi death camps, which had put modern scientific knowledge to the most evil of ends.[25]

In retrospect, most of the large nineteenth century systems and unifying stories do indeed look more like ideologies than science. That was because the science behind them was too thin to build robust intellectual systems, and had to be padded out with much speculative wadding. Though the nineteenth century did yield powerful unifying ideas, such as Darwin's theory of evolution, or Maxwell's unification of electricity and magnetism, there also appeared many pseudo-scientific systems of thought, such as phrenology, or Social Darwinism. These undermined the credibility of the Enlightenment project, and encouraged a turning away from unifying schema towards less ambitious scholarly agendas. The retreat from unifying projects was almost universal in the Humanities disciplines, which lacked the paradigm ideas that kept hopes of unification alive in the natural sciences. Historians reacted against the "scientific history" of Marx and his followers. And Anthropologists turned away from pseudo-scientific accounts of human progress, towards detailed studies of particular cultures. "In cleansing historical and cultural analysis of their nineteenth-century ideological baggage," write Shryock and Smail, "most of the high modern (and postmodern) versions of cultural anthropology and history turned their backs on the deep human past …"[26]

But the structure of distinct disciplines inhibited the search for deep unifying ideas even in the natural sciences. In 1944, Erwin Schrödinger wrote:

> … the spread, both in width and depth, of the multifarious branches of knowledge during the last hundred odd years has confronted us with a queer dilemma. We feel clearly that we are only now beginning to acquire reliable material for welding together the sum total of all that is known into a whole; but, on the other hand, it has become next to impossible for a single mind fully to command more than a small specialized portion of it.[27]

Critiques of hyper-disciplinarity

As this passage suggests, there survived within the fragmented world of distinct scholarly disciplines a deep nostalgia for a lost world of intellectual cohesion. And it may be that the ideal of some sort of universalism survived better beyond the Atlantic world. Marxist traditions in the Soviet Union and China preserved the ideal of universal knowledge, though in forms that were archaic and constricted by censorship; but survival of the ideal may help explain the profoundly inter-disciplinary ideas of Soviet astrobiologists such as Iosif Shklovksy, and geologists such as Vladimir Vernadsky, who pioneered the idea of a biosphere.[28] And small numbers of scholars in many different parts of the world continued to insist on the importance of transcending discipline boundaries and preserving a sense of the underlying unity of knowledge and research.[29]

In the early twentieth century, and particularly in the Atlantic world, nostalgia for some sort of intellectual coherence shaped much modern art, literature, philosophy and scholarship. Yeats' poem, "The Second Coming", captures that nostalgia and the terror of living in a world without intellectual unity or meaning.

> Turning and turning in the widening gyre
> The falcon cannot hear the falconer;
> Things fall apart; the centre cannot hold;

> Mere anarchy is loosed upon the world,
> The blood-dimmed tide is loosed, and everywhere
> The ceremony of innocence is drowned;
> The best lack all conviction, while the worst
> Are full of passionate intensity.

The yearning for a lost intellectual unity drove many scholarly attempts to cross disciplinary borders, but few made much headway because there was now little institutional support for genuinely transdisciplinary research, particularly in Europe and North America. Erwin Schrödinger wrote, forlornly:

> I can see no other escape from this dilemma (lest our true aim be lost for ever) than that some of us should venture to embark on a synthesis of facts and theories, albeit with second-hand and incomplete knowledge of some of them–and at the risk of making fools of ourselves.[30]

By the middle of the twentieth century, education, scholarship and research were so deeply embedded within the matrix of disciplines that even the most successful attempts at unification were no longer seen as unifying projects, but as attempts to travel between disciplines. It was the disciplines that now seemed fundamental rather than the networks of knowledge that linked them. Their borders seemed to map reality itself. As Wordsworth, a lifelong seeker of unity, wrote in *The Prelude* (Book 2):

> In weakness we create distinctions, then
> Deem that our puny boundaries are things
> Which we perceive, and not which we have made.

Attempts to unify knowledge were increasingly described as "interdisciplinary research". Interest in interdisciplinary research blossomed in the 1960s. The 1972 OECD report on interdisciplinarity that has already been mentioned argued that scepticism about science arose from "specialised applications of knowledge, without a corresponding development of the synthesising framework which can illuminate their side-effects and long-term implications."[31] Interest in interdisciplinary research was also driven by new research areas, such as genetics or gender studies, that overflowed existing disciplinary boundaries.

There were also some spectacular examples of the synergies that could be released by interdisciplinary expeditions. Erwin Schrödinger's attempt to cross disciplines in his book, What is Life?, provides a good example. Here was a physicist writing about a fundamental problem in biology. Schrödinger argued that life and reproduction must involve a sort of coding in large molecules, in which a small number of components could be arranged and re-arranged like letters in an alphabet. He suggested, therefore, that the chromosomes inside cell nuclei might each consist of what he called "an aperiodic crystal or solid".[32] That idea inspired a generation of biologists, including the discoverers of the structure of DNA. Indeed, Francis Crick, though originally a physicist, switched to biology and origin-of-life research after reading Schrödinger's book.[33]

By the 1970s, there were increasing demands for more interdisciplinary research. The first major conclusion of the influential 1972 OECD report on interdisciplinarity was that: "Interdisciplinary teaching and research are the key innovation points in universities," in part because interdisciplinarity can "help the drift of science and research towards unity". But the report's second major conclusion was that the scholarly disciplines made the quest for unity extremely difficult. "Introducing this innovation comes up against enormous difficulties …", above all because of "The organization of universities into monodisciplinary Schools or 'Faculties' which jealously protect their branch of knowledge …"[34]

The mid twentieth century vogue for interdisciplinarity generated new university and research structures and spawned new composite disciplines, such as biochemistry or environmental science. And that is why, today, some forms of

interdisciplinary research are familiar and well-funded. But the return to unifying projects was hesitant, partial and limited, and took several different forms. New typologies were constructed to describe different degrees of interdisciplinarity. The most widely used categories have been "Multidisciplinarity", "Interdisciplinarity" (in a non- generic sense) and "Transdisciplinarity".[35]

"Multidisciplinarity" refers to a loose linking of disciplines, often around a common problem or research agenda, while the individual disciplines "… continue to speak as separate voices in encyclopedic alignment. Underlying assumptions are not examined and the status quo remains intact." "Interdisciplinarity" refers to a closer integration of disciplines that: "integrates separate data, methods, tools, concepts theories and perspectives in order to answer a question, solve a problem, or address a topic that is too broad or complex to be dealt with by one discipline. … in interdisciplinary fields a new body of knowledge emerges."[36]

Finally, "Transdisciplinarity" takes us even closer to the unifying projects of the Enlightenment. Transdisciplinarity refers to an even closer integration of methods and insights from different disciplines that points towards "an over-arching synthesis that transcends the narrow scope of disciplinary worldviews."[37] Julie Klein describes the most ambitious forms of transciplinarity as: "… the epistemological quest for systematic integration of knowledge".[38] In a world of disciplinary fiefdoms, transdisciplinarity, the most integrated form of interdisciplinary scholarship, made the least headway. It remains rare and poorly funded, and has had a limited impact on most of the Academy, despite the existence of some specially designed transdisciplinary institutions such as the Santa Fe Institute for Complexity studies.

The re-emergence of unifying projects from the late twentieth century

Despite all this, in the late twentieth century and early twenty first century there have been some promising signs of a return to the unifying projects of the past.

Transdisciplinary thought and research made most headway in the Natural Sciences, where they were buoyed by new paradigm ideas, including Big Bang Cosmology, the Standard Model of Particle Physics, Plate Tectonics and the modern Darwinian synthesis.[39] Some scientists even began to dream of super-paradigms or "Grand Unified Theories" that would capture the fundamental rules by which our Universe was constructed. But the new paradigms also encouraged the quest for narrative coherence, because they were all historical in nature. They all described how the Universe, planet earth, and life had evolved over vast periods of time. The Harvard astronomer, Harlow Shapley (who once described the splitting of knowledge between disciplines as "education-defeating"), advocated for university curricula that: "would present the history of the universe and mankind as deduced from geology, cosmogony, paleontology, anthropology, comparative neurology, political history, and so on. … wide integration is the essential key."[40] And he was as good as his word, teaching such courses at Harvard for several decades, before his successor, Carl Sagan, built from them a wildly popular television series, "Cosmos".[41] Similar courses were taught in the Soviet Union by Iosif Shklovksy, in France by Hubert Reeves, and in Austria by Erich Jantsch.[42]

In the late twentieth century, several scientists wrote synthetic works that combined conceptual and narrative coherence over large areas of knowledge. They included histories of the earth by Preston Cloud, histories of the universe by the astronomers, George Field and Eric Chaisson, and the astrophysicists, Erich Jantsch and Siegfried Kutter.[43] In the 1990s, Eric

Chaisson wrote a history of the universe built around the central theme of increasing complexity, driven by increasingly dense flows of energy.[44] He called his unifying project "Cosmic Evolution", using a phrase first introduced in the late 1970s by George Field.[45] Fred Spier would later offer a theory of universal history that focussed on the emergence of "regimes" or semi-stable structures of many different kinds, an idea that had been partially prefigured in the work of Erich Jantsch.[46]

Scholars in the Humanities took longer to embark on serious transdisciplinary journeys, partly because the Humanities did not generate paradigm ideas as persuasive as those that emerged within the Natural Sciences. The unifying ideas that did emerge within disciplines such as Economics or Sociology or Archaeology were always contested, unlike some of the big ideas in the natural sciences, which were so widely accepted that they achieved the status of Kuhnian paradigms.[47] The "pre-paradigm" nature of most Humanities disciplines encouraged a focus on specifics, and a deep scepticism about attempts at intellectual unification, or the construction of "grand narratives".

Nevertheless, even in the Humanities disciplines, there were large, general problems, such as the rapidly increasing human impact on the biosphere, that encouraged some researchers to travel tentatively between disciplines.[48] And the historical narratives emerging within the natural sciences encouraged some scholars to seek links between their own historical narratives and the large-scale narratives emerging within Cosmology, Geology and Palaeontology. Though most historians remained sceptical of the idea of universal history, fearing a return to the unsuccessful historical schema of the nineteenth century, some were attracted by the challenge of linking human history to the emerging histories of the biosphere, planet earth and the Universe as a whole. They were inspired, not only by the new unifying narratives being constructed within the natural sciences, but also by the fact that the science was so much richer and more rigorous than it had been in the nineteenth century. That encouraged hopes for unifying stories free of most of the non-scientific intellectual baggage of the less successful nineteenth century systems.

New dating methods also transformed the task of constructing universal histories. When H.G. Wells wrote a history of the Universe in the 1920s, he could offer no reliable absolute dates for any event before the first Greek Olympiad. All earlier events disappeared into a chronological fog. In the 1950s, new dating techniques were developed, based on the breakdown of radioactive materials. Radiometric dating allowed the construction of reliable chronologies reaching, eventually, to the origins of the Universe. These dates provided the chronological spine for a rigorous, science-based modern origin story.[49]

To scholars from the Humanities, unification meant, almost inevitably, narrative unification rather than the conceptual unification sought by scholars in the natural sciences. For scholars in the Humanities, the challenge was to link stories told in many different disciplines into a coherent universal account of the past. What larger plot lines could be seen, and what new themes and forms of coherence would emerge if you tried to weave together the stories told by cosmologists, astronomers, geologists, biochemists, palaeontologists, anthropologists and historians?

My own experience of approaching these challenges as a historian may be fairly typical. When I first tried to teach a big history course embracing the whole of time, in 1989, I invited scholars from many different disciplines to lecture on the core ideas of their disciplines. My colleagues and I watched to see what would come out of the mix. What we got was a brilliant tour of modern paradigms alongside a rather loose account of human history. But the stories did not cohere, because lecturers spoke to the major themes

of their disciplines, used the methods and jargon with which they were familiar, and had little time to build bridges between disciplines. I began to fear that big history courses would remain "interdisciplinary" in the most limited sense. They could not transcend the disciplines, and could, at best, serve up a sort of intellectual smorgasbord.

Over several years, though, broader plot-lines and a deeper coherence began to appear. It became apparent that one major narrative theme was the emergence of many forms of complexity, at many different scales, from galaxies to viruses to human civilizations. That theme raised deep questions about the creativity of the Universe as a whole, and about the relationship between complexity in the human world and complexity in the biosphere and the Universe as a whole. Watching unifying themes emerge over several years was a bit like watching a developing photograph in the chemical bath of a traditional photographic dark room. And the gradual appearance of unifying themes showed that the difficulties of seeking unified knowledge arose not from the intrinsic difficulties of the project, so much as from the habits of thought that dominated a world of distinct scholarly disciplines.

Since the late twentieth century, many scholars have taken up the challenge of constructing "big histories" or modern origin stories, and they have done so in many different parts of the world which suggests that there is an emerging "global conjuncture" around the idea of such projects.[50] Today, there is a growing scholarly literature on big history, and big history courses are being taught in a number of universities, mostly in the USA, Australia and the Netherlands. Online courses in big history have also been developed for high schools, through the "Big History Project" (generously supported by Bill Gates) and, in 2018, through "Big History School" (supported by Macquarie University), which includes a Primary School curriculum in big history.[51]

New transdisciplinary projects and new research agendas

The final section of this essay is frankly speculative. If the changes described in the previous section are early signs of a scholarly return to more transdisciplinary research and thought, what impact will this have on the research landscape?

A world in which the unification of knowledge is taken seriously will be intellectually more balanced than today's world. The disciplines will survive, not just because of institutional inertia, but also because they serve many useful functions. And they will continue to shape research at smaller scales. But as transdisciplinary research becomes more important, the disciplines will have to become more sensitive to developments in neighbouring fields and in scholarship as a whole. Disciplinary boundaries will have to become more flexible, more permeable and more open to transformative changes.

To support, fund, and offer career paths to the increasing number of scholars drawn to transdisciplinary problems, new institutions will be needed to link disciplines and encourage more traffic between them. Amongst those most drawn to unifying projects, something of C.P. Snow's distinction between the cultures of the sciences and humanities will surely survive. But the differences will no longer arise from mutual incomprehension, but rather from sustained dialogue, in which some scholars will focus mainly on the narrative coherence between different fields, while others focus on the conceptual challenge of teasing out unifying paradigms.

A more unified knowledge world will transform school syllabi. But the changes need not be complex, and most of the existing infrastructure of education will remain in place. Most traditional disciplines will survive. But new, unifying disciplines will emerge, such as "Big History", which can help students see the underlying coherence of modern knowledge, and

the many links between traditional disciplines. Such courses already exist and they offer students the metaphorical equivalent of a journey to the top of the mountain, from where they can see more clearly what links different disciplines as well as what divides them. If such courses were to become standard components of school curricula throughout the world, they could provide students, as traditional origin stories once did, with a coherent vision that they could take with them into adult life.

In Universities, too, teaching within existing disciplines will no longer create intellectual blinkers if students are also exposed to courses that help them see the unity beneath modern disciplines. Such courses are already being taught in many universities, and there already exist rich resources, both printed and electronic, to support their teaching.

A return to the unifying project of the Enlightenment may have its greatest impact in advanced research environments, which is where they have had the least impact so far. Today, scholars attracted by the challenges of transdisciplinary research struggle to gain recognition, to raise funding, and to find scholarly support. But a world that takes such projects more seriously will surely take more seriously the intellectual and institutional challenges faced by those researchers most interested in transdisciplinary research.

What will unifying research projects look like? We already have some answers because paradigm builders such as Darwin and Einstein have shown that there are deep, powerful unifying ideas waiting to be discovered by those who look for them. And there are areas of research where the need for unifying ideas is apparent to everyone, such as the challenge of linking Relativity Theory and Quantum Theory. Both theories work spectacularly well, yet one assumes a granular universe while the other does not. What are we missing? In the Humanities, the question that may drive unifying agendas most powerfully concerns the distinctiveness of our own species. What makes humans different, so different that our species is now dominating change in the biosphere?[52]

These large questions offer good models for unifying research in general, because to pursue them, scholars will have to link methods, insights, concepts, terminology and perspectives from many different disciplines. Their task will be to translate between disciplines. Can you translate the concept of entropy, which does extraordinarily powerful work in the natural sciences, into the Humanities? Is the historian's "decline and fall" similar to the physicist's "entropy"? Is there enough common ground between the two concepts that, with some tweaking we may find ways of describing entropy that can inform research in the humanities? Much the same is true of concepts like information (do acoustic engineers, quantum theorists, geneticists and historians mean the same thing when they use the word?), or complexity, or energy.

The task is also to tweak how concepts are used at different scales, because many concepts work well at some scales and less well at others.[53] One of the most fundamental problems in contemporary science is how to make Quantum Physics work not just at the atomic scale but also at the cosmological scales of relativity? For the historian, concepts such as energy or information are too general to be helpful in most types of historical research, so the abstract concepts do not loom large in historical discussions, though specific forms of energy and information are woven into all historical narratives. Can we link these different levels of explanation, and will doing so prove illuminating?[54] The transdisciplinary challenge here is to check that the concepts used at different levels are aligned logically. That is a bit like assembling a conceptual ladder, all of whose rungs are part of the same system even though particular users may use a small part of the ladder. Or perhaps a better

metaphor is a Mandelbrot set, in which each level seems very different from other levels despite some eerie similarities and despite the fact that all levels are generated by the same equation.

There are huge intellectual synergies awaiting scholars who can reformulate fundamental ideas so as to extend their reach and the amount of useful intellectual work they can do. Network theory is another field that promises huge synergies if its methods and ideas can be extended beyond their existing range. I have tried myself to use network theory to understand the accumulation of knowledge within and between different types of human communities, and the Israeli historian, Irad Malkin, has shown how network theory can illuminate our understanding of ancient Greece.[55]

In addition to re-working and extending existing concepts, unifying research projects will surely generate new unifying concepts as well, ideas that can do useful work across large intellectual spaces. Many such ideas also exist. Eric Chaisson has explored the idea that the density of energy flows may provide one way of measuring and explaining different levels of complexity in a Universe in which the upper levels of complexity seem to have increased over time. Is this an idea that can help us make sense of phenomena as diverse as stars, solar systems, cellular life, ecosystems and human history? Fred Spier has argued for the usefulness of the idea of "regimes" in universal history. There have been many attempts to extend the concept of natural selection beyond the biological realm that first generated it, as a way of explaining increasing complexity through what Richard Dawkins describes as Universal Darwinism. In a famous 1960 essay called "Blind Variation and Selective Retention", Donald Campbell argued that, whatever the domain, evolution needs "a mechanism for introducing variation, a consistent selection process, and a mechanism for preserving and reproducing the selected variations."[56] Do similar mechanisms explain emerging complexity in human cultures, or even in Cosmology, or in Quantum Physics, as some have argued?[57] Whatever answers eventually emerge to such questions, these are rich and profound research agendas that will be very hard to pursue successfully until the world of scholarship returns once more to the unifying projects of the Enlightenment.

Unifying research agendas, requiring plenty of conceptual translation, will also emerge in response to complex, transdisciplinary problems. Environmental history offers a good model, as historians and climatologists and ecologists and scholars in many different fields have reached out towards each other to create what is now a vibrant and strategic transdisciplinary research field. Closely related, and driven by similar synergies is the rapidly expanding field of "Anthropocene" studies. Understanding the planet-changing impacts of human activities in the twentieth century is a task that requires the sharing of insights and perspectives from historians, economists, climatologists, palaeontologists, biologists, geologists, and more.

These guesses about the research agendas and approaches of a world that takes seriously Schrödinger's "longing for unified, all-embracing knowledge" are all based on developments that are already apparent. Today's scholarly world may be slowly recovering the ancient balance between detailed and unifying knowledge. And doing that is increasingly urgent in a world that faces the colossal challenge of managing an entire planet, a challenge that cannot even be seen clearly through the narrow lenses of existing scholarly disciplines. The discipline-based scholarly world of the twentieth century generated such rich knowledge in so many fields that it should now be possible to return to the unifying projects of the Enlightenment, and tackle the new problems of the Anthropocene with a rigour and richness, and a global scholarly reach, that was unthinkable before the twenty first century.

Endnotes

1 My thanks to Ian Crawford, Marnie Hughes-Warrington, Barry Rodrigue, and Nobuo Tsujimura for helpful comments on earlier drafts of this paper.

2 I will use the label "big history" and "cosmic evolution" to describe different approaches to the same unifying project. There is a rapidly growing literature. A start up list might include Eric Chaisson, *Cosmic Evolution: The Rise of Complexity in Nature*, Cambridge, MA: Harvard University Press, 2001; David Christian, *Maps of Time: An Introduction to Big History*, Berkeley, CA: University of California Press, 2nd ed., 2011, and *Origin Story: A Big History of Everything*, Little, Brown and Penguin, 2018; Fred Spier, *Big History and the Future of Humanity*, 2nd ed., Malden, MA: Wiley/Blackwell, 2015; Cynthia Stokes Brown, *Big History: From the Big Bang to the Present*, 2nd ed., New York: New Press, 2012; a university text, David Christian, Cynthia Stokes Brown, and Craig Benjamin, *Big History: Between Nothing and Everything*, New York: McGraw-Hill, 2014; anthologies of essays, such as Barry Rodrigue, Leonid Grinin and Andrey Korotayev, eds., F*rom Big Bang to Galactic Civilizations: A Big History Anthology*, Vol. 1, *Our Place in the Universe*, Delhi: Primus Books, 2015; a beautifully illustrated overview, Macquarie University Big History Institute, *Big History*, London: DK books, 2016; and the forthcoming Routledge *Companion to Big History*, ed. Craig Benjamin, Esther Quaedackers and David Baker, Routledge, 2021.

3 This essay expands on and develops arguments presented earlier in David Christian, "The Return of Universal History," *History and Theory*, Theme Issue, 49 (December 2010), 5-26, and "What is Big History?", *Journal of Big History*, Vol. 1, No. 1 (2017), 4-19.

4 All quotes from Erwin Schrödinger, *What is Life?*, Cambridge: Cambridge University Press, 2000, p. 1 [first publ. 1944]

5 I have made this argument in David Christian, *Origin Story: A Big History of Everything*, London: Penguin, and New York: Little, Brown, 2018. For an introduction to modern theories of "myth", and their relationship to modern thought and science, see Robert Segal, *Myth: A Very Short Introduction*, 2nd ed., Oxford University Press, 2015.

6 "In our creation myths we tell the world, or at least ourselves, who we are." David Leeming, *Myth: A Biography of Belief*, New York: Oxford University Press, 2002, Kindle ed., p. 36.

7 Marie-Louise von Franz, *Creation Myths*, Rev. Ed., Boulder Colorado: Shambala, 1995. Ch. 1.

8 Richard S. Westfall, *The Life of Isaac Newton*, Cambridge: Cambridge University Press, 1993, 259; Newton later abandoned the metaphor of a sensorium, but continued to believe that God was literally "omnipresent" in the Universe.

9 Richard S. Westfall, *The Life of Isaac Newton*, Cambridge: Cambridge University Press, 1993.

10 That all myths evolve is the core argument of David Leeming, *Myth: A Biography of Belief*, New York: OUP, 2002; Tony Swain, *A Place for Strangers: Towards a History of Australian Aboriginal Being*, Cambridge: CUP, 1993 explores how indigenous Australian mythologies changed when faced with new, introduced origin stories, including those of Christianity.

11 David Hume, A Treatise of Human Nature, Introduction.

12 Adapted from the dual-language text of Kant's "What is Enlightenment?", at https://bdfwia.github.io/bdfwia.html.

13 Anthony Pagden, *The Enlightenment: And Why it Still Matters*, Oxford: Oxford University Press, 2013, Kindle ed., p. 147 ff.

14 In an important article on the emergence of Big History, Eric Chaisson offers a similar, but not identical distinction, when talking of "two ways up the mountain." Eric Chaisson, "Big History's Risk and Challenge", *Expositions*, 8.1 (2014) 85–95, https://expositions.journals.villanova.edu/article/view/1774 from 85-6.

15 Fred Spier, "Big history: the emergence of a novel interdisciplinary approach", *Interdisciplinary Science Reviews*, 33 (2008):2, 141-152, from pp. 143-4; On Humboldt as a universal historian, see Fred Spier, *Big History and the Future of Humanity*, 2nd ed. (Malden, Mass.: Wiley Blackwell, 2015, 18-21, and Andrea Wulf, *The Invention of Nature: The Adventures of Alexander von Humboldt, the Lost Hero of Science*, (London: John Murray, 2015.)

16 The Ranke quote is from "A Fragment from the 1860's", in Fritz Stern, ed., *The Varieties of History: From Voltaire to the Present*, Cleveland and New York: World Publishing Company, 1956, pp. 61-2.

17 There are good introductory descriptions of the emergence of modern scholarly disciplines in Bjorn Wittrock, "Discipline Formation in the Social Sciences", from *International Encyclopedia of the Social and Behavioural Sciences*, ed. James D. Wright, 2nd ed., Elsevier, 2015, 485-90; and Rudolf Stichweh, "Scientific Disciplines, History of", from *International Encyclopedia of the Social and Behavioural Sciences*, ed. James D. Wright, 2nd ed., Elsevier, 2015, 287-290.

18 The metaphor of autonomous fiefdoms comes from Léo Apostel, Guy Berger, Asa Briggs, Guy Michaud, eds., *Interdisciplinarity: Problems of Teaching and Research in Universities*, Paris: OECD, 1972, pp. 9.

19 Stephen Turner, "Knowledge Formations: An Analytic Framework", Ch. 2 of *The Oxford Handbook of Interdisciplinarity*, 2nd ed., Oxford: OUP, 2017, p. 9; Turner offers a useful short survey of the evolution of disciplines.

20 Stephen Turner, "Knowledge Formations: An Analytic Framework", Ch. 2 of *The Oxford Handbook of Interdisciplinarity*, 2nd ed., Oxford: OUP, 2017, p. 18.

21 Fred Spier, "Big history: the emergence of a novel interdisciplinary approach", *Interdisciplinary Science Reviews*, 33:2, 141-152, from pp. 144.

22 Cited from C. P. Snow, "The Two Cultures and the Scientific Revolution", in C. P. Snow, *Public Affairs* (London and Basingstoke: Macmillan, 1971; 1st published 1959), pp. 13-46.

23 Both quotations from an essay on the 50th anniversary of C. P. Snow's lecture on "The Two Cultures": Martin Kemp, "Dissecting the Two Cultures", *Nature*, Vol. 459/7, May 2009, pp. 32-3; my thanks to Ian Crawford for this reference.

24 From E. O. Wilson, *Consilience: The Unity of Knowledge*, London: Abacus, 1998, p. 8.

25 Max Horkheimer and Theodor W. Adorno, *Dialectic of Enlightenment*, translated by Edmund Jephcott, Stanford University Press, 2002.

26 Andrew Shryock and Daniel Lord Smail, *Deep History: The Architecture of Past and Present*, Berkeley: UC Press, 2011, Kindle ed, loc. 294.

27 Erwin Schrödinger, *What is Life?*, Cambridge: CUP, 2000, p. 1 [first publ. 1944].

28 On Soviet writing on big history, see Akop P. Nazaretyan, "Western and Russian Traditions of Big History: A Philosophical Insight", in *Journal for General Philosophy of Science* (2005) 36: 63–80; on Soviet pioneers of astrobiology, see David Grinspoon, *Earth in Human Hands: Shaping our Planet's Future*, New York: Grand Central Publishing, 2016, pp. 301-26; Shklovksy would later collaborate with Carl Sagan; on Vernadsky, a good introduction is V. I. Vernadsky, *The Biosphere*, New York: Springer-Verlag, 1998.

29 A famous example is Jawaharlal Nehru, *Glimpses of World History*, a world history published in 1942

and written in prison.

30 Erwin Schrödinger, *What is Life?*, Cambridge: CUP, 2000, p. 1 [first publ. 1944].

31 Léo Apostel, Guy Berger, Asa Briggs, Guy Michaud, eds., *Interdisciplinarity: Problems of Teaching and Research in Universities*, Paris: OECD, 1972, p. 10.

32 Erwin Schrödinger, *What is Life?*, Cambridge: CUP, 2000, 60-62.

33 James D. Watson, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA*, Penguin books, 1973, p. 23.

34 Léo Apostel, Guy Berger, Asa Briggs, Guy Michaud, eds., *Interdisciplinarity: Problems of Teaching and Research in Universities*, Paris: OECD, 1972, p. 12.

35 Léo Apostel, Guy Berger, Asa Briggs, Guy Michaud, eds., *Interdisciplinarity: Problems of Teaching and Research in Universities*, Paris: OECD, 1972, pp. 25-6.

36 These definitions from Julie Klein, "Interdisciplinarity", in Carl Mitcham, ed., *Encyclopedia of Science, Technology and Ethics*, Detroit, MI: Macmillan reference, 2005, 1034-37, from pages 1034-35; and see Julie Klein, "Typologies of Interdisciplinarity: The Boundary Work of Definition", Ch. 3 of *The Oxford Handbook of Interdisciplinarity*, 2nd ed., Oxford: OUP, 2017.

37 Julie Klein, "Interdisciplinarity", in Carl Mitcham, ed., *Encyclopedia of Science, Technology and Ethics*, Detroit, MI: Macmillan reference, 2005, 1034-37, from pages 1034-35.

38 Julie Klein, "Typologies of Interdisciplinarity: The Boundary Work of Definition", Ch. 3 of *The Oxford Handbook of Interdisciplinarity*, 2nd ed., Oxford: OUP, 2017, p. 29.

39 For more examples of such unifying approaches in the natural sciences, see Ian Crawford, (2019) "Widening Perspectives: The Intellectual and Social Benefits of Astrobiology, Big History, and the Exploration of Space." *Journal of Big History*, III(3); 163 - 182, in this volume.

40 Harlow Shapley, *The View from a Distant Star: Man's Future in the Universe*. Dell Publishing, New York, 1963, p. 135-6, cited from Ian Crawford, "Widening Perspectives", this volume.

41 Eric Chaisson, "Big History's Risk and Challenge", *Expositions*, 8.1 (2014) 85–95, p. 87.

42 Eric Chaisson, "Big History's Risk and Challenge", Expositions, 8.1 (2014) 85–95, https://expositions.journals.villanova.edu/article/view/1774, p. 87.

43 Fred Spier, "Big history: the emergence of a novel interdisciplinary approach", *Interdisciplinary Science Reviews*, 33:2, 141-152, from pp. 144.

44 Eric Chaisson, *Cosmic Evolution: the Rise of Complexity in Nature*, Cambridge, Mass: Harvard University Press, 2001.

45 See George Field, Gerrit Verschuur and Cyril Ponnamperuma, *Cosmic Evolution: An Introduction to Astronomy*, Boston: Houghton Mifflin, 1978 and E.J. Chaisson, "Relating Big History to Cosmic Evolution," in *From Big Bang to Galactic Civilizations: A Big History Anthology*, Vol II, B. Rodrigue, L. Grinin, and A. Korotayev (eds.), pp 17-30, Primus Books, Delhi, 2016.

46 Fred Spier, *The Structure of Big History: From the Big Bang until Today*, Amsterdam: Amsterdam University Press, 1996.

47 Thomas Kuhn, *The Structure of Scientific Revolutions*, 2nd ed., Chicago: University of Chicago Press, 1970.

48 Julie Klein, "Une taxinomie de l'interdisciplinarité", in *Nouvelles perspectives en sciences sociales*, Volume 7, numéro 1, octobre 2011, pp. 15-48, see p. 15.

49 A crucial work here was Colin Renfrew's classic

study of the implications of radiometric dating for archaeology: 1973, *Before Civilisation, the Radiocarbon Revolution and Prehistoric Europe*, London: Pimlico, 1973. On the chronometric revolution, see also David Christian, "History and Science after the Chronometric Revolution." In Steven J. Dick and Mark L. Lupisella, eds., *Cosmos & Culture: Cultural Evolution in a Cosmic Context*, NASA, 2009, pp. 441-462.

50 See Barry Rodrigue, 'The Study of All Existence: Big History, Universal Studies and the Global Conjuncture', pp. 15-34, in *Big History and Universal Consciousness*, ed. Barry Rodrigue, special edition of *The International Journal for the Transformation of Consciousness* 3 (1), June 2017.

51 These are available, respectively, at: https://www.bighistoryproject.com/home and https://school.bighistoryproject.com/bhplive.

52 My own attempt at such ideas is the notion of "Collective Learning", which I have developed in Maps of Time and elsewhere; that idea is close to, and overlaps with many other attempts to tackle the same question; see Alex Mesoudi, *Cultural Evolution: How Darwinian Theory can Explain Human Culture and Synthesize the Social Sciences*, Chicago and London: University of Chicago Press, 2011, for a fine recent survey of the rich body of research surveying cultural change from a Darwinian perspective.

53 See David Christian, "Scales", in Marnie Hughes-Warrington, ed., *Advances in World History*, Basingstoke: Palgrave/Macmillan, 2005, 64-89.

54 I have attempted to tease out links between complexity, flows of energy and information at several different scales in Christian, "Complexity, Energy and Information in Big History and Human History", in Charles Weller, ed., *21st-Century Narratives of World History: Global and Multidisciplinary Perspectives*, Palgrave/Macmillan, 2017, pp. 111-42.

55 Irad Malkin, *A Small Greek World: Networks in the Ancient Mediterranean*, OUP, 2011.

56 Donald T. Campbell, "Blind Variation and Selective Retention in Creative Thought as in other Knowledge Processes", *Psychological Review*, 67 (1960), No. 6: 380-400, from p. 381.

57 David Christian, "Swimming Upstream: Universal Darwinism and Human History", in Leonid Grinin, David Baker, Esther Quaedackers, and Andrey Korotayev eds., *Teaching & Researching Big History: Exploring a New Scholarly Field*, 'Uchitel' Publishing House, Volgograd, 2014, ISBN: ISBN 978-5-7057-4027-7, pp. 19-40.

“O intenso anseio por um conhecimento unificado e abrangente”: Big History, Evolução Cósmica e novas agendas de pesquisa [1]

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RESUMO: Este artigo oferece uma interpretação acerca das tentativas recentes de unificação do conhecimento. Propõe que o mundo acadêmico de hoje é aberrante. Está fracionado em disciplinas acadêmicas distintas, a tal ponto que universidades e institutos de pesquisa acabaram por perder aquilo que Erwin Schrödinger veio a chamar de “o intenso anseio por um conhecimento unificado e abrangente”. Em contraste, a maioria das sociedades humanas arcaicas valorizava a busca por uma unidade subjacente ao conhecimento humano, uma unidade que era ao mesmo tempo conceitual e narrativa, que em muitos casos tomava a forma de “histórias originárias”. Unificar o conhecimento com base na ciência moderna também foi um dos projetos centrais do Iluminismo e de muitos pensadores do século XIX. Mas no início do século XX, em todos os países do mundo, o conhecimento foi dividido em disciplinas, a tal ponto que a maioria dos educadores e pesquisadores perdeu de vista a antiga esperança de buscar uma unidade subjacente ao conhecimento em sua totalidade. Esse ensaio descreve a fragmentação do conhecimento no século XX e discute as razões dessa mudança radical no sistema de conhecimento moderno. Mas também sugere que o período de extrema disciplinaridade, no qual foi contido o livre fluxo de ideias interdisciplinares pode ser efêmero. Os emergentes campos transdisciplinares da “Big History” ou “Evolução Cósmica” podem anunciar um retorno acadêmico a uma relação mais equilibrada entre a pesquisa detalhada e a busca por estruturas amplas e unificadoras. [2] Este artigo conclui com uma especulação sobre como um retorno ao projeto do conhecimento unificador pode transformar a educação, as agendas de pesquisa, e as instituições nas quais elas ocorrem. [3]

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Charles Darwin:
Desde jovem, tive o mais forte desejo de entender ou explicar o que observava – ou seja, o de agrupar todos os fatos sob algumas leis gerais. [Autobiografia]

Erwin Schrödinger:
Nós herdamos de nossos antepassados o intenso anseio por um conhecimento unificado e abrangente. O próprio nome dado às mais altas instituições de ensino nos lembra de que, desde a Antiguidade e ao longo de muitos séculos, o aspecto universal tem sido o único a receber todo crédito. [4]
[*O que é vida?*, Cambridge: CUP, 2000, p. 1, primeiro publ. 1944]

Introdução:

As epígrafes apreendem a conclusão central deste ensaio: de que boa educação e pesquisa dependem de um equilíbrio entre detalhes e generalidade, entre a investigação com foco e os arcabouços intelectuais unificadores que nos ajudam a encontrar sentido e significado nos resultados de uma pesquisa detalhada.

No tempo de Darwin, a necessidade de tal equilíbrio era bem compreendida, e sua própria carreira oferece um exemplo espetacular das extraordinárias sinergias

que podem ser geradas ao se conectar a pesquisa detalhada a ideias profundas, unificadoras. Schrödinger escreveu logo após a Segunda Guerra Mundial, quando estudiosos na maioria dos campos do saber abandonavam a busca por ideias unificadoras. Seu comentário é justamente um apelo para restabelecer um equilíbrio perdido.

Ainda hoje vivemos em um mundo academicamente desequilibrado em que pesquisa normalmente significa investigação agudamente focalizada nos marcos de disciplinas particulares. Num mundo assim, pesquisa que tente vincular ideias entre muitas disciplinas parece extrema, e (um pouco como esportes radicais) pode parecer ambiciosa e irrealista em demasia. Mas projetos como esses parecem hoje extremos apenas em função do surgimento, no início do século XX, de estruturas que dividiam o ensino e a pesquisa entre disciplinas acadêmicas distintas. Essa mudança foi tão rápida e tão decisiva que hoje poucos acadêmicos demonstram interesse nos projetos unificadores que antes eram o complemento de toda pesquisa detalhada.

Mundos coerentes de conhecimento antes do século XX

Tão completo foi o desaparecimento da antiga busca pela unidade e harmonia intelectual que pode ser surpreendente perceber o quão importante foram esses projetos unificadores para muito da história intelectual humana, e como recentemente eles perderam sua centralidade na maioria dos campos acadêmicos.

Quase todas as sociedades humanas construíram histórias de origem ou mitos de criação: grandes coleções de histórias interligadas que resumem o melhor entendimento de uma comunidade sobre como as coisas vieram a ser como são, por meio da harmonização de muitos tipos diferentes de conhecimento [5]. Seja em sociedades de pequena escala, com antigas tradições orais construídas ao longo de muitas gerações, seja em sociedades com escrita e tradições religiosas institucionalizadas, histórias de origem eram poderosas porque amalgamavam entendimentos fundamentais de uma sociedade acerca da realidade. Histórias de origem conformaram identidades porque diziam a você quem você era, a que conjunto pertencia como parte, que papéis poderia representar, e que papéis deveria representar, de modo que estruturavam o modo pelo qual os jovens seriam educados [6]. Como Marie-Louise Von Franz argumenta, Mitos da Criação: "... referem-se aos problemas mais básicos da vida humana, pois eles estão voltados para o significado último, não apenas da nossa existência, mas da existência de todo o cosmos" [7]. Para tomarmos uma ilustração aleatória, o mundo mental de Isaac Newton foi conformado desde sua infância até sua velhice pelas histórias de origem enraizadas no Cristianismo, e a ciência de Newton floresceu no âmbito dessas histórias unificadoras. Ele pensou em Deus como a "primeira causa" e uma vez descreveu o Universo como "o Sensorium de um Ser incorpóreo, vivo e inteligente" [8].

É importante evitar o erro comum de supor que projetos unificadores devem suprimir a diversidade e a dissidência. Isso nunca foi verdade. As histórias de origem sempre foram suficientemente amplas para permitir discordâncias. Isaac Newton, ainda que cristão devoto, foi contrário à doutrina da Trindade e foi, tecnicamente (e discretamente) um "ariano", um negador da divindade de Cristo[9]. Tensões semelhantes existiam em todas as histórias de origem, em todas as tradições religiosas e filosóficas. De fato, como nos paradigmas científicos modernos, foi o compartilhamento de ideias fundamentais que deu relevância e significância às próprias diferenças de interpretação, tornando-as às vezes valiosas o suficiente para serem defendidas. Descrições modernas de todas as "grandes narrativas" ou projetos unificadores como necessariamente monolíticas e imutáveis são caricaturas simplistas [10].

Conforme a ciência moderna emergia, ela

redirecionava a busca pela harmonia e pela união intelectual. Os pioneiros da ciência moderna, e os maiores pensadores da era do Iluminismo, aspiraram a uma nova compreensão da realidade, e por histórias de origem baseadas não na tradição, na fé ou na autoridade, mas na razão e na pesquisa empírica. "Na verdade, propomos um sistema completo de ciências", escreveu David Hume, "construído sobre uma base quase inteiramente nova e a única sobre a qual possam repousar em segurança" [11]. A ciência, acreditavam eles, estabeleceria novos padrões de conhecimento confiável, e libertaria a humanidade da confiança ingênua na fé ou na autoridade. "Ilustração", escreveu Immanuel Kant, "é a libertação do homem da tutela imposta a ele por ele mesmo [literalmente, Unmündigkeit, ou" menoridade "] ... [sua] incapacidade de fazer uso de seu entendimento sem que seja dirigido por outrem … Sapere aude! "Tenha coragem de usar sua própria razão!" - esse é o lema da Ilustração [12]. A maioria dos pensadores do Iluminismo estava convencida de que uma compreensão melhor e mais coerente da realidade iria promover o progresso da humanidade como um todo [13].

É possível identificar duas colorações ou qualidades sobrepostas ao projeto unificador do Iluminismo, e pode ser que as mesmas duas colorações possam ser identificadas em todas as histórias de origem [14]. A primeira enfatiza a coerência histórica ou narrativa, por isso tende a assumir a forma de histórias ou histórias. Ela reúne diversos tipos de conhecimento, como muitos blocos coloridos ou pixels, em relatos coerentes de como as coisas vieram a ser o que são. Tais narrativas podem ser encontradas no núcleo da maioria das tradições religiosas. A segunda abordagem também pode gerar grandes narrativas unificadoras, mas sua ênfase principal é na unidade conceitual, na busca por redes de ideias que são unidas com força suficiente para fornecer uma base para a maior parte do conhecimento. Tradicionalmente, essa abordagem moldou muito do pensamento teológico, filosófico e matemático, e hoje ela pode ser encontrada em ideias unificadoras como a Relatividade Geral ou a Física Quântica. As duas abordagens sempre se sobrepuseram e se reforçaram mutuamente. Assim, todas as religiões do mundo contêm grandes histórias ligadas a sistemas de ideias fundacionais logicamente rigorosos a respeito de como o universo funciona.

A busca por uma história de origem baseada em ciência floresceu na Europa a partir do início do século XVIII. A busca da unificação conceitual impulsionou os grandes sistemas intelectuais do século XIX, os de Hegel, Comte, Marx, Spencer e muitos outros, embora a maioria desses sistemas, por sua vez, também viesse a gerar grandes narrativas históricas. A ênfase numa unidade narrativa moldou as histórias naturais de Buffon ou as histórias universais de Voltaire, bem como as histórias universais do século XIX, como os vários volumes de *Kosmos* de Alexander Von Humboldt, ou *Vestiges of the Natural History of Creation* de Robert Chambers, que teria uma profunda influência sobre Charles Darwin [15]. O profundo desejo de manter contato com a unidade subjacente da vida e do universo também impulsionou muito da reação dos românticos contra aquilo que entendiam como sendo um cientificismo árido e um foco extremo nos detalhes, presente em parte do pensamento científico.

A busca pela unidade intelectual ainda florescia ao final do século XIX, tanto em suas formas conceituais quanto narrativas. Enquanto James Clerk Maxwell mostrou que a eletricidade e o magnetismo eram expressões diferentes da mesma força subjacente, o historiador Leopold Von Ranke (frequentemente considerado como o principal representante da pesquisa histórica em "pequena escala") alertou contra "o perigo de perder de vista o universal, do tipo de conhecimento que todos desejam. Pois a história não é simplesmente um assunto acadêmico: o conhecimento da história da humanidade deveria ser uma propriedade comum da humanidade..." [16].

O mundo do conhecimento fragmentado do século XX

No início do século XX, o projeto unificador desapareceu como um fantasma ao amanhecer. E desapareceu tão completamente que, um século depois, é fácil esquecer o quanto esses projetos pareciam normais. Nas primeiras duas décadas do século XX, a maior parte dos estudos e pesquisas foi conduzida no âmbito de fronteiras bem delimitadas de determinadas disciplinas acadêmicas, e cada vez menos acadêmicos estavam aptos ou dispostos a buscar a conceitos harmonizadores ou histórias que cruzassem múltiplas disciplinas [17]. Aqueles que o tentaram, como H.G. Wells, foram considerados diletantes, e tiveram pouco impacto na academia. De repente, exceto em áreas como a Física, onde floresceram ideias paradigmáticas unificadoras como a Relatividade Geral, a pesquisa interdisciplinar começou a parecer extravagante, supérflua e desnecessária: parecia o resultado de uma curiosa ressaca intelectual, vinda de uma época em que os estudiosos ainda não haviam compreendido o quão impossível seria uma investigação de cunho interdisciplinar.

Durante a maior parte do século XX, eruditos e pesquisadores habitavam um mundo intelectual cujas fronteiras eram tão bem patrulhadas quanto as dos Estados-nação modernos. Um influente relatório da OCDE sobre interdisciplinaridade, de 1972, observou a exclusividade e competitividade destes novos "principados" intelectuais. Cada disciplina, argumentava, consistia em: "Um corpo específico de conhecimento ensinável, com seu próprio histórico de educação, treinamento, procedimentos, métodos e áreas de conteúdo", e seus próprios territórios, interesses, rituais e líderes bem definidos, de modo que frequentemente funcionavam como "feudos autônomos" [18].

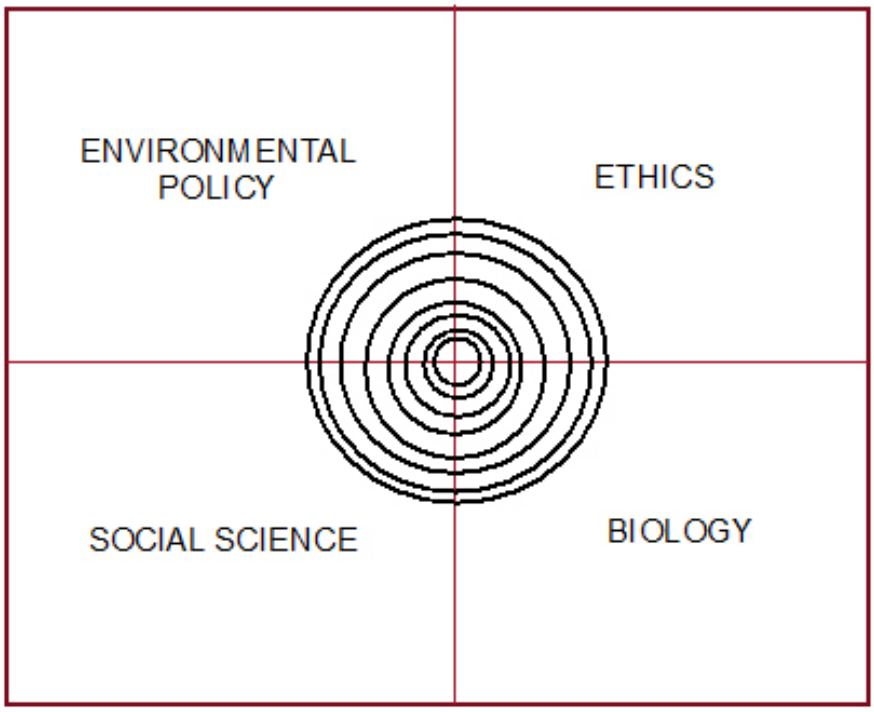
É antiga a ideia de distintas disciplinas acadêmicas, tão antiga quanto as primeiras tentativas de descrever e certificar conhecimentos e habilidades especializados. Mas, no sentido mais restrito mencionado aqui, as "disciplinas" surgiram no final do século XIX, juntamente com as universidades modernas de pesquisa [19]. Universidades alemãs capitanearam a combinação atual de pesquisa e ensino dentro de fronteiras disciplinares bem definidas. Mas o modelo logo foi copiado em toda parte e, no início do século XX, havia se espalhado pelo mundo.

> "No final do século XIX, na prática, uma revolução mundial estava começando. O desejo de imitar as universidades alemãs levou, em um país após o outro, ao surgimento da universidade moderna. Disciplinas desenvolvidas em associação com regras de licenciamento ou seus substitutos de fato, e organizações disciplinares se desenvolveram para definir as fronteiras do território acadêmico. Em 1910, as disciplinas modernas e a moderna universidade de pesquisa estavam definidas" [20].

De muitas maneiras, a virada para a disciplinaridade extrema foi um sucesso. As disciplinas abrigaram agendas de investigação que poderiam ter crescido de outro modo desordenadas. Naqueles espaços seguros, a pesquisa floresceu ao longo do século XX.

Mas as conquistas tiveram um custo. A pesquisa disciplinarizada floresceu um pouco como plantas em vasos, porque estava confinada. Onde o pensamento ameaçava alastrar-se incontidamente, as disciplinas vinham podar ramos e raízes mais amplas, criando o equivalente intelectual a um jardim de *bonsais*. Como diz Fred Spier: "No mundo real, tudo permaneceu conectado com todo o resto. Como resultado da contínua disciplinarização das universidades, no entanto, esse importante *insight*, familiar o suficiente para Alexander Von Humboldt, foi perdido" [21]. A educação moderna definiu o que era ser educado, criando o mundo de tribos eruditas mutuamente

Why Consilience is difficult:
a diagram adapted from E.O. Wilson, *Consilience*, p. 8



O problema não é tanto a existência de disciplinas, mas o fato de que elas tendem a bloquear a livre circulação de ideias. Em 1998, E.O. Wilson argumentou que as fronteiras entre as disciplinas estavam prejudicando a pesquisa fundamental em muitas áreas. O sucesso da pesquisa no âmbito disciplinar estava criando mais e mais zonas mortas entre disciplinas, onde novas questões se acumulavam apenas para serem ignoradas por pesquisadores disciplinarmente embasados, até que elas viessem a murchar em uma terra acadêmica de extrema aridez. Wilson usou um diagrama para esclarecer o ponto.

Aqui, cada quadrante representa um mundo de pesquisa distinto, com suas próprias regras, seus próprios critérios para uma boa pesquisa, seus próprios mecanismos de financiamento, periódicos acadêmicos e medidas de prestígio e sucesso. Mas, ele escreveu, perto das fronteiras entre as disciplinas, "nós nos encontramos em uma região cada vez mais instável e desorientadora. O círculo mais próximo da interseção, onde existe a maioria dos problemas do mundo real, é aquele em que a análise fundamental é mais necessária" [24]. Embora vibrantes e produtivas dentro de seus limites, as disciplinas estavam criando zonas mortas intelectuais em suas fronteiras. Insira no diagrama de Wilson outras disciplinas como Antropologia, Neurociência, História e Primatologia e você encontrará, na zona morta, a questão mais fundamental de todas para as Humanidades: o que é que define nossa própria espécie e explica por que nós são tão incomuns?

incompreensivas que C.P. Snow lamentou em sua famosa palestra de 1959 sobre "as duas culturas" [22]. Em 1963, Snow escreveu:

> "As pessoas mais bem formadas que conhecemos não podem mais se comunicar umas com as outras no plano de suas maiores preocupações intelectuais. Isso é sério para nossa vida criativa, intelectual e, acima de tudo, para nossa vida normal. Está nos levando a interpretar erradamente o passado, julgar mal o presente e negar nossas esperanças do futuro. Está tornando difícil ou impossível agirmos bem".

Em tal mundo, como Martin Kemp escreveu: "um abismo de entendimento se abre quando os estudantes entram na universidade" [23].

O que explica essa súbita fragmentação do conhecimento que fortaleceu e limitou a educação e a pesquisa por um século? O crescente gerenciamento governamental da educação e da pesquisa, impulsionado pelo aumento do papel dos governos durante as guerras mundiais, incentivou um foco em problemas específicos e um alto grau de compartimentalização institucional. Mas duas outras forças poderosas também estavam em ação: a ampliação espetacular de novas informações no Século XIX; e o ceticismo acerca do fracasso de tentativas anteriores de unificação intelectual.

Hoje, é fácil de esquecer como era aterrorizante e desestabilizador o tsunami de novos conhecimentos criados pelo terremoto da industrialização. Em uma famosa passagem do *Manifesto Comunista*, Marx e Engels escreveram: "Todas as relações fixas e congeladas, com sua série de antigos e veneráveis preconceitos e opiniões, são varridas, todas as relações recém-formadas tornam-se antiquadas antes de poderem ossificar. Tudo o que é sólido se desmancha no ar, tudo o que é sagrado é profanado". Nenhum sistema ou história universal parecia robusto o suficiente para sobreviver ileso em um mundo de tamanha agitação intelectual, nenhum dos antigos sistemas religiosos ou filosóficos, e nem mesmo os sistemas mais modernos dos grandes pensadores do Iluminismo. As disciplinas forneceram abrigos intelectuais contra o furacão de novos conhecimentos.

A segunda razão para abandonar os projetos unificadores do Iluminismo foi a de que nenhum desses projetos realmente funcionou. O sucesso do sistema de Newton não foi igualado na história ou na sociologia, nem mesmo nas ciências, e no início do século XX, Einstein mostrou que até a física de Newton precisava de ajustes. Além disso, o Terror Revolucionário francês e a sangrenta história do século XIX minaram o otimismo intelectual do Iluminismo, ao mostrar que a Razão, a ciência e os novos tipos de conhecimento poderiam servir tanto à opressão quanto ao progresso. O ceticismo foi ampliado pelas guerras mundiais do início do século XX e pela ascensão de sistemas totalitários sustentados pela ciência e que alegavam serem construídos com base na Razão. Uma das críticas modernas mais influentes do pensamento iluminista, a *Dialética do Esclarecimento* de Adorno e Horkheimer, foi escrita à sombra dos campos de extermínio nazistas, que puseram o conhecimento científico moderno a serviço dos fins mais malignos[25].

Em retrospecto, a maior parte dos grandes sistemas do século XIX e as histórias unificadoras parecem-se, de fato, mais com ideologias do que ciência. Isso porque a ciência que os embasava era frágil demais para permitir a construção de sistemas intelectuais robustos, e tinha que ser preenchida com muito material especulativo. Embora o século XIX tenha gerado ideias unificadoras poderosas, como a teoria da evolução de Darwin, ou a unificação entre a eletricidade e o magnetismo por Maxwell, também surgiram muitos sistemas pseudocientíficos de pensamento, como a frenologia ou o darwinismo social. Estes minaram a credibilidade do projeto iluminista, e encorajaram o abandono de um esquema unificador em prol de agendas acadêmicas menos ambiciosas. O abandono de projetos unificadores foi quase universal nas disciplinas de Humanidades, que não tinham as ideias paradigmáticas que mantinham as esperanças de unificação vivas nas ciências naturais. Os historiadores reagiram à "história científica" de Marx e de seus seguidores. E os antropólogos se afastaram dos relatos pseudocientíficos sobre o progresso humano, indo em direção a estudos detalhados de culturas particulares. "Ao limpar a análise histórica e cultural de sua bagagem ideológica do século XIX", escrevem Shryock e Smail, "a maioria das versões modernas (e pós-modernas) da antropologia e da história cultural deram as costas para o profundo passado humano…" [26].

Mas a estrutura de distintas disciplinas inibiu a busca de ideias unificadoras profundas, mesmo nas ciências

naturais. Em 1944, Erwin Schrödinger escreveu:

> "A disseminação, em largura e profundidade, dos vários ramos do conhecimento durante os estranhos últimos cem anos nos confrontou com um dilema. Sentimos claramente que só agora estamos começando a adquirir material confiável para soldar tudo o que é conhecido em um todo; mas, por outro lado, tornou-se quase impossível para uma única mente comandar mais do que uma pequena parte especializada dela" [27].

Críticas à hiper-disciplinaridade

Como esse item sugere, uma profunda nostalgia por um mundo perdido de coesão intelectual sobreviveu dentro do mundo fragmentado de distintas disciplinas acadêmicas. Podia ser que o ideal de algum tipo de universalismo tivesse sobrevivido melhor para além do mundo atlântico. As tradições marxistas na União Soviética e na China preservaram o ideal do conhecimento universal, embora em formas arcaicas e constritas pela censura; mas a sobrevivência desse ideal pode ajudar a explicar as ideias profundamente interdisciplinares de astrobiólogos soviéticos tais como Iosif Shklovski, e geólogos como Vladimir Vernadsky, pioneiro da ideia de uma biosfera [28]. E um pequeno número de estudiosos em muitas partes diferentes do mundo continuou a insistir na importância de transcender os limites disciplinares e de preservar um sentido de unidade subjacente entre conhecimento e pesquisa [29].

No início do século XX, e particularmente no mundo atlântico, a nostalgia por algum tipo de coerência intelectual moldou muito da arte moderna, da literatura, da filosofia e da pesquisa acadêmica. O poema de Yeats, "The Second Coming", capta a nostalgia e o terror de viver num mundo sem unidade intelectual ou significado.

> Girando e girando no volteio crescente
> O falcão não pode ouvir o falcoeiro
> As coisas desmoronam; o centro não se mantém;
> Mera anarquia desenfreada sobre o mundo,
> A maré sangrenta incontrolada, e em toda parte
> A cerimônia da inocência é afogada;
> Os melhores não têm convicção, enquanto os piores
> São cheios de intensidade apaixonada.

O anseio por uma unidade intelectual perdida levou a muitas tentativas acadêmicas de cruzar fronteiras disciplinares, mas poucas avançaram suficientemente porque havia pouco apoio institucional para pesquisas genuinamente transdisciplinares, particularmente na Europa e na América do Norte. Erwin Schrödinger escreveu, desamparadamente:

> "Não vejo outra saída para esse dilema (para que nosso verdadeiro objetivo não seja perdido para sempre) senão a de que algum de nós se aventure a embarcar em uma síntese de fatos e teorias, ainda que a partir de conhecimento de segunda mão e incompleto – mesmo com o risco de passarmos por tolos" [30].

Em meados do século XX, a educação, a erudição e a pesquisa estavam tão profundamente inseridas na matriz de disciplinas que até mesmo as tentativas mais bem-sucedidas de unificação não eram mais vistas como projetos unificadores, mas como tentativas de transitar entre as disciplinas. Eram as disciplinas que pareciam fundamentais e não as redes de conhecimento que as ligavam. Suas fronteiras pareciam mapear a realidade em si. Como Wordsworth - incansável buscador da unidade – escreveu em *The Prelude* (Livro 2):

> Na fraqueza criamos distinções, então
> Considere que nossos insignificantes limites são coisas
> Que percebemos, e não obra nossa.

Tentativas de unificar o conhecimento foram cada vez mais descritas como "pesquisa interdisciplinar". O interesse pela pesquisa interdisciplinar floresceu

na década de 1960. O já mencionado relatório de 1972 da OCDE sobre interdisciplinaridade sugeria que o ceticismo sobre a ciência havia surgido de "aplicações especializadas do conhecimento, sem um correspondente desenvolvimento de uma estrutura sintetizadora que pudesse destacar seus efeitos colaterais e implicações de longo prazo" [31]. O interesse na pesquisa interdisciplinar também foi impulsionado por novas áreas de pesquisa, como a genética ou estudos de gênero, que transbordaram os limites disciplinares existentes.

Havia também exemplos espetaculares de sinergias que poderiam ser liberadas por empreitadas interdisciplinares. A tentativa de Erwin Schrödinger de cruzar disciplinas em seu livro, *What is Life?*, fornece um bom exemplo. Estava ali um físico escrevendo sobre um problema fundamental na biologia. Schrödinger argumentou que a vida e a reprodução deviam envolver uma espécie de codificação em grandes moléculas, na qual um pequeno número de componentes poderia ser organizado e reorganizado como letras em um alfabeto. Ele sugeriu, portanto, que os cromossomos dentro dos núcleos das células pudessem cada um consistir no que ele chamou de "um cristal aperiódico ou sólido" [32]. Essa ideia inspirou uma geração de biólogos, incluindo os descobridores da estrutura do DNA. De fato, Francis Crick, embora originalmente um físico, converteu-se à biologia e à pesquisa sobre a origem da vida após a leitura de Schrödinger [33].

Por volta da década de 1970, havia crescentes demandas por mais pesquisas interdisciplinares. A primeira grande conclusão do influente relatório da OCDE sobre interdisciplinaridade era que: "o ensino e a pesquisa interdisciplinar são os pontos de inovação-chave nas universidades", em parte porque a interdisciplinaridade pode "ajudar a mover a ciência e a investigação em direção à unidade". Mas a segunda grande conclusão do relatório foi de que as disciplinas acadêmicas tornaram a busca pela unidade extremamente difícil. "A introdução desta inovação esbarra em enormes dificuldades…", acima de tudo em decorrência da "organização das universidades em escolas monodisciplinares ou 'faculdades' que protegem zelosamente o seu ramo de conhecimento…"[34].

A moda interdisciplinar de meados do século XX gerou novas estruturas universitárias e de pesquisa, e promoveu novas disciplinas combinadas, tais como a bioquímica ou a ciência ambiental. E é por isso que, hoje algumas formas de pesquisa interdisciplinar são familiares e bem financiadas. Mas o retorno a projetos unificadores foi hesitante, parcial e limitado, e assumiu várias formas diferentes. Novas tipologias foram construídas para descrever diferentes graus de interdisciplinaridade. As categorias mais utilizadas foram "multidisciplinaridade", "interdisciplinaridade" (num sentido não genérico) e "transdisciplinaridade[35].

"Multidisciplinaridade" refere-se a uma ligação frouxa de disciplinas, muitas vezes em torno de um problema comum ou agenda de pesquisa, enquanto as disciplinas individuais "... continuam a falar como vozes separadas no alinhamento enciclopédico. As hipóteses subjacentes não são examinadas e o status quo permanece intacto". "Interdisciplinaridade" se refere a uma integração mais próxima de disciplinas que: "integra dados, métodos, ferramentas, teorias e perspectivas separadas para responder uma questão, resolver um problema ou abordar um tópico que é muito amplo ou complexo para ser tratado por uma disciplina.… Em campos interdisciplinares, surge um novo corpo de conhecimento" [36].

Finalmente, a "transdisciplinaridade" nos aproxima ainda mais dos projetos unificadores do Iluminismo. Transdisciplinaridade se refere a uma integração ainda mais firme entre métodos e insights de diferentes disciplinas, que aponta para "uma síntese abrangente que transcende o escopo restrito das visões de mundo disciplinares" [37]. Julie Klein descreve as formas

mais ambiciosas de transciplinaridade como: "... a busca epistemológica pela integração sistemática do conhecimento" [38]. Em um mundo de feudos disciplinares, a transdisciplinaridade, essa forma mais integrada de esforço acadêmico interdisciplinar, fez pouco progresso. Segue sendo rara e mal financiada, e teve um impacto limitado na maior parte da academia, apesar da existência de algumas instituições concebidas como especialmente transdisciplinares, como o Santa Fe Institute for Complexity Studies.

O ressurgimento de projetos unificadores do final do século XX

Apesar de tudo, ao final do século XX e início do século XX, alguns sinais promissores de retorno aos projetos unificadores do passado se manifestaram.

Pensamento e pesquisa transdisciplinares fizeram mais progressos nas ciências naturais, impulsionados por novas ideias paradigmáticas, incluindo a Cosmologia do Big Bang, o Modelo Padrão da Física de Partículas, a Tectônica de Placas e a moderna síntese darwiniana [39]. Alguns cientistas até começaram a sonhar com super-paradigmas ou "Grandes Teorias Unificadas" que capturariam as regras fundamentais pelas quais nosso Universo foi construído. Mas os novos paradigmas também encorajavam a busca pela coerência narrativa, porque eram todos de natureza histórica. Descreveram como o Universo, o planeta Terra e a vida evoluíram durante vastos períodos de tempo. O astrônomo de Harvard, Harlow Shapley (que certa vez descreveu a divisão do conhecimento entre disciplinas como "derrotista"), defendeu currículos universitários que: "apresentariam a história do universo e da humanidade como deduzida da geologia, cosmogonia, paleontologia, antropologia. neurologia comparativa, história política e assim por diante… ampla integração é a chave essencial." [40]. E Shapley cumpriu sua palavra, ministrando cursos com esse teor em Harvard por várias décadas, antes de seu sucessor, Carl Sagan, montar a partir deles uma popular série de televisão, "Cosmos" [41]. Cursos similares foram ministrados na União Soviética por Iosif Shklovksy, na França, por Hubert Reeves, e na Áustria, por Erich Jantsch [42].

No final do século XX, vários cientistas escreveram trabalhos sintéticos que combinavam coerência conceitual e narrativa passando por grandes áreas do conhecimento. Entre eles figuram histórias do planeta Terra de autoria de Preston Cloud, histórias do universo de autoria de astrônomos como George Field e Eric Chaisson, e de astrofísicos como Erich Jantsch e Siegfried Kutter [43]. Na década de 1990, Eric Chaisson escreveu uma história do universo construída em torno do tema central da complexidade crescente, impulsionada por fluxos de energia cada vez mais densos [44]. Ele chamou seu projeto unificador de "*Cosmic Evolution*", usando o termo introduzido pela primeira vez no final dos anos 1970 por George Field [45]. Fred Spier ofereceria mais tarde uma teoria da história universal que destacava o surgimento de "regimes" ou estruturas semiestáveis de muitos tipos diferentes, uma ideia que havia sido parcialmente prefigurada no trabalho de Erich Jantsch [46].

Estudiosos no campo das Humanidades demoraram mais para embarcar em empreitadas transdisciplinares sérias, em parte porque as Humanidades não geraram ideias paradigmáticas tão persuasivas quanto as que surgiram no âmbito das Ciências Naturais. As ideias unificadoras que emergiram em disciplinas como Economia ou Sociologia ou Arqueologia foram sempre contestadas, ao contrário de algumas das grandes ideias nas ciências naturais, que eram tão amplamente aceitas que alcançaram o status de paradigmas kuhnianos [47]. A natureza "pré-paradigmática" da maioria das disciplinas de Humanidades encorajou um foco em especificidades e um profundo ceticismo sobre tentativas de unificação intelectual, ou sobre a construção de "grandes narrativas".

No entanto, mesmo nas disciplinas de Humanidades,

houve grandes problemas gerais, como o rápido aumento do impacto humano na biosfera, que encorajaram alguns pesquisadores a atravessar tentativamente as fronteiras disciplinares [48]. E as narrativas históricas emergentes no âmbito das ciências naturais incentivaram alguns estudiosos a procurar ligações entre as suas próprias narrativas históricas e as narrativas de grande escala emergentes nos campos da cosmologia, da geologia e da paleontologia. Embora a maioria dos historiadores permanecesse cética quanto à ideia de uma história universal, temendo um retorno ao esquema histórico mal sucedido do século XIX, alguns foram atraídos pelo desafio de ligar a história humana às histórias emergentes da biosfera, do planeta Terra e do Universo como um todo. Eles foram inspirados não apenas pelas novas narrativas unificadas sendo construídas no âmbito das ciências naturais, mas também pelo fato de que essa ciência era muito mais rica e rigorosa do que havia sido no século XIX. Isso aumentou a esperança de unificar histórias sem o peso de uma bagagem intelectual não científica, provinda dos sistemas oitocentistas menos bem-sucedidos.

Novos métodos de datação também transformaram a tarefa de construir histórias universais. Quando H.G. Wells escreveu uma história do Universo na década de 1920, não tinha à sua disposição datas absolutas que fossem confiáveis para qualquer evento anterior à primeira Olimpíada grega. Todos os eventos anteriores desapareceram em uma névoa cronológica. Na década de 1950, novas técnicas de datação foram desenvolvidas, com base no decaimento de materiais radioativos. A datação radiométrica permitiu a construção de cronologias confiáveis, chegando, eventualmente, às origens do Universo. Essas datas forneciam a espinha cronológica para uma história de origem moderna, rigorosa e baseada na ciência [49].

Para os estudiosos das Humanidades, a unificação significava, quase inevitavelmente, a unificação narrativa, e não a unificação conceitual buscada pelos estudiosos das ciências naturais. Para os estudiosos das ciências humanas, o desafio seria o de vincular as histórias contadas em muitas disciplinas diferentes a um relato universal coerente do passado. Que enredos maiores poderiam ser vistos, e que novos temas e formas de coerência surgiriam, ao se tentar costurar histórias contadas por cosmólogos, astrônomos, geólogos, bioquímicos, paleontólogos, antropólogos e historiadores?

Minha própria experiência de historiador na abordagem desses desafios pode ser bastante típica. Quando tentei, pela primeira vez, ministrar um curso de história que abrangia a integralidade do tempo, em 1989, convidei estudiosos de muitas disciplinas diferentes para palestrar sobre as ideias centrais de suas disciplinas. Meus colegas e eu assistimos para ver o que sairia dessa mistura. O que obtivemos foi um brilhante passeio por paradigmas modernos em conjunto com um relato da história humana relativamente frouxo. Mas as histórias narradas não eram coerentes entre si, porque os professores falavam sobre os principais temas de suas disciplinas, usavam os métodos e o jargão com os quais estavam familiarizados e tinham pouco tempo para construir pontes entre as disciplinas. Comecei a temer que cursos de história nessa perspectiva ampla permanecessem "interdisciplinares" no sentido mais limitado. Eles não podiam transcender as disciplinas e podiam, na melhor das hipóteses, servir-se de uma espécie de miscelânea intelectual.

Ao longo de vários anos, entretanto, maior amplitude de temas e maior coerência começaram a aparecer. Tornava-se aparente que o surgimento de diferentes formas de complexidade em múltiplas escalas, de galáxias a vírus e civilizações humanas, era um tema narrativo de maior relevância. Levantava questões profundas sobre a criatividade do Universo como um todo, e sobre a relação entre a complexidade no mundo humano e a complexidade na biosfera em nível universal. Testemunhar a emergência de temas unificadores ao longo de vários anos foi um pouco

como assistir à gradual revelação de uma fotografia no banho químico de uma câmara escura. E o aparecimento paulatino de temas unificadores mostrou que as dificuldades de se buscar conhecimento unificado surgiram não das dificuldades intrínsecas do projeto, mas dos hábitos de pensamento que dominavam um mundo de distintas disciplinas acadêmicas.

Desde o final do século XX, muitos estudiosos assumiram o desafio de construir "grandes histórias" ou narrativas originárias modernas, e o fizeram em muitas partes diferentes do mundo, o que sugere a existência de uma emergente "conjuntura global" em torno da ideia [50]. Hoje, há uma crescente literatura acadêmica sobre Big History, e cursos nessa abordagem estão sendo ministrados em várias universidades, principalmente nos EUA, Austrália e Holanda. Cursos on-line sobre Big History também foram desenvolvidos para escolas secundárias através do "Big History Project" (generosamente apoiado por Bill Gates) e, em 2018, através da "Big History School" (apoiada pela Macquarie University), que inclui o tema na grade curricular do ensino primário [51].

Novos projetos transdisciplinares e novas agendas de pesquisa

A seção final deste ensaio é francamente especulativa. Se as mudanças descritas na seção anterior são sinais precoces de um retorno acadêmico a pesquisas e pensamentos com maior apelo transdisciplinar, que impacto isso terá no cenário da pesquisa?

Um mundo em que a unificação do conhecimento é levada a sério será intelectualmente mais equilibrado do que o mundo de hoje. As disciplinas sobreviverão, não apenas devido à inércia institucional, mas também porque elas servem a muitas funções úteis. E eles continuarão a moldar a pesquisa em escalas menores. Mas à medida que a pesquisa transdisciplinar se torna mais importante, as disciplinas vão tendo de se tornar mais sensíveis aos desenvolvimentos nos campos vizinhos e na pesquisa acadêmica como um todo. Os limites disciplinares terão de se tornar mais flexíveis, mais permeáveis e mais abertos a mudanças transformadoras.

Para apoiar, financiar e oferecer planos de carreira ao crescente número de acadêmicos atraídos por problemas transdisciplinares, novas instituições serão necessárias para unir disciplinas e incentivar um maior trânsito entre elas. Entre as mais atraídas por projetos unificadores, acabará por sobreviver algo da distinção entre ciências e Humanidades, como distinguiu C. P. Snow. Mas as diferenças não surgirão da incompreensão mútua, e sim do diálogo sustentado, em que alguns estudiosos se concentrarão principalmente na coerência narrativa entre diferentes campos, enquanto outros se concentram no desafio conceitual de instigar paradigmas unificadores.

Um mundo de conhecimento mais unificado irá transformar os currículos escolares. Mas as mudanças não precisam ser complexas, e a maior parte da infraestrutura educacional existente permanecerá como está. A maioria das disciplinas tradicionais sobreviverá. Mas disciplinas novas e unificadoras surgirão, como a "Big History", que pode ajudar os alunos a ver a coerência subjacente no conhecimento moderno, e as muitas ligações entre as disciplinas tradicionais. Cursos desse tipo já existem e oferecem aos alunos o equivalente metafórico a uma jornada ao topo de uma montanha, a partir de onde podem ver mais claramente aquilo que liga disciplinas diferentes, bem como o que as divide. Se esses cursos se tornassem componentes padronizados dos currículos escolares em todo o mundo, eles poderiam fornecer aos alunos, como fizeram as histórias tradicionais de origem, uma visão coerente que poderiam levar consigo para a vida adulta.

Nas Universidades, o ensino em âmbito disciplinar não mais condicionará a atenção se os alunos também

forem expostos a cursos que os ajudem a ver a unidade subjacente às disciplinas modernas. Tais cursos já são ministrados em muitas universidades, e já existem recursos impressos e eletrônicos de grande valia para apoiá-los.

Um retorno ao projeto unificador do Iluminismo pode ter seu maior impacto nos ambientes de pesquisa, ambiente sobre o qual tiveram o menor impacto até agora. Hoje, os estudiosos atraídos pelos desafios da pesquisa transdisciplinar lutam para ganhar reconhecimento, para levantar fundos e encontrar apoio acadêmico. Um mundo que leva esses projetos mais a sério certamente considerará os desafios intelectuais e institucionais enfrentados por pesquisadores interessados no trabalho transdisciplinar.

Como serão os projetos de pesquisa unificadores? Temos algumas respostas, já que construtores de paradigmas como Darwin e Einstein mostraram a existência de profundas ideias unificadoras esperando para serem descobertas por aqueles que as procuram. E há áreas de pesquisa onde a necessidade de unificar ideias é evidente para todos, como o desafio de unificar a Teoria da Relatividade e a Teoria Quântica. Ambas funcionam espetacularmente bem, mas uma assume um universo granular enquanto a outra não. O que não estamos vendo? Nas Humanidades, a questão que pode impulsionar agendas unificadoras diz respeito à distinção de nossa própria espécie. O que torna os humanos diferentes, tão diferentes que nossa espécie agora está dominando a mudança na biosfera? [52]

Essas grandes perguntas oferecem bons modelos para unificar a pesquisa em geral, porque, para persegui-las, os acadêmicos terão de vincular métodos, insights, conceitos, terminologia e perspectivas de diferentes disciplinas. Precisarão ser verdadeiros tradutores entre disciplinas. Pode você traduzir o conceito de entropia, algo extraordinariamente poderoso nas ciências naturais, para as Humanidades? O "declínio e queda" do historiador é semelhante à "entropia" do físico? Existe tanto em comum entre os dois conceitos de modo que, com alguns ajustes, possamos encontrar maneiras de descrever a entropia que sejam capazes de informar a pesquisa nas Humanidades? O mesmo vale para conceitos como informação (engenheiros acústicos, teóricos quânticos, geneticistas e historiadores se referem à mesma coisa quando usam a palavra?), ou complexidade, ou energia.

A tarefa também é a de ajustar a maneira pela qual conceitos são usados em diferentes escalas, porque muitos conceitos funcionam bem em algumas delas e menos bem em outras [53]. Um dos problemas mais fundamentais da ciência contemporânea é como fazer a física quântica funcionar não apenas em escala atômica, mas também nas escalas cosmológicas da relatividade? Para o historiador, conceitos como energia ou informação são muito genéricos para ajudar na maioria dos tipos de pesquisa histórica; desse modo, conceitos abstratos acabam por não serem evidenciados nas discussões históricas, embora formas específicas de energia e informação apareçam entrelaçadas em todas elas. Podemos conectar esses diferentes níveis de explicação e ganharmos em termos de esclarecimento? [54] O desafio transdisciplinar aqui é verificar se os conceitos usados em diferentes níveis estão alinhados logicamente. Isso é um pouco como montar uma escada conceitual, cujos degraus são parte do mesmo sistema, ainda que usos particulares possam empregar apenas parte da escada, e não ela toda. Ou talvez uma metáfora melhor seja um conjunto de Mandelbrot, em que cada nível parece muito diferente de outros níveis, a despeito de que existam semelhanças assombrosas e de que todos os níveis possam ser gerados pela mesma equação.

Existem enormes sinergias intelectuais à espera de estudiosos que possam reformular ideias fundamentais de modo a ampliar o alcance e a quantidade de trabalho intelectual útil que possam empreender. A teoria de redes é outro campo que promete enormes sinergias se seus métodos e ideias puderem ser estendidos além de

seu alcance corrente. Eu tentei usar a teoria das redes para entender o acúmulo de conhecimento no interior e entre diferentes tipos de comunidades humanas, e o historiador israelense Irad Malkin mostrou como essa mesma teoria pode iluminar nossa compreensão da Grécia antiga [55].

Além de retrabalhar e estender os conceitos existentes, a unificação de projetos de pesquisa certamente gerará novos conceitos unificadores, ideias que possam gerar frutos úteis por vastos espaços intelectuais. Eric Chaisson explorou a ideia de que a densidade dos fluxos de energia pode fornecer uma maneira de medir e explicar diferentes níveis de complexidade em um Universo em que os níveis superiores de complexidade parecem ter aumentado ao longo do tempo. Será esta uma ideia que pode ajudar-nos a compreender fenômenos tão diversos como as estrelas, os sistemas solares, a vida celular, os ecossistemas e a história humana? Fred Spier defendeu a utilidade da ideia de "regimes" na história universal. Houve muitas tentativas de estender o conceito de seleção natural para além do âmbito biológico original, como uma forma de explicar a complexidade crescente através do que Richard Dawkins descreve como darwinismo universal. Em um famoso ensaio de 1960 chamado "Blind Variation and Selective Retention", Donald Campbell argumentou que, qualquer que seja o domínio, a evolução precisa de "um mecanismo para introduzir variação, um processo de seleção consistente e um mecanismo para preservar e reproduzir as variações selecionadas" [56]. Podem mecanismos similares explicar a complexidade emergente em culturas humanas, ou mesmo na cosmologia, ou na física quântica, como alguns argumentaram? [57] Quaisquer que sejam as respostas que eventualmente surjam para tais questões, estas são agendas de pesquisa ricas e profundas que serão muito difíceis de serem realizadas com sucesso até que o mundo da erudição retorne mais uma vez aos projetos unificadores do Iluminismo.

A unificação de agendas de pesquisa, exigindo vasta tradução conceitual, também surgirá em resposta a problemas transdisciplinares complexos. A história ambiental oferece um bom modelo, no ponto em que historiadores, climatologistas, ecologistas e acadêmicos de diversos campos convergiram para criar o que é hoje um campo de pesquisa transdisciplinar vibrante e estratégico. Intimamente relacionado a isso, e impulsionado por sinergias semelhantes, é o campo de estudos do "Antropoceno", em rápida ascensão. Compreender os impactos das atividades humanas na mudança do planeta no século XX é uma tarefa que requer o compartilhamento de percepções e perspectivas de historiadores, economistas, climatologistas, paleontólogos, biólogos, geólogos e muito mais.

Esses palpites sobre as agendas e abordagens de pesquisa de um mundo que leva a sério o "anseio por conhecimento unificado e abrangente" de Schrödinger são todos baseados em desenvolvimentos já evidentes. O mundo acadêmico de hoje pode estar recuperando lentamente o antigo equilíbrio entre conhecimento detalhado e unificador. E fazer isso é cada vez mais urgente em um mundo que enfrenta o desafio colossal de administrar um planeta inteiro, um desafio que sequer pode ser visto claramente através das lentes estreitas das disciplinas acadêmicas existentes. O mundo acadêmico disciplinar do século XX gerou um conhecimento tão rico em tantos campos que agora deve nos permitir retornar aos projetos unificadores do Iluminismo, e enfrentar os novos problemas do Antropoceno com um rigor e riqueza, e um alcance acadêmico global, que era impensável antes do século XXI.

Notas finais

[1] Meus agradecimentos a Marnie Hughes-Warrington, Barry Rodrigue, and Nobuo Tsujimura pelos úteis comentários em rascunhos anteriores desse artigo.

[2] Empregarei a rubrica "big history" and "evolução

cósmica" para descrever diferentes abordagens aos mesmos projetos unificadores. Sobre o assunto há uma literatura que cresce rapidamente. Uma lista inicial deve incluir Eric Chaisson, *Cosmic Evolution: The Rise of Complexity in Nature*, Cambridge, MA: Harvard University Press, 2001; David Christian, *Maps of Time: An Introduction to Big History*, Berkeley, CA: University of California Press, 2 nd ed., 2011, and *Origin Story: A Big History of Everything*, Little, Brown and Penguin, 2018; Fred Spier, *Big History and the Future of Humanity*, 2nd ed., Malden, MA: Wiley/Blackwell, 2015; Cynthia Stokes Brown, *Big History: From the Big Bang to the Present*, 2nd ed., New York: New Press, 2012 (com tradução em português: Brown, C. S. A *Grande História: do Big Bang aos dias de hoje*. Rio de Janeiro, Civilização Brasileira: 2010); um livro-texto acadêmico, David Christian, Cynthia Stokes Brown, and Craig Benjamin, *Big History: Between Nothing and Everything*, New York: McGraw-Hill, 2014; antologias de ensaios como a de Barry Rodrigue, Leonid Grinin and Andrey Korotayev, eds., *From Big Bang to Galactic Civilizations: A Big History Anthology, Vol. 1, Our Place in the Universe*, Delhi: Primus Books, 2015; um panorama ricamente ilustrado como Macquarie University Big History Institute, Big History, London: DK books, 2016; e a publicação, no prelo, Routledge *Companion to Big History*, ed. Craig Benjamin, Esther Quaedackers and David Baker, Routledge, 2021.

[3] Esse ensaio expande e desenvolve argumentos apresentados anterioremente em David Christian, "The Return of Universal History," *History and Theory*, Theme Issue, 49 (December 2010), 5-26, e "What is Big History?", Journal of Big History, Vol. 1, No. 1 (2017), 4-19.

[4] Todas as citações vêm de Erwin Schrödinger, *What is Life?* , Cambridge: CUP, 2000, p. 1 [primeira publicação. 1944]

[5] Apresentei esse argumento em David Christian, *Origin Story: A Big History of Everything*, London: Penguin, and New York: Little, Brown, 2018. Para uma introdução às teorias modernas sobre "mitos", e sua relação com o pensamento moderno e a ciência ver Robert Segal, *Myth: A Very Short Introduction*, 2nd ed., OUP, 2015.

[6] "Em nossos mitos de criação dizemos ao mundo, ou pelo menos a nós mesmos, quem somos". David Leeming, *Myth: A Biography of Belief*, New York: OUP, 2002, kindle ed., p. 36

[7] Marie-Louise von Franz, *Creation Myths*, Rev. Ed., Boulder Colorado: Shambala, 1995. Ch. 1

[8] Richard S. Westfall, *The Life of Isaac Newton*, Cambridge: CUP, 1993, 259; Newton abandonou posteriormente a metáfora, mas continuou a crer que Deus era literalmente onipresente no Universo.

[9] Richard S. Westfall, *The Life of Isaac Newton*, Cambridge: CUP, 1993

[10] Que todos os mitos evoluem é o principal argumento de David Leeming, *Myth: A Biography of Belief*, New York: OUP, 2002; Tony Swain, *A Place for Strangers: Towards a History of Australian Aboriginal Being*, Cambridge: CUP, 1993, explora como as mitologias dos nativos australianos modificaram-se diante de novas histórias de criação introduzidas ali posteriormente, incluindo a cristã.

[11] David Hume, *A Treatise of Human Nature, Introduction*

[12] Adaptado a partir de um texto bilíngue de Kant, "What is Enlightenment?", em https://bdfwia.github.io/bdfwia.html.

[13] Anthony Pagden, *The Enlightenment: And Why it Still Matters*, Oxford: Oxford University Press, 2013, kindle ed., p. 147 ff.

[14] Em um artigo importante sobre a emergência da Big History, Eric Chaisson oferece uma distinção similar, mas não idêntica, quando fala de "duas formas de subir a montanha". Eric Chaisson , "Big History's Risk and Challenge", *Expositions*, 8.1 (2014) 85–95, from 85-6. https://expositions.journals.villanova.edu/article/view/1774.

[15] Fred Spier, "Big history: the emergence of a novel interdisciplinary approach", *Interdisciplinary Science Reviews*, 33 (2008) :2, 141-152, from pp. 143-4 ; A respeito de Humboldt como um historiador universal ver see Fred Spier, *Big History and the Future of Humanity*, 2nd ed. (Malden, Mass.: Wiley Blackwell, 2015, 18-21, e Andrea Wulf, *The Invention of Nature: The Adventures of Alexander von Humboldt, the Lost Hero of Science*,

(London: John Murray, 2015)

[16] A citação de Ranke vem de "A Fragment from the 1860's", em Fritz Stern, ed., *The Varieties of History: From Voltaire to the Present* , Cleveland and New York: World Publishing Company, 1956, pp. 61-2

[17] Existem boas descrições introdutórias acerca do surgimento das disciplinas acadêmicas modernas em Bjorn Wittrock, "Discipline Formation in the Social Sciences", na *International Encyclopedia of the Social and Behavioural Sciences*, ed. James D. Wright, 2nd ed., Elsevier, 2015, 485-90; e Rudolf Stichweh , "Scientific Disciplines, History of", from *International Encyclopedia of the Social and Behavioural Sciences*, ed. James D. Wright, 2nd ed., Elsevier, 2015, 287-290

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[19] Stephen Turner, "Knowledge Formations: An Analytic Framework", Ch. 2 of *The Oxford Handbook of Interdisciplinarity*, 2 nd ed., Oxford: OUP, 2017, p. 9; Turner apresenta um levantamento útil e sucinto sobre a evolução das disciplinas acadêmicas.

[20] Stephen Turner, "Knowledge Formations: An Analytic Framework", Ch. 2 of The Oxford Handbook of Interdisciplinarity, 2 nd ed., Oxford: OUP, 2017, p. 18

[21] Fred Spier, ""Big history: the emergence of a novel interdisciplinary approach", *Interdisciplinary Science Reviews*, 33:2, 141-152, from pp. 144.

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[23] Ambas as citações de um ensaio sobre o 50º aniversário da palestra de CP Snow em "The Two Cultures": Martin Kemp, "Dissecting the Two Cultures", *Nature*, Vol. 459/7, maio de 2009, pp. 32-3; meus agradecimentos a Ian Crawford por esta referência.

[24] De E.O. Wilson, Consilience : The Unity of Knowledge, London: Abacus, 1998, p. 8. [25] Max Horkheimer e Theodor W. Adorno, *Dialectic of Enlightenment*, translated by Edmund Jephcott, Stanford University Press, 2002.

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[27] Erwin Schrödinger, *What is Life?*, Cambridge: CUP, 2000, p. 1 [first publ. 1944].

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[30] Erwin Schrödinger, *What is Life?*, Cambridge: CUP, 2000, p. 1 [first publ. 1944].

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[32] Erwin Schrödinger, *What is Life?*, Cambridge: CUP, 2000, 60-62.

[33] James D. Watson, *The Double Helix: A Personal Account of the Discovery of the Structure of DNA*, Penguin books, 1973, p. 23.

[34] Léo Apostel, Guy Berger, Asa Briggs, Guy Michaud, eds., Interdisciplinarity: Problems of Teaching and Research in Universities, Paris: OECD, 1972, p. 12.

[35] Léo Apostel, Guy Berger, Asa Briggs, Guy Michaud, eds., *Interdisciplinarity: Problems of Teaching and Research in Universities*, Paris: OECD, 1972, pp. 25-6.

[36] Estas definições provém de Julie Klein, "Interdisciplinarity", em Carl Mitcham, ed., *Encyclopedia of Science, Technology and Ethics*, Detroit,

MI: Macmillan reference, 2005, 1034-37, a 1034-35; e ver Julie Klein, "Typologies of Interdisciplinarity: The Boundary Work of Definition", Ch. 3 of *The Oxford Handbook of Interdisciplinarity*, 2nd ed., Oxford: OUP, 2017.

[37] Julie Klein, "Interdisciplinarity", em Carl Mitcham, ed., *Encyclopedia of Science, Technology and Ethics*, Detroit, MI: Macmillan reference, 2005, 1034-37, from pages 1034-35.

[38] Julie Klein, "Typologies of Interdisciplinarity: The Boundary Work of Definition", Ch. 3 of *The Oxford Handbook of Interdisciplinarity*, 2nd ed., Oxford: OUP, 2017, p. 29.

[39] Para mais exemplos de tais abordagens unificadoras nas ciências naturais, veja Ian Crawford, neste volume.

[40] Harlow Shapley, The View from a Distant Star: Man's Future in the Universe. Dell Publishing, New York, 1963, p. 135- 6, citado de Ian Crawford, "Widening Perspectives", this volume.

[41] Eric Chaisson , "Big History's Risk and Challenge", *Expositions*, 8.1 (2014) 85–95 , p. 87

[42] Eric Chaisson , "Big History's Risk and Challenge", *Expositions*,, 8.1 (2014) 85–95 , p. 87 https://expositions.journals.villanova.edu/article/view/1774.

[43] Fred Spier. "Big history: the emergence of a novel interdisciplinary approach", *Interdisciplinary Science Reviews*, 33:2, 141-152, a pp. 144.

[44] Eric Chaisson, *Cosmic Evolution: the Rise of Complexity in Nature*, Cambridge, Mass: Harvard University Press, 2001.

[45] Ver George Field, Gerrit Verschuur and Cyril Ponnamperuma, Cosmic Evolution: Na *Introduction to Astronomy*, Boston: Houghton Mifflin, 1978 and E.J. Chaisson, "Relating Big History to Cosmic Evolution," *em From Big Bang to Galactic Civilizations: A Big History Anthology*, Vol II, B. Rodrigue, L. Grinin, and A. Korotayev (eds.), pp 17-30, Primus Books, Delhi, 2016.

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[47] Thomas Kuhn, *The Structure of Scientific Revolutions*, 2nd ed., Chicago: University of Chicago Press, 1970.

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How Big History Could Change the World for the Better

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Abstract

Big History is ideally positioned to act as a major driver of social change through the promotion of a rigorous and accessible scientific origin story. This origin story appeals to our species' universal predilection for storytelling and unifies key scientific theories across disciplines within a single, coherent narrative. Below, I identify two interrelated problems that Big History can help combat: suboptimal cultural knowledge priorities, and scientific illiteracy. I then explore how Big History can be part of the solution, with reference to my own experience teaching Big History in Australia. I argue that if taught globally and promoted as a core part of the assumed knowledge of every culture, Big History could help facilitate a much needed shift towards a more enlightened, rational, scientifically literate, and future conscious society.

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Introduction

Contemplating the role of Big History in the social sphere is a crucial and ongoing task for big historians and one that must, at this early stage in the evolution of this academic culture, make reference to subjective opinions and anecdotal experiences. I hope this paper, and the others that appear in this collection, helps to start a conversation in the Big History community about our ongoing research, teaching and social outreach objectives. While Big History is unlikely to be a panacea for the world's ills, this paper is an argument for why we should think *big* when it comes to what we can achieve as teachers and researchers of this modern, scientific origin story. We should not underestimate the potential for a cultural shift in modern knowledge priorities to have major impacts down the line, perhaps even extending to our species' odds of ongoing survival.

Knowledge Priorities and Scientific Literacy

Our knowledge priorities in the Western world are currently skewed far too heavily towards things that don't matter much in terms of ongoing human and planetary survival, like sport, celebrity gossip, TV shows, and the theatre of partisan politics. Meanwhile, far more important issues, like existential risks, policy and funding priorities, and the promotion of scientific literacy, are massively underweighted. Most existential risks are not strongly politically prioritised and we still overwhelmingly favour short-term thinking and problem solving in the political arena (Bostrom 2002 & 2013, Todd 2017).

Outside of professions where scientific literacy is essential, nobody bats an eyelid if you say that you hated science in school, or if you admit that you can't explain basic scientific concepts and terms like thermodynamics, or natural selection. On the contrary, people are likely to nod in vigorous agreement and bond with you over the fact that they also find science hard and boring (Pew Research Center 2013). But if you've never heard of Kim Kardashian, Shakespeare, Harry Potter, or Donald Trump, many people in the Western world would be flabbergasted to hear you admit it. These are names that everybody *just knows*. You don't have to know a great deal about the characters in question, but keeping a few factoids up your sleeve allows you to signal that you are an informed participant in modern Western culture and it reassures others that you have a basic sense of what's going on in the world.

In contrast to the emphasis that we place on celebrity culture and human drama, few people seem to need reassuring at dinner parties, or in the office tea room, that you can explain terms like matter, or DNA, or that you know the difference between viruses and bacteria. C. P. Snow made a similar point over 50 years ago when he expressed consternation over the divide between the two intellectual cultures of the sciences and humanities. Of many humanities scholars, he noted:

> They give a pitying chuckle at the news of scientists who have never read a major work of English literature. They dismiss them as ignorant specialists. Yet their own ignorance and their own specialisation is just as startling. A good many times I have been present at gatherings of people who, by the standards of the traditional culture, are thought highly educated and who have with considerable gusto been expressing their incredulity at the illiteracy of scientists. Once or twice I have been provoked and have asked the company how many of them could describe the Second Law of Thermodynamics. The response was cold: it was also negative. Yet I was asking something which is about the scientific equivalent of *Have you read a work of Shakespeare's?*
>
> I now believe that if I had asked an even simpler question—such as, What do you mean by mass, or acceleration, which is the scientific equivalent of saying, *Can you read?*—not more than one in ten of the highly educated would have felt that I was speaking the same language. So the great edifice of modern physics goes up, and the majority of the cleverest people in the western world have about as much insight into it as their neolithic ancestors would have had (1959).

Snow's concerns about discpilinary siloisation and scientific illiteracy are as relevant today as they were in the 1950's. In a world where science and technology are major drivers of rapid economic growth and social change, it is more important than ever that the voting populace is informed about basic scientific concepts and that we are aware of how physical laws and phenomena have shaped the world around us, from the climate and ecology, to human nature itself. We don't need everyone to become scientists, but we should seek to bridge the growing chasm between how scientists and laypeople view the world, particularly with regards to how they reason and make decisions.

The greater the chasm between the knowledge of scientists and tech leaders, and that of the general public, the more likely our society is to fracture into tribes that speak past each other—right at a key historical moment when we need to unite in order to confront challenges on a global scale. Unfortunately, a knowledge chasm between scientists and the public already exists in the West. According to a recent Pew survey, 50% of Americans believe that climate change is mostly due to human activity, compared with 86% of scientists. 59% of Americans believe that a growing world population will be a major world problem, compared with 82% of scientists. 37% of Americans believe that it is safe to eat genetically modified foods, compared with 88% of scientists, while 65% of Americans believe humans have evolved over time compared with 98% of scientists (Pew 2015). In another representative survey of 1,000 Americans, 80% of respondents stated that they supported mandatory labels on food containing DNA (Department of Agricultural Economics 2015). That's a lot of labels!

It is important that our broader set of cultural values includes at least as much respect for evidence and objective inquiry as it does for sporting heroes and celebrities. It is not magic, myth or mysticism that will help us build a sustainable future, combat the worst effects of climate change, deflect asteroid collisions, send rockets to Mars, or safely develop human level artificial intelligence, or superintelligence. If the majority of citizens don't learn to think beyond the immediate needs of their communities and countries, our governments will not have the necessary political impetus to plan ahead and work collaboratively to

solve global problems like climate change, or develop strategies to cushion the blows and upheavals that could be wrought by widespread automation (Ford 2009, Pistono 2012, Yang 2018).

Although Western governments have recently begun to fetishise STEM education and publically emphasise its importance in the modern knowledge economy, there is a major roadblock standing in the way of the successful global spread of scientific literacy. Science is *hard* and human brains are not optimally wired to think about huge numbers and temporal and physical scales, or phenomena that are invisible to the naked eye. Given a choice between a human story with human actors, or a story involving microbes gallivanting around on our skin and in our guts, we will gravitate to the human story.

To get a majority of humans to value science and take a basic interest in its foundations, we must show how it frames their lives, explains their hardwired biases, emotions, motivations and predilections. We must demonstrate how this knowledge can help them make smarter decisions and think more insightfully about the future in this age of accelerating techno-social evolution. Telling the world to wake up and embrace the STEM revolution because the robots are coming for their jobs is a band-aid solution and a scare tactic. Our social priorities need to extend far beyond trying to make sure as many people as possible remain employable in the age of automation.

A respect and reverence for evidence, reason and empiricism, and an understanding of the biases and limitations that are encoded in human cognition and preferences will place us on higher ground when it comes to making collective decisions and defending ourselves against the modern onslaught of novel and emerging risks. I suggest here that the key to the *cultural* promotion of the Enlightenment values of reason, empiricism and the pursuit of rigorous scientific knowledge, is to bring science back to the human level and promote it through a unified narrative like Big History, which places life, the universe and everything into a comprehensible framework and renders scientific concepts and phenomena more digestible.

The Awkward Idea of Ranking Knowledge

Some kinds of knowledge are more important and more useful than others and we should value them higher in our societies and education systems. Claims like this tend to worry people in the humanities who think that hordes of beady-eyed STEM imperialists are coming to wipe art and literature and all things 'humanities' off the face of the planet. They needn't worry. Short of enslaving and oppressing the entire human race, you couldn't expunge art from human societies no matter how hard you tried. People will still write, blog, make videos and design impressive new things even if nobody pays them and even if nobody does humanities degrees. The arts are safe—indeed, they are flourishing in the information age, as there are more avenues than ever to create and share content. Humanities majors like literature are probably not very safe, but that's a separate issue from the survival of the arts themselves, and a subject for another paper.

The point here is that every choice to teach X, is a choice not to teach Y. We don't seem to have a good grasp of this when we talk about educational priorities. If I suggest that teaching Shakespeare to twenty-first century teenagers might not be the *best* use of their time, English teachers and Shakespeare enthusiasts may get very fired up and passionately explain how wonderful Shakespeare is, how much his work enriched their lives, and how outrageous it is to suggest that literature and the arts are not important. They seem to miss the word *best* and assume I'm claiming that Shakespeare is garbage and has no value whatsoever (which I'm not).

The point is that for every hour of a school day

that you teach a class of teenagers about Shakespeare, that's an hour that you're not teaching them millions of other things. If, as a society, we decide to teach Shakespeare in schools, we should be very confident in our belief that this subject is of equal or greater importance than all those other possibilities. We have finite time and finite brain capacity to dedicate to the study or an enormous and ever expanding body of material. We can't know a lot about everything and we have to make hard choices and rank some things as higher cultural knowledge priorities than others.

But what could possibly be more important than for most human beings to understand on a deep evolutionary level where we come from, how we have evolved, what kinds of cognitive biases we are still saddled with, and how we fit into a larger evolutionary framework of physical, chemical, biological, cultural and technological evolution? It should be a universal cultural expectation that human general knowledge includes a knowledge of the age of the universe and the Earth, how stars and planets formed, continental drift, natural and sexual selection, the laws of thermodynamics, and how profoundly non-human actors like asteroids, pathogens and ice ages have shaped the course of planetary and biological evolution. This macro-evolutionary history gives us the context to comprehend how and why humans have become a major driver of planetary evolution and accelerating change in the past two hundred and fifty years (Crutzen & Stoermer 2000; Steffen et al 2015; Zalasiewicz 2011). Understanding how we've got to now sets us up to think more robustly about where we're going, how much influence we have over our actions, and how we can mobilise to try and shape the future for the better.

Now, back to Shakespeare. Of the many possible arguments defending the proposition that exposure to Shakespeare is extremely important, I think the best would state that his work deftly captures universal human traits and shows in dramatic form how social and environmental pressures can drive human beings to regicide, existential despair, or the contemplation of suicide. It's all there: competition, jealousy, love, death, vaulting ambition—human nature in a nutshell. There's just one problem; the evolutionary underpinnings of these facets of human nature are not explained in the texts, as they were not yet understood. Perhaps a discussion of evolution could be brought in to the lessons to great effect? But why explore texts written in old English that many teenagers will find boring and inaccessible when there are millions of other works of art and literature that deal with the same themes? Every choice to teach X is a choice not to teach Y.

Now let's push the argument about knowledge priorities into more extreme territory with a hypothetical. If every work by Shakespeare and all knowledge of him evaporated overnight, would we have more wars? More cruel and ignorant societies? Would all the power go out? Would there be chaos? I happen to love Shakespeare's work, but my life would not be measurably worse if all traces of it were vaporised tomorrow. If all traces of the internet, electricity, or modern medicine were vaporised, or if we wound scientific knowledge back to its state in the Middle Ages, my life (and yours) would be dramatically, qualitatively worse.

A world where nobody knows anything about Shakespeare, Harry Potter, or Kim Kardashian is not dangerous. The loss of these memes poses no obstacle to long-term human flourishing. But a world where nobody understands evolution, or basic scientific concepts, and where many people distrust scientific findings, is very dangerous. Scientific ignorance and distrust can literally up humanity's existential risk ante. It matters for the whole of humanity that people continue to vaccinate their children. It matters that there is continued political support for research and development in areas that could lead to cures for diseases and extend the human life and healthspans. It

matters that we don't elect loose cannon leaders who may be more likely to consider a nuclear first-strike. It matters that we have effective global policies in place to that enable us to mobilise immediately in the event of a pandemic.

I argue that in the Western world, our hierarchy of assumed knowledge and values needs to be stripped away and rewritten with science forming a key part of the new foundations. Cultivating a basic knowledge of how evolution works, and how the universe and the world evolved, is *more* important than many of the things we spend much longer learning, thinking and gossiping about. Such a project will take generations, but significant gains could be made in a single generation if we collectively decide to rank some forms of knowledge and memes higher than others.

Why Big History Should Be a Key Knowledge Priority

A scientific origin story like Big History can help the global community make sense of the novel phenomena of the modern world, imparting a general knowledge of evolutionary history that places humanity within a 13.8 billion year cosmic continuum (Christian 2005, 2018; Christian Brown and Benjamin 2014). This origin story can also promote an epistemology that emphasises reason, science and empiricism, over magic, myth and mysticism. If a large-scale cultural shift could be effected in knowledge priorities, and if humans learned to think more scientifically and prioritise issues on a global scale, the world could be a safer and more cohesive place. Such a shift might even make the difference between human survival and extinction.

Teaching Big History at Macquarie University in Sydney revealed to me how powerful this origin story could be if it were universally taught to children and adults around the world. Macquarie University is the major global hub of Big History and is home to the Big History Institute, which is headed by the founding big historian, Professor David Christian. David was my PhD supervisor, and I taught alongside him for two semesters on Macquarie's flagship first year Big History Course MHIS115: An Introduction to Big History in 2016 and 2017.

For the most part, my Big History classes at Macquarie University were made up of humanities majors, who often told me they hated science in school. At the start of the course, most of them couldn't explain natural selection to me if their lives depended on it. The majority also couldn't explain the difference between a scientific theory and a hypothesis and many of the students throughout the course continually asked, "but isn't evolution just a theory?"

These were smart, educated university students who had no idea how old the Earth or the universe is, how it got here, how organisms are related, or how the struggle for existence works. I also came out of high school not knowing any of that—I don't know how, but it's an alarmingly common story in Australia. When teaching Big History to a cohort of mostly humanities majors, I often wondered: how can we truly call them *humanities* majors if they don't know anything about the evolutionary history of humans?

Understanding natural and sexual selection, and the selection pressures that have shaped our brains, our physiology and motivations can help us to understand families, bonding, love, competition, war, reciprocal altruism, adultery, virtue signaling, gossip, humble bragging and Twitter mobs—the stuff that our lives are made of. These things do not appear out of thin air and nor does racism, nationalism, or any other form of tribal behaviour. The same goes for civilisations, technologies, and everything else created by humans or studied in human history.

In Big History, we aim to bridge the two cultures divide, bringing the sciences and the humanities

in closer communion (Snow 1959, Wilson 2013). We do not do this tokenistically, but for the sake of rendering important knowledge about the world more accessible (Christian 2017). It is helpful to harness robust scientific knowledge and use it as a starting point to explore questions of meaning, purpose, ethics and values, which have traditionally been the bread and butter of the humanities. This merging of the two cultures appears to give students a more robust framework to start thinking, not just about what life is and how it evolved, but about how to live well in the Anthropocene—a time when things are changing very fast.

Although my experiences are anecdotal, I believe that Big History is an ideal educational tool to impart scientific knowledge globally, because the delivery method of an origin story appeals to the universal human predilection for storytelling (Corballis 2009, Gottschall 2012, Gottschall & Sloan Wilson 2005). Most people will never become scientists or experts in particular fields of science. But most people have a deep hunger to find meaning in the world and to orient their lives within a broader framework of existence (Wilson 2013). Big History satisfies the enduring human drives for storytelling, myth making and meaning, but it helps modern humans make sense of the world with reference to the theories and findings of modern science. It is also "the product of a globalized world" and "the first origin story for all humans" (Christian 2017). We need a global worldview like Big History, as it can help humans across continents and cultures find common ground and learn to view each other as kin.

What Do We Teach In Big History?

The first year undergraduate Big History course at Macquarie University is open to students from all faculties and disciplines. The cohort is large—usually between 150-300 hundred students. The course spans 13 weeks and the students are taken on an epic journey from the big bang to the present and the future.

The course is rapid fire, to be sure, but students are introduced to:

- The big bang and the evolution of the early universe
- Stellar and planetary evolution
- Gravity
- The laws of thermodynamics
- Plate tectonics and continental drift
- The origins of life, biological evolution and natural selection
- Hominid and human evolution
- The rise of collective learning and the accelerating pace of cultural and technological evolution in the Palaeolithic, Neolithic and modern eras
- The rise of a single world system of communication and trade
- The Industrial Revolution
- The Anthropocene and the future

My understanding is that this teaching structure remains in place at Macquarie. Instead of teaching about each topic in isolation, Big History tutors illustrate how all of these phenomena fit together in a larger sequence of billions of years of evolution. They remind students how fleeting and recent all of human life and history is in the larger scheme of space and time and introduce them to the core bodies of evidence that support the leading scientific theories on which Big History is built. Tutors also draw students' attention to knowledge gaps on important questions like when, where and how life originated on Earth, and encourage them to critically evaluate the robustness of the bodies of evidence they encounter.

When I taught Big History at Macquarie, we also primed students to start thinking about the future of human, planetary and cosmic evolution. How did humans muster the power to start shaping the future of

terrestrial evolution? Are we wise enough to wield the powerful new technologies we have invented? What will become of our planet and the universe long term? And how can our choices today affect how the lives of future generations will unfold? (Christian 2005; Christian, Brown and Benjamin 2014).

By the end of a thirteen week Big History course, it's remarkable how many students wrote in their feedback forms that their worldview had changed. This feedback was heartening, in no small part because these students vote and influence market trends with their consumer behaviour. Many of them will eventually have children and they will have to make choices about what to teach the next generation. Just imagine what a difference it could make to their lives and to society if they didn't start this intellectual awakening in their twenties, but had the tools and frameworks to think about the big picture of evolution and humanity from the get-go.

Of course I can't make concrete claims about how much knowledge big history students retain after completing a tertiary big history unit. The lack of data on the social impacts and benefits of Big History courses is conspicuous—though it is worth pointing out that the discipline is young and has not had the social cachet to attract the interest of education researches until recently. Nevertheless, similarly encouraging preliminary feedback has been reported by Joseph Voros (2018), who teaches Big History at Swinburne University of Technology in Melbourne, Australia. In addition, the Italian education researchers Adalberto Codetta Raiteiri et al (2018) have flagged Big History as a knowledge framework that could play an important role in helping young people develop as global citizens who will be capable of responding to the unique challenges of the twenty-first century.

Seconding the thoughts of the researchers above, I can't help thinking that as long as students of Big History carry away with them some of the gist of the story, some sense of the scale of history, and some feeling that change is an evolutionary constant, they're better off than they were before and more likely to pick up new scientific ideas and keep assimilating them into a larger worldview in the future.

Concluding remarks

We currently devote a huge proportion of the human-headspace pie to entertaining memes focused on human dramas. There is nothing objectionable about the fact that humans love stories and gravitate to gossip and drama. But it is problematic that we are *so* enamored with human drama that we allocate little time or headspace to the contemplation of anything else.

I have argued in this paper that it should be a universal cultural expectation that human general knowledge includes a knowledge of the age of the universe and the Earth, how stars and planets formed, continental drift, natural and sexual selection, the laws of thermodynamics, and how profoundly non-human actors like asteroids, pathogens and ice ages have shaped the course of planetary and biological evolution. Among other things, this cosmic evolutionary narrative gives us the context to comprehend how and why humans have become a major driver of planetary evolution and accelerating change in the past two hundred and fifty years (Crutzen & Stoermer 2000; Steffen et al 2015; Zalasiewicz 2011). Understanding how we've got to now sets us up to think more robustly about where we're going.

If there is only one thing the next generation of students walks away from high school knowing, the evolutionary worldview conveyed through Big History would be my choice over any other single subject area. Whatever a person chooses to do from there, it's relevant, not just in work, but in family life, relationships, future planning and self-understanding. Big History is a modern, scientific map of reality that renders key scientific concepts and theories accessible

to all. If taught globally, Big History could serve as a much-needed torch against ignorance, superstition and tribal thinking—or to use Carl Sagan's (1996) turn of phrase, act as "a candle in the dark".

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Como a Big History pode mudar o mundo para melhor

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Tradução de Tatiana Massuno

Resumo:

A *Big History* está idealmente posicionada como uma grande propulsora de mudança social através da promoção de uma história científica, rigorosa e acessível, da origem. Essa história da origem apela a nossa universal predileção de espécie por narrativas e unifica teorias científicas chave entre disciplinas em uma única narrativa coerente. Abaixo, eu identifico dois problemas interrelacionados que a *Big History* poderia ajudar a combater: prioridades de conhecimento cultural subótimas, e analfabetismo científico. Eu então exploro como a *Big History* pode fazer parte da solução, tendo como referência a minha própria experiência de ensino de *Big History* na Austrália. Defendo que, se ensinada globalmente e promovida como parte central do conhecimento assumido de cada cultura, a *Big History* pode facilitar uma tão necessária mudança no sentido de uma futura sociedade mais consciente, esclarecida, racional e cientificamente letrada.

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Introdução

Contemplar o papel da Big History nessa esfera social é uma tarefa crucial e contínua para os historiadores da Big History e uma que deve, nesse estágio inicial na evolução dessa cultura acadêmica, fazer referência a opiniões subjetivas e experiências anedóticas. Espero nesse artigo, e nos próximos que aparecerem nessa coleção, ajudar a iniciar uma conversa na comunidade da Big History sobre nossos objetivos de pesquisa em andamento, ensino e alcance social. Enquanto a Big History é improvável de ser uma panaceia para os males do mundo, o presente artigo é um argumento do porquê devemos pensar grande com relação ao que podemos conseguir enquanto professores e pesquisadores dessa história da origem científica e moderna. Não devemos subestimar o potencial de uma mudança cultural nas prioridades de conhecimento moderno ter grandes impactos futuros, talvez até mesmo aumentando a probabilidade de sobrevivência de nossa espécie.

Prioridades de Conhecimentos e Letramento científico

Nossas prioridades de conhecimento no mundo ocidental estão atualmente muito inclinadas para coisas que não importam em termos de sobrevivência planetária e humana, tais como esportes, fofocas de celebridades, shows de TV, e o teatro da política partidária. Enquanto isso, questões muito mais importantes, tais como riscos existenciais, prioridades de financiamento e políticas, e a promoção de letramento científico, são massivamente menosprezadas. Boa parte dos riscos existenciais não é fortemente priorizada politicamente e nós ainda favorecemos, em grande escala, soluções e pensamentos de curto prazo na arena política. (Bostrom 2002 & 2013, Todd 2017).

Fora de profissões onde o letramento científico é essencial, ninguém se surpreende se você diz ter odiado ciências na escola, ou se você admitir não saber explicar conceitos e termos científicos básicos, tais como termodinâmica e seleção natural. Ao

contrário, as pessoas estão mais propensas a concordar vigorosamente e a se conectar com você por também acharem as ciências difíceis e chatas (Pew Research Center, 2013). Mas se você nunca ouviu falar de Kim Kardashian, Shakespeare, Harry Potter, ou Donald Trump, muitas pessoas no mundo ocidental ficariam espantadas de ouvi-lo assim admitir. Esses são nomes que todos *simplesmente conhecem*. Você não precisa saber muito sobre os personagens em questão, mas manter alguns factoides na manga te permite sinalizar que você é um participante informado na cultura ocidental moderna e assegura aos outros de que você tem um senso básico do que está acontecendo no mundo.

Em contraste à ênfase dada à cultura das celebridades e ao drama humano, poucas pessoas parecem necessitar serem asseguradas em jantares, ou na sala de chá do escritório, de que você consegue explicar termos tais como matéria, ou DNA, ou que você sabe a diferença entre um vírus e uma bactéria. C. P. Snow disse algo parecido há 50 anos quando expressou a sua consternação acerca da divisão entre as duas culturas intelectuais das ciências e humanidades. De muitos acadêmicos das humanidades, ele percebeu:

> Eles dão um risinho piedoso ao saber de cientistas que nunca leram alguma grande obra de literatura inglesa. Eles os desmerecem enquanto especialistas ignorantes. Mesmo assim, sua própria ignorância e especializações são igualmente surpreendentes. Muitas vezes estive no meio de grupo de pessoas que, pelos padrões da cultura tradicional, seriam consideradas altamente cultas e que com considerável prazer expressaram sua incredulidade perante a ignorância dos cientistas. Uma ou duas vezes fui provocado e perguntei quantos deles poderiam descrever a segunda lei da termodinâmica. A resposta foi fria: foi também negativa. No entanto perguntava algo como o equivalente científico para *Você já leu alguma obra de Shakespeare*?
>
> Agora acredito que se tive perguntado algo mais simples – tal como, O que significa massa, ou aceleração, que seria o equivalente científico de perguntar, *Você sabe ler*? – não mais do que um em dez de pessoas altamente cultivadas sentiria que falávamos a mesma língua. Então o grande edifício da física moderna se eleva, e a maioria das pessoas mais inteligentes do mundo ocidental tem tanto a dizer sobre ele quanto os seus ancestrais neolíticos teriam (1959)

As preocupações de Snow sobre a divisão entre disciplinas e o analfabetismo científico são tão relevantes nos dias de hoje como eram na década de 50. Em um mundo onde ciência e tecnologia são grandes propulsores de rápido crescimento econômico e mudança social, é mais importante que nunca que a população votante tenha conhecimento acerca de conceitos científicos básicos e que esteja a par de como as leis da física e fenômenos moldaram o mundo ao nosso redor, do clima à ecologia, à própria natureza humana. Não precisamos que todos se tornem cientistas, mas devemos colmatar o crescente abismo que separa a forma como cientistas e leigos veem o mundo, especialmente no que diz respeito a como pensam e tomam decisões.

Quanto maior o abismo entre o conhecimento de cientistas e de líderes do mundo da tecnologia, e aquele do público em geral, quanto maior a probabilidade da nossa sociedade se dividir em tribos que não conseguem dialogar – exatamente em um momento histórico crucial no qual precisamos nos unir para confrontar desafios de escala global. Infelizmente, um abismo entre o conhecimento de cientistas e público já existe no Ocidente. De acordo com uma pesquisa feita pela Pew, 50% dos americanos acreditam que a mudança climática se deve basicamente à atividade humana, comparado a 86% dos cientistas. 59% dos americanos acredita que a população crescente será um grande problema mundial, isso comparado a 82% dos cientistas. 37% dos americanos acredita ser seguro ingerir comidas geneticamente modificadas, no caso de cientistas, a percentagem sobre para 88%; enquanto

65% dos americanos acreditam que os humanos evoluíram com o passar do tempo, 98% dos cientistas assim acreditam (Pew 2015). Em outra pesquisa representativa envolvendo 1000 americanos, 80% afirmaram que apoiavam rótulos compulsórios em comidas contendo DNA (Department of Agricultural Economics 2015). São muitos rótulos!

É importante que nosso conjunto de valores culturais mais amplo inclua pelo menos tanto respeito pela evidência e investigação objetiva quanto tem por heróis do esporte e celebridades. Não são a magia, o mito ou o misticismo que nos vão auxiliar a construir um futuro sustentável, combater os piores efeitos da mudança climática, desviar colisões de asteroides, mandar foguetes para Marte, ou desenvolver, de forma segura, inteligência artificial no nível da humana, ou superinteligência. Se a maioria dos cidadãos não aprender a pensar além das necessidades imediatas de suas comunidades e países, nossos governos não terão o ímpeto político necessário para planejar e trabalhar colaborativamente para resolver problemas globais tais como a mudança climática, ou desenvolver estratégias para amortecer os golpes e transtornos que poderiam ser causados pela automação generalizada. (Ford 2009, Pistono 2012, Yang 2018).

Apesar de os governos ocidentais terem recentemente começado a fetichizar a educação de STEM e publicamente enfatizar sua importância na economia de conhecimento moderno, há um grande obstáculo para uma bem sucedida propagação global de letramento cientifico. A ciência é *difícil* e o cérebro humano não está otimamente preparado para pensar em grandes números e escalas físicas e temporais, ou em fenômenos que são invisíveis a olho nu. Dada a escolha entre uma história humana com atores humanos e uma história envolvendo micróbios vagando por nossa pele e entranhas, vamos optar pela história humana.

Para fazer com que a maioria dos humanos valorize a ciência e tenha interesse básico em seus fundamentos, nós precisamos mostrar como ela molda suas vidas, explica seus vieses, emoções, motivações e predileções internalizadas. Devemos demonstrar como esse conhecimento pode ajudá-los a tomar decisões mais inteligentes e pensar mais criteriosamente sobre o futuro nesta era de aceleração da evolução tecno-social. Dizer ao mundo para acordar e abraçar a revolução STEM porque os robôs estão vindo tomar seus empregos é uma solução temporária e uma tática de intimidação. Nossas prioridades sociais precisam se estender para além de tentar garantir que o maior número possível de pessoas continue empregável na era da automação.

Respeito e reverência pela evidência, razão e empiricismo, e entendimento acerca dos vieses e limitações que estão inscritos na cognição humana e preferências nos colocará em uma posição privilegiada para tomar decisões coletivas e nos defender contra o ataque moderno de riscos novos e emergentes. Sugiro aqui que a chave para a promoção *cultural* de valores iluministas como razão, empiricismo e a busca rigorosa por conhecimento científico, é trazer a ciência novamente para o nível humano e promovê-la através de uma narrativa unificada como a Big History, que posiciona vida, universo e tudo mais em um enquandramento compreensível, tornando conceitos e fenômenos científicos mais digeríveis.

A ideia estranha de hierarquizar conhecimento

Alguns tipos de conhecimento são mais importantes e mais úteis que outros e devemos valorizá-los em nossas sociedades e sistemas educacionais. Afirmações desse tipo tendem a preocupar pessoas nas humanidades que imaginam que hordas de imperialistas STEM de olhos maliciosos estão chegando para eliminar as artes e a literatura e todas as humanidades da face da terra. Eles não precisam se preocupar. A não ser que se escravize e oprima toda a raça humana, você não conseguirá expurgar a arte das

sociedades humanas, não importa o quanto tente. As pessoas sempre irão escrever, fazer vídeos e blogs e projetar novas coisas impressionantes mesmo que não sejam pagas e mesmo que ninguém tenha formação em humanidades. As artes estão seguras – de fato, estão florescendo na era da informação, já que há mais possibilidades do que nunca para criar e compartilhar conteúdos. Cursos de humanidades como a literatura provavelmente não estão muito seguros, mas isso é algo distinto da sobrevivência das artes, e assunto para outro artigo.

O ponto aqui é que toda escolha de ensinar X é uma escolha para não ensinar Y. Parece que não temos uma boa compreensão disso quando falamos de prioridades educacionais. Se eu sugerir que ensinar Shakespeare aos adolescentes do século XXI pode não ser o melhor uso para seus tempos, professores de inglês e entusiastas de Shakespeare podem se entusiasmar e começar a dizer, passionalmente, como Shakespeare é maravilhoso, a explicar o quanto seu trabalho enriqueceu suas vidas e dizer como é ultrajante sugerir que a literatura e as artes não são importantes. Eles parecem interpretar mal a palavra *melhor* e assumir que estou afirmando que Shakespeare é um lixo e que não possui qualquer valor (o que não estou).

Cada hora de um dia escolar em que você ensina a uma turma de adolescentes sobre Shakespeare é uma hora em que você não está ensinando um milhão de outras coisas. Se, enquanto uma sociedade, decidirmos ensinar Shakespeare nas escolas, devemos estar bastante confiantes na nossa crença de que esse assunto é de igual ou mais relevância que todas as outras possibilidades. Temos tempo finito e capacidade cerebral finita para dedicar ao estudo de um conjunto de material enorme e em constante expansão. Não podemos saber tudo e temos que fazer decisões difíceis e categorizar algumas coisas como prioridades culturais mais elevadas que outras.

Mas o que poderia ser mais importante do que boa parte dos humanos entender em um nível evolucionário profundo de onde viemos, como evoluimos, com que tipos de vieses cognitivos ainda estamos sobrecarregados, e como nos encaixamos na escala evolucionária mais ampla de evolução física, química, biológica, cultural e tecnológica? Deveria ser uma expectativa cultural que o conhecimento geral humano inclua um conhecimento sobre a idade do universo e da Terra, sobre como as estrelas e planetas se formaram, sobre a deriva continental, sobre a seleção natural e sexual, sobre as leis da termodinâmica, e sobre quão profundamente agentes não-humanos tais como os asteroides, patógenos e idades glaciais deram forma ao curso de evolução planetária e biológica. Essa história macro-evolucionária nos dá o contexto para compreender como e o porquê dos humanos terem se tornado os grandes propulsores de evolução planetária e de mudança acelerada nos últimos duzentos e cinquenta anos (Crutzen & Stoermer 2000; Steffen et al 2015; Zalasiewicz 2011). Entender como chegamos até aqui nos prepara para pensar de forma mais robusta sobre aonde iremos, sobre quanta influência temos sobre nossas ações, sobre como podemos nos mobilizar para tentar e modificar o futuro para melhor.

Agora, de volta a Shakespeare. De todos os argumentos possíveis defendendo a proposição de que a exposição a Shakespeare é extremamente importante, acho que o melhor afirmaria que seu trabalho capta com destreza características humanas universais e mostra na forma dramática como pressões sociais e ambientais podem levar os humanos ao regicídio, ao desespero existencial, ou à contemplação do suicídio. Tudo está lá: competição, ciúme, amor, morte, ambição excessiva – a natureza humana, em poucas palavras. Há apenas um problema: os fundamentos evolucionários dessas facetas humanas não estão explicados nos textos, uma vez que ainda não haviam sido entendidos. Talvez a discussão sobre a evolução poderia ser trazida às aulas com grande sucesso? Mas por que explorar textos escritos em inglês antigo que muitos adolescentes acharão chatos e inacessíveis

quando há milhões de outras obras de arte e de literatura que lidam com os mesmos temas? Toda escolha de ensinar X é uma escolha de não ensinar Y.

Agora vamos levar o argumento sobre prioridades de conhecimento a um território mais extremo com uma hipótese. Se toda obra de Shakespeare e todo conhecimento sobre ele desaparecesse de uma hora para outra, teríamos mais guerras? Sociedades mais cruéis e ignorantes? A energia acabaria? Teríamos o caos? Eu amo a obra de Shakespeare, mas a minha vida não seria mensuravelmente pior se todos os vestígios dela desaparecessem amanhã. Se os vestígios da internet, eletricidade, ou da medicina moderna evaporassem, ou se o conhecimento científico voltar ao seu estado na Idade Média, minha vida (e a sua) seriam dramaticamente, qualitativamente piores.

Um mundo onde ninguém saiba nada sobre Shakespeare, Harry Potter, ou Kim Kardashian não é perigoso. A perda desses memes não traz grandes obstáculos ao florescimento humano no longo prazo. Mas um mundo onde ninguém entende sobre evolução, conhecimentos básicos científicos, e onde muitas pessoas desacreditam descobertas científicas é muito perigoso. Ignorância e descrédito científico podem literalmente elevar o risco existencial da humanidade. É importante para toda a humanidade que as pessoas continuem a vacinar suas crianças. É importante que haja apoio político contínuo à pesquisa e ao desenvolvimento em áreas que possam levar à cura de doenças e estender as expectativas de vida humana e saúde. É importante que não elejamos líderes inconsequentes que estejam mais propensos em considerar uma primeira ofensiva nuclear. É importante que tenhamos políticas globais efetivas em vigor que nos permitam nos mobilizar imediatamente no caso de uma pandemia.

Afirmo que no mundo ocidental, nossa hierarquia de conhecimento e valores assumidos precisa ser eliminada e reescrita tendo as ciências como parte chave de sua nova fundação. Cultivar o conhecimento básico de como a evolução funciona, e como o universo e o mundo evoluíram, é *mais* importante que muitas das coisas que passamos boa parte do tempo estudando, pensando sobre e fofocando a respeito. Tal projeto levará gerações, mas ganhos significativos poderão acontecer em uma única geração se decidirmos coletivamente categorizar algumas formas de conhecimento e memes como mais elevados que outros.

Porque a Big History deveria ser a prioridade de conhecimento chave

Uma história científica da origem tal como a Big History pode ajudar a comunidade global a entender os fenômenos novo do mundo moderno, ao transmitir o conhecimento geral da história evolucionária que coloca a humanidade dentro do continuum cósmico de 13, 8 bilhões de anos (Christian 2005, 2018; Christian, Brown e Benjamin 2014). Essa história da origem pode também promover uma epistemologia que enfatize a razão, a ciência e a empiria, em detrimento da magia, do mito e do misticismo. Se uma mudança cultural em larga escala pudesse afetar as prioridades de conhecimento, e se os humanos aprendessem a pensar mais cientificamente e priorizar questões de escala global, o mundo poderia ser um lugar mais seguro e coeso. Tal mudança poderia até fazer a diferença entre a sobrevivência e a extinção humana.

Ensinar a Big History na Macquarie University em Sydney mostrou quão poderosa a história da origem seria se fosse ensinada universalmente a crianças e adultos ao redor do mundo. A Macquarie University é o maior centro de Big History no mundo e abriga o Big History Institute, que é liderado pelo historiador fundador, o professor David Christian. David foi meu orientador de doutorado, e ao seu lado, lecionei por dois semestres, na Macquarie, o emblemático curso de Big History do primeiro ano MHIS115: Uma introdução à Big History em 2016 e 2017.

Minhas turmas de Big History na Macquarie University eram majoritariamente compostas por alunos de humanidades, que frequentemente me diziam terem odiado ciências na escola. No início do curso, muitos não conseguiam explicar seleção natural, nem que suas vidas disso dependessem. A maioria também não conseguia explicar a diferença entre uma teoria científica e uma hipótese e muitos alunos ao longo do curso continuamente me perguntavam, "mas a evolução não é apenas uma teoria?".

Esses eram alunos universitários inteligentes e cultivados que não tinham ideia de quantos anos a Terra ou o universo tinham, de como chegamos aqui, de como os organismos se relacionavam, de como a luta pela existência funciona. Também saí do ensino médio sem saber nada disso – não sei como, mas é uma história alarmantemente comum na Austrália. Ao ensinar Big History a um grupo de estudantes de humanidades (majoritariamente), frequentemente me perguntava: como podemos realmente chamá-los de estudantes de humanidades se eles não sabem nada sobre a história evolucionária dos humanos?

Entender as seleções natural e sexual, e as pressões de seleção que moldaram nossos cérebros, nossa fisiologia e motivações pode nos ajudar a entender as famílias, as ligações, o amor, a competição, a guerra, o altruísmo recíproco, o adultério, a sinalização de virtude, a fofoca, o se gabar humilde e as mobilizações no Twitter (Twitter mobs) – coisas de que nossas vidas são feitas. Essas coisas não aparecem do nada assim como o racismo, o nacionalismo e qualquer outra forma de comportamento tribal. O mesmo serve para as civilizações, as tecnologias e tudo mais criado por humanos e estudado na história humana.

Na Big History, pretendemos colmatar a divisão entre duas culturas, ao aproximar as ciências e as humanidades (Snow 1959, Wilson 2013). Nós não fazemos isso de maneira simbólica, mas sim para tornar mais acessível o conhecimento importante sobre o mundo (Christian 2017). É útil aproveitar o conhecimento científico robusto e usá-lo como um ponto de partida para explorar questões de significado, propósito, ética e valores, que tradicionalmente têm sido o pão com manteiga das humanidades. Essa fusão das duas culturas parece dar aos alunos uma estrutura mais robusta para começar a pensar, não apenas sobre o que a vida é e como evoluiu, mas sobre como viver bem no Antropoceno - uma época em que as coisas estão mudando muito rapidamente.

Embora as minhas experiências sejam anedóticas, acredito ser a Big History uma ferramenta educacional ideal para transmitir conhecimento científico globalmente, porque o instrumento de veiculação de uma história da origem apela a nossa predileção universal por narrativas (Corballis 2009, Gottschall 2012, Gottschall & Sloan Wilson 2005). Maior parte das pessoas nunca se tornará cientistas ou especialistas em um campo particular da ciência. Mas boa parte das pessoas tem grande desejo de achar sentido no mundo e orientar suas vidas dentro de uma estrutura de existência mais ampla (Wilson 2013). A Big History satisfaz os duradouros impulsos humanos por narrativas, criação de mitos e de significados, mas ajuda aos humanos modernos entender o mundo tendo como referência as teorias e descobertas da ciência moderna. Também é "o produto de um mundo globalizado" e "a primeira história da origem para todos os humanos" (Christian 2017). Precisamos de uma visão de mundo global tal como a Big History, já que ela pode ajudar humanos de diferentes continentes e culturas a encontrar uma base comum e aprender a ver um ao outro como semelhante.

O que ensinamos na Big History?

O curso de graduação, de primeiro ano, de Big History na Macquarie University é aberto a alunos de todos os cursos e faculdades. O grupo é grande – geralmente entre 150 e 300 alunos. O curso dura 13

semanas e os alunos são levados a uma jornada épica desde o Big Bang até o presente e o futuro.

O curso é jogo rápido, com certeza, mas os alunos são apresentados a:

- O big bang e a evolução do universo inicial
- A evolução estelar e planetária
- Gravidade
- As leis da termodinâmica
- As placas tectônicas e a deriva continental
- As origens da vida, a evolução biológica e a seleção natural
- O hominídeo e a evolução humana
- A ascensão do aprendizado coletivo e o ritmo acelerado de evolução cultural e tecnológica no Paleolítico, Neolítico e eras modernas.
- A ascensão de um único sistema mundial de comunicação e troca
- A revolução industrial
- O Antropoceno e o futuro

Acredito que essa estrutura de ensino ainda perdure na Macquarie. Ao invés de ensinar cada tópico isoladamente, os tutores de Big History ilustram como todos esses fenômenos se encaixam em uma sequencia mais ampla de bilhões de anos de evolução. Eles relembram aos alunos quão fugaz e recente toda a vida e história humanas são no esquema mais amplo de espaço e tempo e os apresenta aos principais corpos de evidência que dão base às principais teorias científicas que formam a Big History. Os tutores também chamam a atenção dos alunos para as lacunas de conhecimento em questões importantes tais como quando, onde e como a vida se originou na Terra, e os encoraja a avaliar criticamente a robustez dos corpos de evidência que encontram.

Quando ensinei Big History na Macquarie, também estimulávamos os alunos a começar a pensar sobre o futuro da evolução humana, planetária e cósmica. Como os humanos reuniram o poder de começar a moldar o futuro da evolução terrestre? Somos sábios o suficiente para manejar as poderosas novas tecnologias que inventamos? O que será do nosso planeta e do universo a longo prazo? E como podem nossas escolhas hoje afetar como as vidas das gerações futuras se desdobrarão? (Christian 2005; Christian, Brown e Benjamin 2014)

É claro que não posso fazer afirmações concretas sobre quanto conhecimento os alunos de Big History retêm após completar uma unidade terciária de Big History. A falta de dados sobre os impactos sociais e benefícios dos cursos de Big History é conspícua – no entanto, é importante mencionar que a disciplina é nova e não possuía o prestígio social para atrair o interesse de pesquisadores de educação até recentemente. Entretanto, um feedback preliminar similarmente encorajador foi reportado por Joseph Voros (2018), que ensina Big History na Swinburne University of Technology em Melbourne, Austrália. Além disso, os pesquisadores italianos de educação Adalberto Codetta Raiteiri et al (2018) indicaram a Big History como um esquema de conhecimento que poderia cumprir um papel importante ao ajudar os jovens a se tornarem cidadãos globais que serão capazes de responder aos desafios únicos do século XXI.

Endossando os pensamentos dos pesquisadores acima, não posso deixar de pensar que enquanto os estudantes da Big History levarem consigo algumas das teorias da história, algum sentido da escala da história e algum sentimento de que a mudança é uma evolução constante, eles estão em melhor situação do que estavam antes e mais propensos a captar novas idéias científicas e continuar a assimilá-las em uma visão de mundo mais ampla no futuro.

Considerações Finais

Nós atualmente devotamos uma grande proporção

de nossa capacidade mental humana aos memes divertidos focados nos dramas humanos. Não há nada censurável no fato de os humanos amarem histórias e serem atraídos por fofoca e drama. Mas é problemático que estejamos *tão* enamorados pelo drama humano que aloquemos pouco tempo ou espaço mental à contemplação de qualquer outra coisa.

Defendi nesse artigo que deveria ser uma expectativa cultural universal que o conhecimento geral humano inclua o conhecimento da idade do universo e da Terra, de como planetas e estrelas se formaram, da deriva continental, das seleções natural e sexual, das leis da termodinâmica, de quão profundamente agentes não humanos tais como asteroides, patógenos e idades glaciais moldaram o curso da evolução planetária e biológica. Entre outras coisas, essa narrativa evolucionária cósmica dá o contexto para se compreender como e o porquê de os humanos terem se tornado os grandes propulsores de evolução planetária e mudança acelerada nos últimos duzentos e cinquenta anos (Crutzen & Stoermer 2000; Steffen et al 2015; Zalasiewicz 2011). Compreender como chegamos até aqui nos prepara para pensar mais robustamente sobre aonde vamos.

Se há apenas uma coisa que a próxima geração de alunos saia do ensino médio sabendo, a visão de mundo evolucionária transmitida através da Big History seria minha escolha em detrimento de qualquer outra área de saber. O que a pessoa escolher fazer a partir daí, é relevante, não apenas no trabalho, mas na vida familiar, nas relações, nos planejamentos futuros e em termos de autoconhecimento. A Big History é o mapa científico e moderno da realidade que torna conceitos e teorias científicas centrais acessíveis a todos. Se ensinada globalmente, a Big History pode se tornar a tão necessária tocha contra a ignorância, superstição e pensamento tribal – ou para usar a expressão de Carl Sagan (1996), ser "a vela no escuro".

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Big History in its Cosmic Context

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Abstract
Current models of Big History customarily take the observed increases over cosmic time of material-energetic complexity as their central concept. In this paper, we use Erich Jantsch's pioneering masterwork *The Self-Organizing Universe* as the primary perspective from which to extend the customary 'increasing material-energetic complexity' view of Big History in two principal 'directions'. Firstly, *outwards*, with an emphasis on increasing scale, scope and context to consider whether non-terrestrial analogues of Big History might exist or have existed elsewhere, and thus to embrace the 'sibling' multidisciplinary fields of SETI (the search for extra-terrestrial intelligence), Astrobiology, and 'Cosmic Evolution'. And secondly, *inwards*, with a focus on (human) consciousness and the increasing complexity of human cognitive experience ('interiority') that has been apparent over the time-frame we have been able to observe it. Since Big History is a narrative which necessarily includes our own awakening to conscious awareness—and the felt sense of 'meaning' which our interiority brings with it—it would be valuable to examine related models which might also allow for an integration or unification of the two perspectives of physical-objective material-energetic complexity, on the one hand, and the complexity of subjective-conscious interiority, on the other. This is important, because it might provide a pathway that could help resolve recent debates around whether, and if so where, 'meaning' might reside in Big History. Current models do not tend to have a clear way to do this, so a particular integrative framework is introduced and outlined—due to the philosopher of consciousness Ken Wilber—which seeks to unify the customary complexity of matter-energy view of Big History with a 'complexity of consciousness' view, and which thereby suggests a very natural way to resolve the question of meaning 'in' Big History. It also provides a useful framework for thinking about a third direction of exploration, namely *onwards*, towards the *future* of our civilisation (and even our species), in both explicit and implicit modes, each of which are also briefly outlined. We end with a dedication to the memory of Erich Jantsch and his work.

Keywords
Big History, SETI (Search for Extra-Terrestrial Intelligence), Astrobiology, Cosmic Evolution, Consciousness, Interiority, Integral Model of Consciousness, 'Meaning' in Big History, Erich Jantsch, Ken Wilber.

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Introduction and Origin

Big History represents an increasingly-visible and -popular approach to the modern scientifically-based understanding of how humankind came to be here—what David Christian (2018) has notably called an "origin story". It is both a very powerful conceptual model—usually based upon the foundational concept of increasing material-energetic complexity over cosmic time-scales—as well as a very engaging narrative that helps us to make sense of the *entirety* of the past, literally, from the beginning of the Universe with the Big Bang nearly 14 billion years ago to our present-day planet-wide information-based technological civilisation (e.g., Brown 2008, 2017; Chaisson 2001, 2007, 2008; Christian 2004, 2008, 2018; Christian, Brown & Benjamin 2013; Delsemme 1998; Jantsch 1980; Spier 1996, 2010, 2015). In my own Big History teaching, I sometimes like to describe this as a narrative that leads "from

hydrogen to humanity" (prompted by a comment by Carl Sagan; see later) or, alternatively, "from quarks to consciousness" (about which latter I will have much to say below). In the more measured and less colloquial language of the International Big History Association (2016), 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 have been many earlier attempts to bring together synoptic views of the history of the Universe or of the totality of what is known about it. Big History pioneer Fred Spier has discussed some of these in the first chapter of both (so far) editions of his recent major theoretical work on the structure of Big History (Spier 2010, 2015), to which the reader is referred for a more detailed exploration. As Spier (2015, p. 26) notes, however, it was Erich Jantsch (1980) who developed perhaps the first systematic model of Big History based upon the modern understanding of the principles of the non-equilibrium thermodynamics of dissipative structures in what has come to be known—and not without some disagreement over the use of the term, e.g., Chaisson (2014, sect. 5.1)—as 'self-organisation'. It remains a stunning example of multidisciplinary integrative scholarship even after four decades, and anyone who is interested in a deeper understanding of the multi-level and multi-scale physical processes underlying Big History would do well to get hold of a copy.[1]

Accordingly, in this paper, Jantsch's seminal pioneering work will serve as the foundational framing perspective for some ideas and discussion around how to extend the customary 'increasing material-energetic complexity' view of Big History in what I hope are fruitful lines of thinking. I propose to do this in two main ways, or in two principal 'directions': *outward*, with an emphasis on increasing scale, scope and context to consider whether other non-terrestrial analogues of Big History might exist or have existed; and *inward*, with a focus on (human) consciousness and the increasing complexity of human cognitive experience ('interiority'). Since Big History is, in a very literal sense, 'our' story—a story which of necessity includes as part of it our own awakening to consciousness and the sense of 'meaning' this awareness has brought with it—it would be valuable to examine any suitable related models which might also allow for any putative integration or unification of the perspectives of increasing physical-objective material-energetic complexity, on the one hand, with increasing complexity of subjective-conscious interiority, on the other. And there are very good reasons for attempting to do so.

Those who were present at the 2014 IBHA Conference at Dominican University in San Rafael would know of the tensions that ensued there around the issue of 'meaning' in Big History, tensions that existed to a greater or lesser degree in various sessions right up to the very last session itself, the final plenary panel discussion (Gustafson et al. 2014). A question was asked by Laura Rahm during that final plenary regarding the variety of approaches to and interpretations of Big History that were evident in the conference program, some of which were openly considered problematic. Along with a couple of the other panellists, I offered some ideas in answer to Laura's question, and mentioned (I think) that "one of these years" when I got time I would probably write something up. Well, I think that perhaps it is now high time to elaborate on the conceptual model informing what I said in that session.[2]

These debates about 'meaning' in Big History can hopefully be accommodated within a view and model to be presented in outline below—primarily through the simple observation that 'meaning' can be regarded

1 Even second-hand copies tend to be quite expensive (some ridiculously so!), but, luckily, it appears to be possible (at least at the time of this writing) to download a free PDF copy from https://monoskop.org/File:166495032-The-Self-Organizing-Universe-by-Erich-Jantsch.pdf

2 This paper is the first of a planned pair of papers that are intended to lay out my personal conception of Big History and how I understand both its broad contours, as well as its place in the cosmic scheme of things. This paper deals with the latter of these. The follow-up paper will deal with the former.

as existing (as it were) 'in here' (i.e., inside our own consciousness or interiority) without requiring it to necessarily exist independently 'out there' in the wider Universe, which proposition was then and is still quite unpalatable to many scientists, especially physical scientists (such as I was trained to be). Hence, part of the purpose of this paper is to begin to attempt to bring together (to the degree possible) some of the disparate perspectives held on this issue under the umbrella of a unifying framework which potentially allows these different viewpoints to co-exist in a mutually-supportive way, even as they might disagree on certain specifics and relative emphases. Of course, it remains to be seen how successful that will be; but it is, I think, still well worth the effort to try. I take heart from the observation that Big Historians as a group tend to be well accustomed to and supportive of allowing for different relative emphases of different parts of the Big History narrative among their colleagues, given that we all tend to share a common interest in and commitment to disseminating the overall general account of Big History, even as we might tend personally to focus in deeper detail on only part(s) of it.

Now, as noted above, current models of Big History usually take as their foundational concept the observed increases over cosmic time-scales of material-energetic complexity. But these models do not tend to have a clear way to also include due consideration of the observed increases in the complexity of human cognitive experience over the time-frame that we have been able to observe it. To this end, therefore, a particular model of Big History will be presented which seeks to unify the usual material-energetic-complexity view of Big History—founded on the physical sciences, especially physics and chemistry, and understood in a most profound and insightful way through the seminal work of Erich Jantsch—with an 'increasing complexity of interiority' view, which has recently emerged from the humanities—especially psychology and anthropology, drawn from the synthesising theoretical work of the philosopher of consciousness Ken Wilber. Such a unifying or integrating framework has at least the potential to do justice to the enduring insights and truths from the physical and social sciences while also incorporating the emerging insights and theoretical advances which have come to light over the last century or so of research into human psychology and culture; this is principally why it is being presented and outlined here.

In the next section, then, a few key aspects of Jantsch's work will be presented as the basis and primary framing perspective for our further discussions. This perspective is then expanded in the 'outward' direction towards 'outer space' to include the over-arching 'sibling' fields of SETI (the search for extra-terrestrial intelligence), astrobiology, and 'cosmic evolution' as a whole (the 'nesting' of which perspectives will be elucidated in more detail below). Following that, the direction of our exploration then reverses 'inwards', towards the 'inner space' of our interior consciousness and culture, and Wilber's 'integral' framework is thereby presented as one possible natural extension to Jantsch's perspective which fully embraces, incorporates and broadens it. This high-level model of "orienting generalisations" (as Wilber often has it) also turns out to provide a very useful framework for thinking about a *third* direction of exploration, namely, the 'onward' direction of the future of our civilisation (and even our species)—from a 'macro' perspective commensurate with the scope and perspective of Big History—via two main modes, 'explicit' and 'implicit', which are each also outlined. Some concluding remarks revisit the principal ideas in summary, and we end with a dedication to the memory of Erich Jantsch and his work, as well as a call-to-action to further continue the multidisciplinary synthesising work which he embarked upon.

Now, though, let us begin our re-framing of the customary Big History viewpoint, in order to see what new insights and perspectives we might yet uncover or bring into view as we slightly shift our usual frame of reference…

The Frame, part 1
Erich Jantsch – The Self-Organizing Universe and The Evolutionary Vision

Erich Jantsch spent the last part of his much-too-short life thinking deeply about the future directions of human civilisation and how it might be more purposefully guided with wisdom and perhaps even with foresight. Over an immensely prolific period of a mere decade and a half or so, his considerable intellect and attention ranged from, initially, technological forecasting (Jantsch 1967), technological planning and social change (Jantsch 1969b, 1972b), and the design of and planning in human systems (Jantsch 1969a, 1972a, 1975), to, ultimately, a deeper view of human evolution, consciousness, self-organisation and even self-transcendence (Jantsch & Waddington 1976), culminating in a unifying vision of evolutionary self-organisation at multiple scales of complexity, brought together in his masterwork *The Self-Organizing Universe* (Jantsch 1980), with a subsequent edited volume, *The Evolutionary Vision* (Jantsch 1981b), published soon after his untimely death.

The Self-Organizing Universe (hereafter *SOU*) attempted to describe—using non-equilibrium thermodynamics as its foundational framework—the fundamental physical processes that give rise to new emergent properties at each new distinctly-persisting level of complexity, a quasi-stable dynamical "process structure" he also called a *régime* (p. 21ff). Spier (1996, p. 14), too—independently and unaware of Jantsch's use of the term—also used the term *regime* for his approach to Big History (Spier 2015, p. 68n4). The relationship of Jantsch's and Spier's 'regimes' to Christian's (2004) well-known concept of 'thresholds' can most easily be understood as essentially analogous to that of the distinction between the floors of a building and the stairs connecting them: the floors are the quasi-stable regimes, while the transitions between floors are the thresholds of step-changes in complexity which give rise to new emergent properties on each floor. Both are useful ways of viewing the overall structure of the building, but one or other view may be relatively more useful depending upon the particular focus taken and/or the specific aspect of Big History under investigation. They are, in other words, complementary and co-exist as essentially a 'figure-ground' pair. (See, e.g., Fig. 1 in Aunger 2007, pp. 1141, for a rough schematic sketch of this general idea.)

One of the very many key ideas in *SOU* is the *simultaneous co-evolution* of both 'microstructures' and 'macrostructures'—that is, of individual entities making up macroscopic collections or collectives of such entities—brought about by the dynamical processes set in motion after the Big Bang, in part by the asymmetry of the arrow of time caused by the

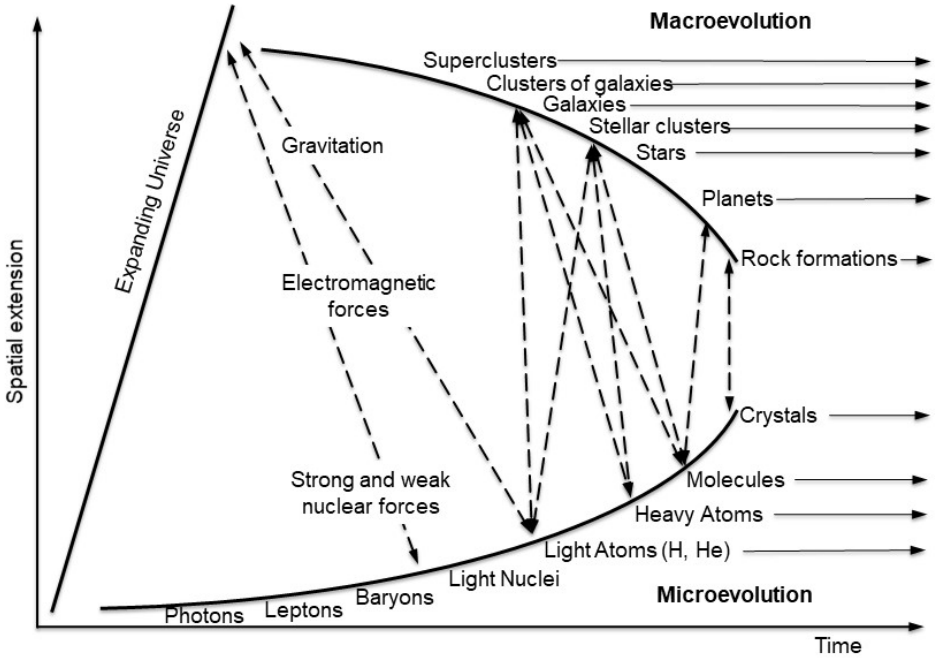

Figure 1. "Cosmic evolution of macro- and micro-structures. … These levels mutually stimulate their evolutions."
Source: Recreated by the author from Jantsch (1980, Fig 24, p. 94.)

expansion of the Universe. Thus, in Figure 1 (taken from Jantsch 1980, Fig. 24, p. 94), we see how the smaller microstructures of 'microevolution' on the bottom of the figure become more complex—sub-atomic particles form into light nuclei which form into light atoms which form into heavier atoms which form into molecules, and so on—while the corresponding macrostructures also evolve in a co-evolutionary process of 'macroevolution' along the top of the figure—most recognisably, as galaxies to stars to planets, and so on.

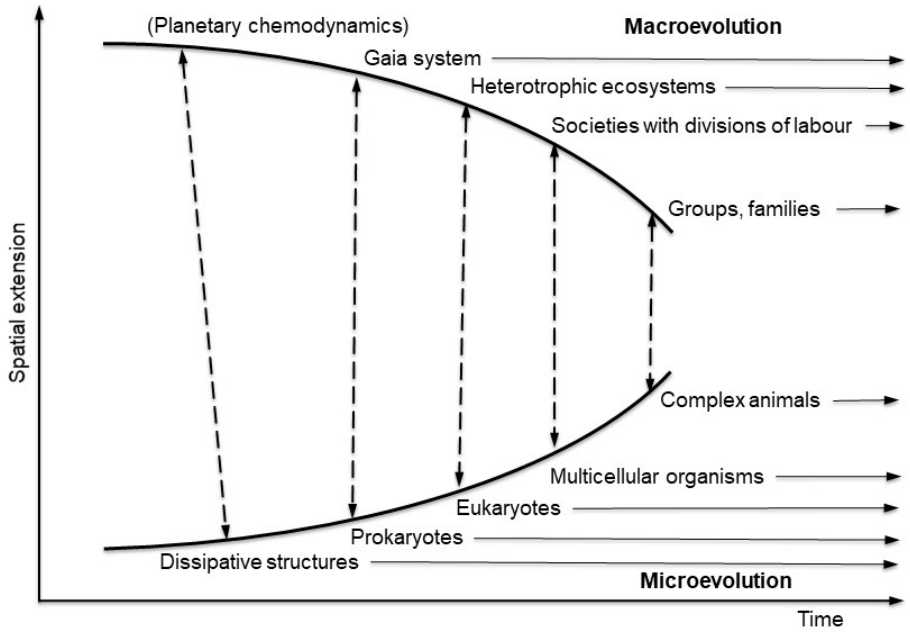

Figure 2. "The history of life on earth expresses the co-evolution of self-organizing macro- and micro-systems in ever higher degrees of differentiation."
Source: Recreated by the author from Jantsch (1980, Fig 28, p. 132.)

The converging arcs in Figure 1 are intended to show that spatial scale is *decreasing over time for the macrostructures*—galaxies are smaller than clusters of galaxies, stellar clusters smaller than galaxies, stars are smaller than stellar clusters, planets are smaller than stars, and so on—while the spatial scale is *increasing over time for the microstructures*—atoms are larger than nuclei, molecules are larger than atoms, and so on. These are all physical structures undergoing physical changes, and Jantsch calls this overarching dual-scale process of physical change 'cosmic evolution', a term that has since that time come to be used by an increasing number of researchers to mean a somewhat broader process than the merely physical, something discussed further below.

This process of dynamical-evolutionary change continued on planet Earth beyond merely physical structures, as is shown in Figure 2, wherein the increasing complexity of distinctly *biological* entities is now also evident—prokaryotes to eukaryotes to multicellular organisms to complex animals, in the micro-evolutionary branch—along with the corresponding macrostructures—the Gaia system to heterotrophic ecosystems to societies with divisions of labour (i.e., specialisations of functions in multicellular organisms) to groups and families of complex animals, in the macro-evolutionary branch. Here, too, spatial extent similarly shows the decreasing/increasing trajectories of macro and micro, respectively.

In this phase of what Jantsch calls "sociobiological evolution" the dominant direction of interaction between macro and micro co-evolution is principally from the macro to the micro. That is, the macrostructural branch influences the entities on the micro-evolutionary branch to a much, much larger degree than the reverse case. This is depicted in the left half of Figure 3 by the bold arrows extending downwards from the macro and the much thinner arrows extending upwards from the micro. Intuitively, this makes sense, since an organism must adapt to the environmental milieu in which it finds itself or else it risks extinction. But this dominance by the macro over the micro in this phase of the universal co-evolutionary process is about to change, as is shown in the centre of Figure 3, which also depicts the third main phase

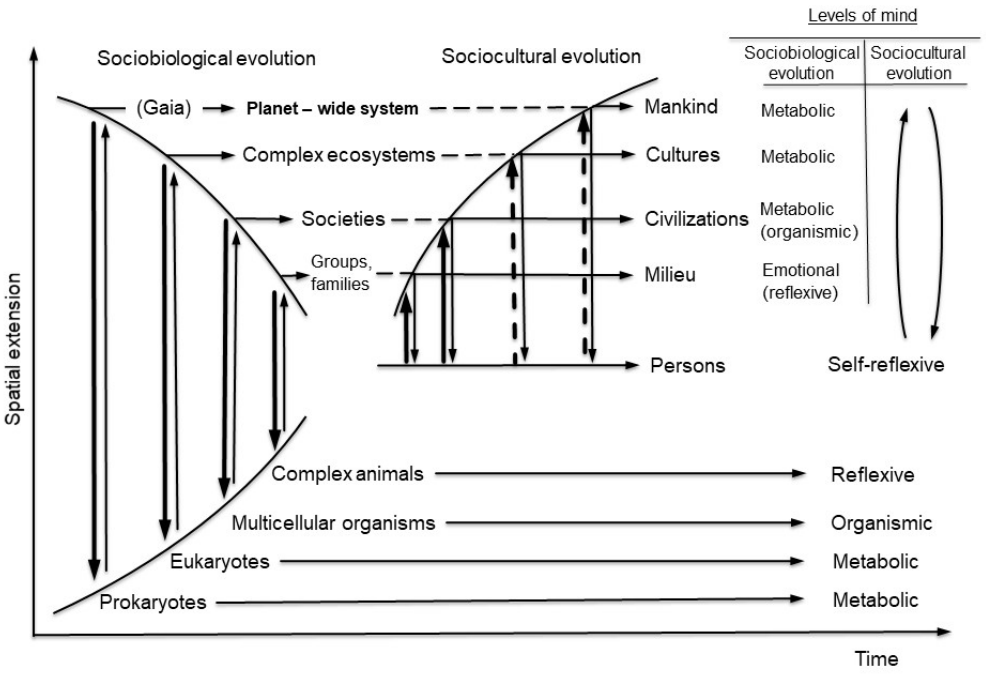

Figure 3. "The transition from the sociobiological to the sociocultural phase of evolution turns things upside down, as far as the dominant relationships in the co-evolution of macro- and micro-systems are concerned. Self-reflexive mind … sets out to re-create the macroworld. … [A]t the levels of culture and mankind-at-large, this is still a partially conscious process only."
Source: Recreated by the author from Jantsch (1980, Fig 32, p. 175.)

of universal co-evolution—the "sociocultural" phase.

In sociocultural evolution, the dynamic 'flips'—micro starts to push back on and influence the macro much more strongly than prior. Rather than only adapting ourselves to suit the environmental milieu (which we were very good at, truth be told, which is why we were able to walk to the ends of the Earth, literally, in only a few tens of thousands of years), we also set out to adapt the environment to suit ourselves, an ability that has become increasingly powerful and pervasive during our tenure here on planet Earth. Beginning slowly in the Palaeolithic, we began to modify to an increasing extent the environments we found ourselves in, and then most definitely once the process of 'extensification' (cf., e.g., Christian 2004, p. 190ff) began to run down and forced us to become increasingly sedentary. The process of increasing intensification of food production *in situ* is of course none other than the transition to agriculture itself (Christian's 'Threshold 7'), and the present global-scale crises we are experiencing can be considered as merely the natural endpoint of that process of, as Jantsch puts it in the caption to Fig. 3, "self-reflexive mind setting out to re-create the macroworld". Once Mankind expanded to become a planet-wide system comparable to Gaia itself (cf. Fig. 3), then something like an 'Anthropocene' epoch (Zalasiewicz, Crutzen & Steffen 2012) is therefore seen to be an almost inevitable result of this sort of dynamic, especially since our influence on the planet is still only (as Jantsch notes) "a partially conscious process" (albeit now slowly becoming more so).

One can see in these three remarkable diagrams essentially the entire process of Big History laid out graphically—from the Big Bang and the expansion of the Universe, to the formation of atoms, galaxies, stars and planets, to the emergence and evolution of life (on Earth), to the subsequent arising of humans, as well as the increasing agency of humanity bumping up against the limits of the biosphere—all driven by an underlying process of increasing complexity of material-energetic structural organisation and informational flows, resulting from energy gradients driving non-equilibrium thermodynamic systems processes of dissipative self-organisation (gasp!).

It is in this way that Jantsch's (r)evolutionary vision was able to bring together so much of the history of the cosmos into a coherent process view based on a few key ideas and principles. Thus, we can see clearly how non-equilibrium thermodynamical processes of ever-

increasing complexity are seen to underlie the entirety of Big History—the means by which the evolutionary processes of the Universe gave rise to us—which Jantsch portrayed through the three main phases of evolution he depicted: cosmic (i.e., astrophysical), sociobiological and sociocultural.

Jantsch died in December 1980 just under a month hort of his 52nd birthday (Capra 1981; Linstone, Maruyama & Kaje 1981; Zeleny 1981) and did not live to see his final work published – the edited volume *The Evolutionary Vision* (Jantsch 1981b) in which he laid out his (as it turns out) final views on the "new emerging paradigm" of evolutionary self-organisation:

> … the greatest importance of today's evolutionary vision may lie not in its present propositions and concepts, but in the new questions it poses in many areas of scientific endeavour and especially in the unifying transdisciplinary 'pull' it exerts in these areas. (p210)
>
> *Of [great] importance will be a precise formulation of the relations between biological/ecological/sociobiological evolution on the one hand and psychological/sociocultural evolution on the other*. … The evolutionary vision opens up the possibility of understanding all creative dynamics in a unified way. (p212) (emphasis added here).

Or, as Zeleny noted (1981, p. 120), quoting Jantsch's "last article" (Jantsch 1981a):

> The new paradigm of self-organization, and with it the focal concept of autopoiesis, ends the alienation of science from life. It forms the backbone of an emergent science of life that includes a science of our own lives, the biological as well as the mental and the spiritual aspects, the physical as well as the social and the cultural.

We shall turn to a version of that unifying view in due course below. In the meantime, let us now look at how we might expand our view beyond our own specific case to consider whether other possible instances of the same universal co-evolutionary processes that gave rise to us might also have occurred elsewhere….

Outward
'Cosmic Evolution'

In the decades since Jantsch wrote, the term *cosmic evolution* has come to be used (often by astronomers, astrobiologists and some other multidisciplinary scientists) to mean not merely the *physical* segment of this overall multi-phase process, but rather the *entirety* of the evolution of the cosmos itself through *all* of these (at least) three distinct phases (see, e.g., Dick 2009). So it was, for example, that Carl Sagan (1980, p. 338) would say, referring to the process leading from the Big Bang to us in chapter/episode 13 of his book/TV series *Cosmos,* that: "these are some of the things that hydrogen atoms do given fifteen billion years of cosmic evolution" (and hence my epithet "from hydrogen to humanity", above). Eric Chaisson (1979, 2001) has also used the term for decades in the same broad manner when referring to the overarching general processes of increasing complexification leading "from the big bang to humankind" (e.g., Chaisson 2008). Some authors, however (e.g., Grinin et al. 2011), and notably Spier (e.g., 2015, ch. 3), continue to use the term 'cosmic evolution' in the same way Jantsch used it—referring to the *physical* processes alone. This is of course a perfectly legitimate use of the terminology, provided one is very clear about what is being referred to by it, notwithstanding that its initial use by Jantsch has since largely been overtaken by the broader meaning used by an increasing number of researchers and scholars in recent years. For my own part, I too prefer to use the term 'cosmic evolution' in the broader sense of Chaisson, Sagan, and Dick, and prefer to instead use the terms *physical*, *astrophysical, material* or even *cosmological evolution* for the more specific and restricted sense of the term as used by Jantsch, Spier, Grinin and others.

Now, there is more to this than mere terminological hair-splitting, however, for when one thinks about this carefully, it should be clear that 'Big History' is ultimately concerned with the history of just *one* planet—ours—among the trillion or so that are now

thought to exist in the Milky Way Galaxy, not to mention the hundreds of billions of trillions that can thereby be inferred to exist in the wider observable universe. As Chaisson (1979, p. 38) put it, "if the processes of cosmic evolution outlined here are valid, then they apply to every nook and cranny of the universe", and therefore, "should the scenario of cosmic evolution be valid, even in its broadest perspective, we can speculate rightfully about the associated implication for the plurality of extraterrestrial life" (p. 24).

Thus, from this perspective, this "scenario of cosmic evolution" (Chaisson) *can*, and perhaps even *should*, be considered a *universal nomothetic* process—a process which could apply (at least in principle) *throughout* the Universe, rather than being regarded simply and merely the (singular) *idiographic* case of how *we* arose through the evolutionary dynamics of the developing Cosmos on this planet in this galaxy. In other words, in this view, 'Cosmic Evolution', as such, is to be regarded as a *general universal process*, while 'Big History' is to be regarded as really just *our particular instance or unfolding of that general universal process*. We are, then, a single instance in the even larger context of what may be countless other instances of the unfolding of the general theme(s) of Cosmic Evolution potentially occurring throughout the Cosmos—what Sagan (1980, ch. 2) so poetically called "one voice in the cosmic fugue". In this view, therefore, whereas 'Big History' is concerned with specifically 'Cosmos, Earth, Life, and Humanity' (per the IBHA), 'Cosmic Evolution' is concerned more generally with 'Cosmos, Planet, Life, and Intelligence', wherever and however that process may play out. For my part, I find it very easy indeed to imagine the possibility of the existence of other planets where life, and perhaps even intelligence, has arisen, as the Cosmic-Evolutionary scenario might have unfolded there to varying degrees, potentially giving rise to those beings' own unique variants or analogues of (what we call our) Big History.

Astrobiology, SETI

This extended perspective now brings clearly into view the closely-related multi-disciplinary 'sibling' fields of SETI, the Search for Extra-Terrestrial Intelligence (e.g., Ekers et al. 2002; Harrison 2009; Morrison, Billingham & Wolfe 1979; Shklovskii & Sagan 1966; Tarter 2001, 2004; Tarter et al. 2010), and Astrobiology, the study of how life might arise and evolve in the Universe (e.g., Chyba & Hand 2005; Domagal-Goldman et al. 2016; Mix et al. 2006). In this expanded conception, then, we are—here on our "pale blue dot" (Sagan 1995)—simply a single 'element' (in the language of set theory) of what may be a *set* of intelligent technology-using civilisations, which itself forms a *sub-set* of intelligent lifeforms in general (i.e., not necessarily technology-using), which itself forms a *sub-set* of lifeforms in general (i.e., not necessarily intelligent), which arise on places/planets where lifeforms *could* arise (i.e., habitable planets, in general). This, in turn, forms a sub-set of all places/planets in the Milky Way Galaxy, which is but one galaxy among perhaps a hundred billion or so in the observable Universe, which is but a small part of what may be an immensely-large, and perhaps even infinite, Universe. And, according to more recent thinking, our Universe may itself simply be one among an uncountable number of other universes in an even larger 'multiverse' of indeterminate and probably unimaginable extent (e.g., Hawking & Mlodinaw 2010). The image of nested Russian 'Matryoshka dolls' is almost irresistibly called to mind.

One can imagine this nested progression (at least in our Universe) in at least two ways: one as a series of *potential* trajectories passing through the various phases of Cosmic Evolution—(cosmological/material/astro)*physical*, *biological*, and (socio)*cultural* (which also clearly includes *technological* as a possible sub-phase); and the other as a nested series of sets each containing a *potential* number of elements/instances, as above. Unfortunately, however—at least, so far, at the time of this writing—the *known* instances of both of these conceptions number only

one, but I do nonetheless (very scientifically!) have my fingers crossed! The 'progression through phases' conception is most clearly embodied in the well-known Drake Equation of SETI, which is intended to yield an estimate of the number N of existing technological civilisations in the Milky Way Galaxy both capable of and willing to undertake interstellar radio communication (Drake 1961). Steven Dick (2003) notes that the Drake Equation can be written as the product of three main types of terms, as shown in Equation (1), as was also very clearly implied by Jantsch's work in *SOU*. The number N of extant communicating technological civilisations is given by:

$$N = \underbrace{R_* \times f_p \times}_{\text{astronomical}} \quad \underbrace{n_e \times f_l \times f_i \times}_{\text{biological}} \quad \underbrace{f_c \times L}_{\text{cultural}} \qquad (1)$$

where R_* is the average rate of star formation in the Galaxy; f_p is the fraction of those that have planets; n_e is the average number of planets in each of these star systems with conditions favourable to life; f_l is the fraction of these planets that go on to actually develop life; f_i is the fraction of these inhabited planets that go on to develop intelligent life; f_c is the fraction of planets with intelligent life that develop technological civilizations capable of interstellar communication; and L is the average communicative lifetime of such a civilization.

There have been many extensions to the Drake Equation and its terms since it was first written down (see, e.g., the related discussion in Voros 2017), including, more recently, by Claudio Maccone (2010) who notably expanded the customary conception of the Drake Equation as the product of seven *static* positive numbers representing the various terms, to their being considered as *variables* which may take arbitrary *random* (albeit positive) values—a considerable extension of the original conception.

In other words, the broad *process* of Cosmic Evolution encompasses several distinct *phases* of evolution: Physical, Biological, Cultural, and indeed, Technological, which one might denote by **P**, **B**, **C** and **T**, respectively. As noted, the only known *instance*, so far, of the Cosmic Evolution process/scenario moving through *all* of these phases **P-B-C-T**, is *us*: Big History, 'BH'. If we denote by $\mathcal{K}$ the set of all known (to us) instances of the full Cosmic Evolutionary scenario moving through all the phases **P-B-C-T**, and also imagine another set, denoted by $\mathcal{A}$, of all *actual*—both those known-to-us *and* those *as-yet-unknown*-to-us—instances of the full Cosmic Evolutionary scenario, then, clearly, $\mathcal{K}$ is either a proper sub-set of, or is equal to, $\mathcal{A}$, thus: $\mathcal{K} \subseteq \mathcal{A}$. Hence, at this point in time, $\mathcal{K}$ is a set containing only a single element, $\mathcal{K} = \{\text{BH}\}$. From a set-theoretical point of view, therefore, it could also be the case that BH is the only member of $\mathcal{A}$ as well, but this *cannot be rigorously concluded*—there is always the *possibility of the existence* of other elements of $\mathcal{A}$ which are not yet part of $\mathcal{K}$. This distinction, while it may appear to be simply mathematical-logical sophistry, is nonetheless a very important point, because it forces us to remember Chaisson's caveat above: *if* it can happen *here*, then it can happen *anywhere*, and just because we are unaware of it does not mean it cannot happen, or cannot already have happened (see, e.g., Norris 2000), somewhere else.

Now, as should be fairly clear, SETI is actually looking for other instances of the full Cosmic Evolutionary scenario moving through phases **P-B-C-T**—indeed, SETI is predicated upon looking for signs of intelligence manifested through the use of technology, whether by signalling (intentionally or not), or perhaps through other occurrences of it (such as engineering projects that are not explicitly designed for signalling but for some other purpose and which we happen to detect incidentally). Indeed, as should also be clear from Eq. (1), the "orthodox" SETI enterprise (as Bradbury, Ćirković & Dvorsky 2011, put it), as it has been carried out for much of its 60-year history (Dick 2006), has assumed a Cosmic Evolutionary scenario of the more-or-less explicit form 'Cosmos, Planet, Life, Intelligence, *Technology*', of which

we—Cosmos, Earth, Life, Humanity—are obviously an example, but one which nonetheless represents only *one* particular type of cultural evolution (per the Drake term f_c), where intelligence acquires, or has the environmental contextual possibility of developing, *technological* capabilities.

However, it should also be clear that intelligent species could evolve whose own cultural evolution does not extend to the development of high-technology (such as radio telescopes, or other macro-engineering capabilities) and which thereby remains wholly *non*-technological, i.e., **P-B-C** (no **T**). Our Earthly cetaceans, for example, do not have such technology, despite their probable very high intelligence (Herzing 2010); nor do they have the environmental context in which such technology could even be developed, living as they do in the oceans of Earth. Non-terrestrial **P-B-C** analogues of these creatures could easily exist elsewhere. In recent years the SETI enterprise has begun to change its operational assumptions to allow for wider search strategies to be devised, which in turn allows for consideration of a wider range of potential scenarios of 'contact'—the usual term used for the discovery of extra-terrestrial life, whether intelligent or not (some of which are discussed in Voros 2018).

I should probably also note, in passing, that in contrast to Claudio Maccone (2014), who has suggested that SETI is a part of Big History, it should be clear from the foregoing argument and discussion that I hold the *converse* view: that Big History is, actually, a part (which is to say, a subset) of SETI.

The field of Astrobiology, by way of comparison, is concerned principally with just the first two phases of the Cosmic Evolutionary scenario, **P-B**, and current and planned searches are usually predicated upon looking for signs of past or present biological activity ('biosignatures') either on bodies in our Solar System (e.g., Mars, Jupiter's moon Europa, or Saturn's moons Titan and Enceladus), or in the spectral imaging of extra-solar planets ('exoplanets') (see, e.g., Domagal-Goldman et al. 2016). The well-known SETI scientist Seth Shostak (2009) has suggested that there is a "three-way horse race to find compelling evidence of life beyond Earth"—two looking for "stupid life" (Astrobiology), and one for intelligence (SETI)—which, in his view, is an even-chance split among the three contenders, and will be resolved within a couple of decades or so as our searches widen and search technologies improve. In his public lectures he often likes to bet everyone in the audience a cup of coffee that this will be so (e.g., Shostak 2012, c.7m). For my part, I'd rather have the 'contact' than the coffee!

In short, then, I see Big History as the central standpoint or 'origin' (to use the term both in a quasi-mathematical sense as well as in resonance with David Christian's sense) from which we can expand our perspective 'outward' to include other multi-disciplinary 'sibling' approaches that, in a sense, 'enfold' the Big History viewpoint in successively nested contexts of scale and scope: SETI, Astrobiology, and Cosmic Evolution in its multi-phase conception. Big History, then, as 'our' trajectory through the full multi-phase scenario of Cosmic Evolution, is thereby seen to be just one strand in what, I hope, may be a cosmic tapestry of many other related analogous trajectories experienced by other intelligent entities who have themselves awoken to their own analogue of the Big History narrative and the sense of wonder and even awe it engenders. Perhaps their trajectories will have similar themes, or perhaps they will have some suitably intriguing contrasting counterpoints, that will further reveal the richness and texture possible in the unfolding processes of Cosmic Evolution. We are, as yet, but one voice, singing alone in the Great Cosmic Dark. We long to hear a second, desperately searching for another to sing harmony with, or at least to know that somebody else is out there. Let us hope, with Sagan and Shostak, that it is not too long before another voice in the "cosmic fugue" joins in with ours…

The Frame, part 2 – Inward

Of course, the 'outward' direction from our customary view of Big History is not the only possible path to

explore further; there is a second direction that takes us 'inwards', not in terms of smallness or miniaturisation, but rather 'inwards' into our consciousness and 'interiority', as intimated by Jantsch's comments above. Contemplative and meditative traditions have been doing this for thousands of years, of course, but it is only in comparatively recent times that some of their insights have begun to be tested and verified scientifically (e.g., Goleman & Davidson 2017; Wright 2017), which is of course an entirely non-negotiable entry prerequisite for any research to be considered seriously by the Big History enterprise per the IBHA ("empirical evidence and scholarly methods"). Thus we now turn our attention from exploring 'outer' space and the expanded set of nested contexts which we examined there, to begin to explore the perhaps even more fascinating terrain of 'inner' space, and the insights and findings that we may yet find awaiting us there. And, in order to do this, we are going to need a good map.

The Integral Framework of Ken Wilber

One of the most comprehensive contemporary models of psychology and consciousness is the 'integral' model or framework developed over several decades of work through five main 'phases' by the American philosopher of consciousness Ken Wilber (1999-2000, 2006, 2007). In 1995, his earlier work elaborating individual psychological and collective sociocultural evolution was integrated and unified with the material-energetic evolutionary complexity view of Jantsch from *SOU* (Wilber 1995), just as was suggested to be possible by Jantsch's comments above. Figure 4, adapted from some of Wilber's more recent work (2016), shows some of the details of a part of the overall model. In essence, it re-depicts, elaborates and extends the material-energetic perspective of Jantsch, with microevolution here placed on top and macroevolution on the bottom. Key milestones in those evolutionary processes can be seen represented, and a comparison with Figs 1-3 will show that humans emerge as a distinct stage of complexity at around milestone 9/10 (the numbers on the diagonals represent arbitrary units of increasing complexity, and are used principally for correlative cross-comparison with the corresponding level of complexity in the other branch).

On the upper branch, for example, one can see the usual progression from atoms to molecules to prokaryotes to eukaryotes to multicellular organisms and beyond, with the (proto-)human structure of a triune

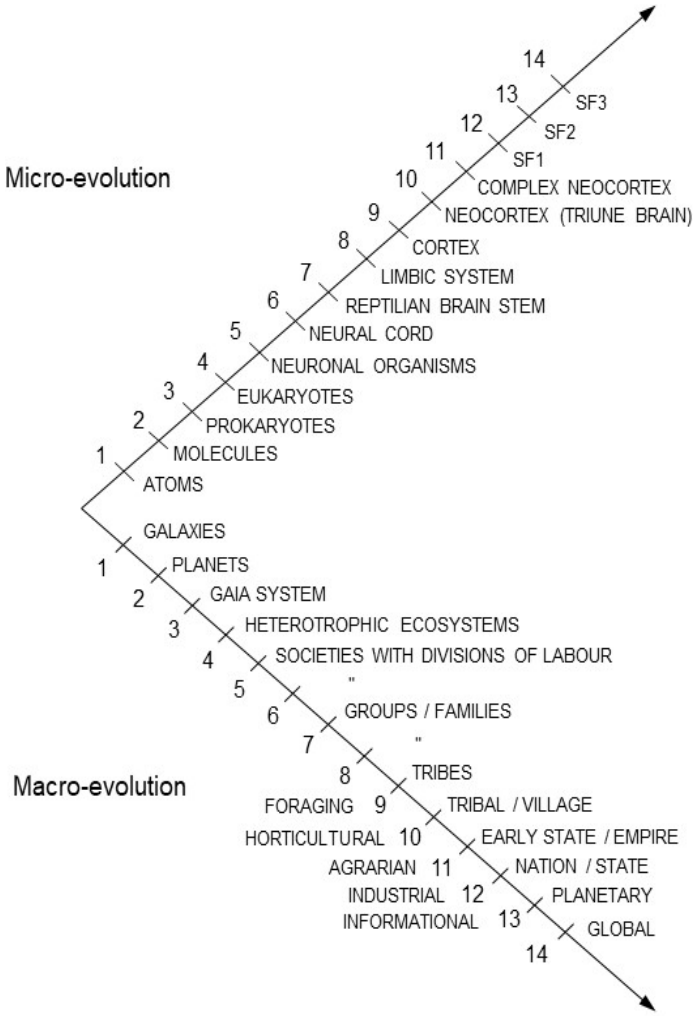

Figure 4: Combination, re-rendering and extension of Figs 1-3, with the positions of micro- and macro-evolution swapped, and with newer more detailed human milestones of complexity elaborated and added. Source: adapted from Wilber (2016, Fig. 3.1, p. 139).

brain appearing at around milestone/level 10. The corresponding macro-evolutionary sequence can be seen along the bottom: galaxies, planets, Gaia system, heterotrophic ecosystems and so on, up to distinctly human forms of social organisation (e.g., villages, early states, and so on) as well as the well-known historical sequence of forms of techno-economic base for human societies: foraging, horticulture, agrarian, industrial and informational.

This figure also implicitly shows the three main phases of 'Cosmic Evolution manifested as Big History', with the origin of the axes ('level 0') representing the Big Bang; the lowest levels of complexity (1 and 2) being the astrophysical/cosmological phase; the next six or seven levels (3 to 8 or 9) being the biological phase; and the further levels of complexity beyond level 9/10 being the cultural phase. The principal way in which Fig. 4 differs from Fig. 3 is in the elaboration of the individual entities in the later milestones/levels of the upper branch to explicitly designate the information-carrying and -processing structures found in complex multicellular organisms, and to show their subsequent complexification and cephalisation: neural cords develop into a brain stem which adds a limbic system and a cortex, then a neocortex (triune brain), and then a complex neocortex. The structures designated 'SF1', 'SF2' and 'SF3' are further more complex structures whose presence in the diagram will become clearer with Figure 5. The lower branch also shows an elaboration of Fig. 3 wherein the distinct forms of polity mentioned in the centre of Fig. 3 are explicated and correlated with the techno-economic base.

Consciousness and Interiority

The large empty gap on the LHS of Figure 4 no doubt alerts the reader to the fact that one can expect to see that side filled-in in a subsequent Figure. This is indeed the case (as a passing glance at Figure 5 shows). The RHS branches of Figure 4 represent (per Jantsch) increasing complexity of material-energetic structural organisation—essentially how matter-energy becomes more complex over time: this is standard Big History. The arrows on the end of the diagonals are intended to show that this process is continuing, and hint at the correlation between the passage of (cosmological) time and increasing complexity. These RHS branches show empirically-measureable material—in other words, 'physical things' that are subject to measurement, and possess what in metaphysics is called "extension", or what the philosopher Alfred North Whitehead in his process philosophy called "simple location" (cf., e.g., Sherburne 1981; Whitehead 1978). When the corresponding LHS is introduced, however, as in Figure 5—which also shows a few more details of the extended diagram adapted from Wilber (2016)—we see that, in contrast, the complexity on the LHS is not that of material with extension or objects possessing simple location, but of *structures of consciousness* (and one can indeed see an instance of Whitehead's terminology in the upper left branch, *viz* "prehension" at level 1).

While Figure 5 may seem a somewhat complicated diagram, it actually represents a considerable *simplification* of two interrelated aspects of the totality of the full multi-faceted, multi-element model.[3] Space does not allow a more extended discussion here, but the interested reader may consult Wilber (1995) for a more detailed introduction to this important 'phase 4' elaboration of the integral model, or Wilber (1997) for a briefer and more accessible introductory commentary on the basics of the model. A more extensive and demanding 'phase 5' elaboration can be found in Wilber (2006), while a more popular rendering for general readership can be found in Wilber (2007).

The best way to read Figure 5 is to (somewhat loosely, and certainly *not* rigidly) correlate the corresponding levels of complexity in one branch with those in another. For example, notice that in the (individual-exterior) upper-right (UR) branch, level 8 of structural complexity ('limbic system') correlates with, in the upper-left (UL) branch, an interior capacity for experiencing 'emotion'. Similarly, at

3 For the information of those who wish to follow this up through the cited references, the two aspects mentioned are Quadrants and Levels.

level 9, a 'cortex' in the UR correlates with an interior capacity for 'symbols', while at level 10, a 'neocortex' correlates with an interior capacity for 'concepts'. Now, we note that, in the UL, beginning with level 11, the sequence of interior capacities is: *rules* (equivalent to 'concrete-operational' cognition), *formal* ('formal-operational' thinking), *pluralistic*, and *'vision-logic'*, the last two being Wilber's terms for certain *post-formal* types of cognition (see, e.g., Commons, Richards & Armon 1984; Commons & Ross 2008). These interior capacities are thereby correlated with certain correspondingly more complex structures in the UR: a complex neocortex at level 11, and the further SF*n* 'structure-functions' of greater structural complexity at higher levels (see, e.g., Wilber 1997). It suffices to say here that the higher levels of complexity of the left and right upper branches of Figure 5 can be thought of as a representation of two different aspects of individual human consciousness—the 'exterior' material-energetic substrate (i.e., the brain, including the brain stem, limbic system, etc) in the UR, and the 'interior' felt, 'lived experience of being conscious' in the UL, supported by this physical substrate. Or, if you will, the physical-material brain is depicted in the later stages of the UR and the consciously-experienced mind in the later stages of the UL.

To see how the lower branches are best interpreted, it will be necessary to further fill in the diagram with another level of structure; this is shown in Figure 6.

The "Four Quadrants" as shown in Fig. 6 depict four distinct aspects of certain entities existing in the natural world. It is important to note that Wilber regards the main diagram of the "Four Quadrants" as merely "a simple outline" (1997, fn1, p.76), or "reasonable schematic summary" of "over two hundred developmental sequences recognised by various branches of human knowledge", which is most certainly "not intended to be cast in stone" (1997, p. 73). That is, these are somewhat fluid general correlations that should *not* be regarded as rigidly strict, which would in fact ruin their very utility as what he calls "orienting generalisations". Thus, as noted, the RHS represents objectively measureable 'exterior' attributes, while the LHS similarly represents subjectively interpreted 'interior'

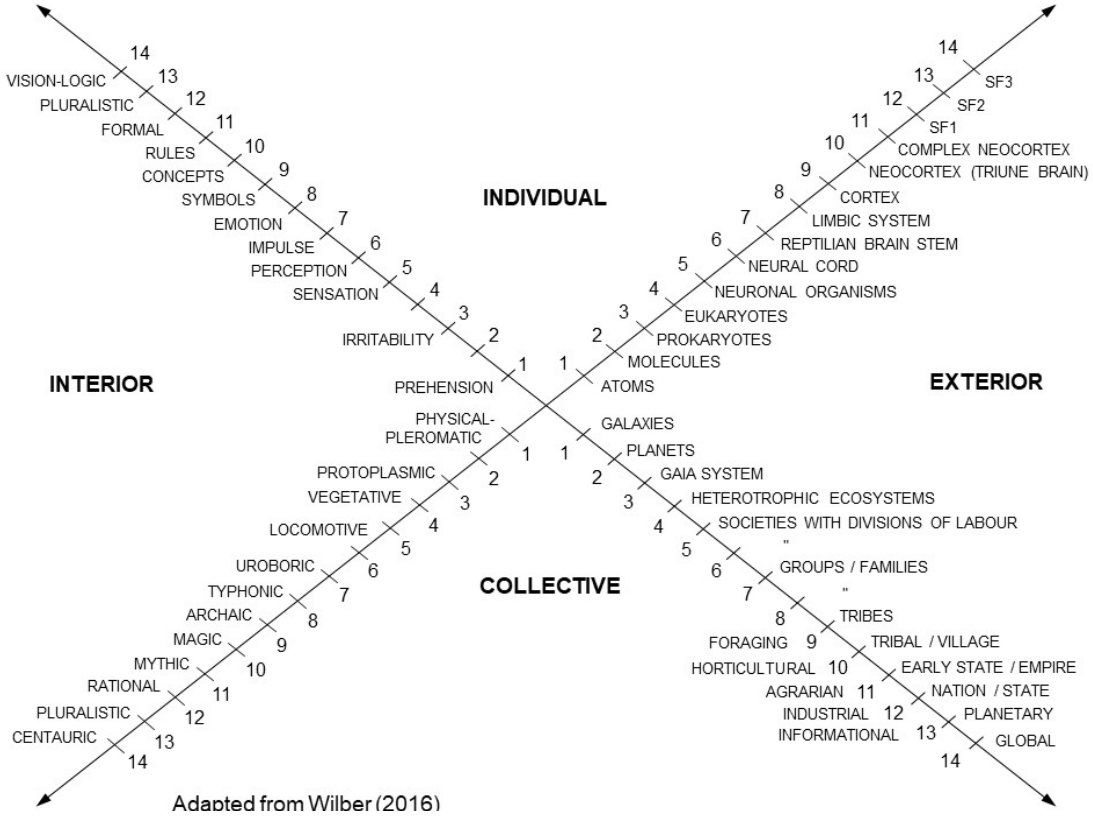

Figure 5: Elaboration of Fig. 4 showing 'interior' experience (interiority) correlated with the corresponding material-energetic 'exteriors' of structural organisation. Source: adapted from Wilber (2016, Fig. 3.1, p. 139).

experience, in both individuals and collectives (upper and lower halves respectively).

The UL thus represents (personal) interiority, or the 'interior of the individual'. Wilber terms this the 'intentional' quadrant as it is where intentions and intentionality reside inside our individual consciousness—thus it is also rendered in the form of the diagram used here (which differs slightly from Wilber's original source version) as 'consciousness'. The UR represents the objectively-measurable attributes of individual entities, which Wilber terms the 'behavioural' quadrant, as this is where empirical observations of entities are made, including the behaviours of those entities or organisms—so it is also rendered here as 'organism' in this form of the diagram (although there are several other forms).[4] The lower-left (LL) represents the common aspects of interiority which a collective of individuals mutually share, which Wilber thereby terms the 'cultural' quadrant, as this is where *shared* beliefs, values, language, mutual understanding and worldviews are found—thus, it is where 'culture' and 'worldviews' reside, which latter is how it is rendered here. The lower-right (LR) represents the objectively measureable aspects of collective social systems, such as forms of activity (e.g., techno-economic base and polity) or forms of organisation, hence Wilber's terminology of the 'social' quadrant, also rendered here as 'organisation'.

The correlations between UR and UL above are now extended to the LR and LL, so that, e.g., level 12 *formal* cognition in the UL correlates to a *rational* worldview in the LL and with an associated *industrial* techno-economic base and *nation-state* form of polity in the LR. Similarly, level 11 *rules*-based cognition correlates to a *mythic* worldview, and an *agrarian* techno-economic base and *early state/empire* polity, and so on. In this view, evolution 'unfolds' in *all four quadrants simultaneously*—on the RHS by way of the familiar macro/micro processes which Jantsch described; on the LHS through analogous mutually-dependent micro/macro processes of psychology with enculturation; as well as across and between both the left hand and right hand sides in concert. Wilber's frequent term for this four-fold interdependent unfolding is "tetra-evolution". Taking some time to carefully study the approximate correlations at each level to see how they 'mesh' across the quadrants will reward the reader with further insight into how the process of Cosmic Evolution has played out in this corner of the universe here on planet Earth. Here then is complexity-based Big History with consciousness added—a unified model of what Jantsch's comments above foreshadowed as a "formulation of the relations between biological / ecological / sociobiological evolution on the one hand and psychological/ sociocultural evolution on the other" — here literally with the former on the RHS and the latter on the LHS. After nearly two-and-a-half decades of familiarity with it, I still find this compelling mutually-interdependent "tetra-evolutionary" perspective to be a gift that just keeps right on giving…

'Meaning' in Big History?

The main utility of Figure 6 for our purposes here is that it shows how customarily-understood Big History, comprising the rise of material-energetic complexity over time (i.e., the RHS, per Jantsch and others) is included as but one-half of an even broader representation of this process that also incorporates human conscious experience and interiority (i.e., the LHS).[5] This is important, because it provides one

4 The origin of the nomenclature "behavioural" for the UR comes from a version of the Quadrant diagram that does not show explicit levels, but simply notes the *general type* of perspective epitomised by each 'quadrant view'. The 'UR quadrant view' derives from approaches to consciousness that are based on observing those objectively physically-measureable aspects of an individual that possess ('exterior') simple location, such as height, weight, brainwave patterns, neurotransmitter concentrations, bodily movements, etc (as opposed to the lived subjective experience of consciousness: the UL). In this quadrant's perspective, therefore, 'consciousness' is viewed in wholly biological and neurophysiological terms, and so consciousness as such is essentially just a neurological system. If you focus on examining just the empirically-measurable aspects and behaviours of the organism, you thus have essentially a Skinnerian 'behaviourist' view of the entity. Whence the terminology.

5 In fact, this was one of the three presentations I made at

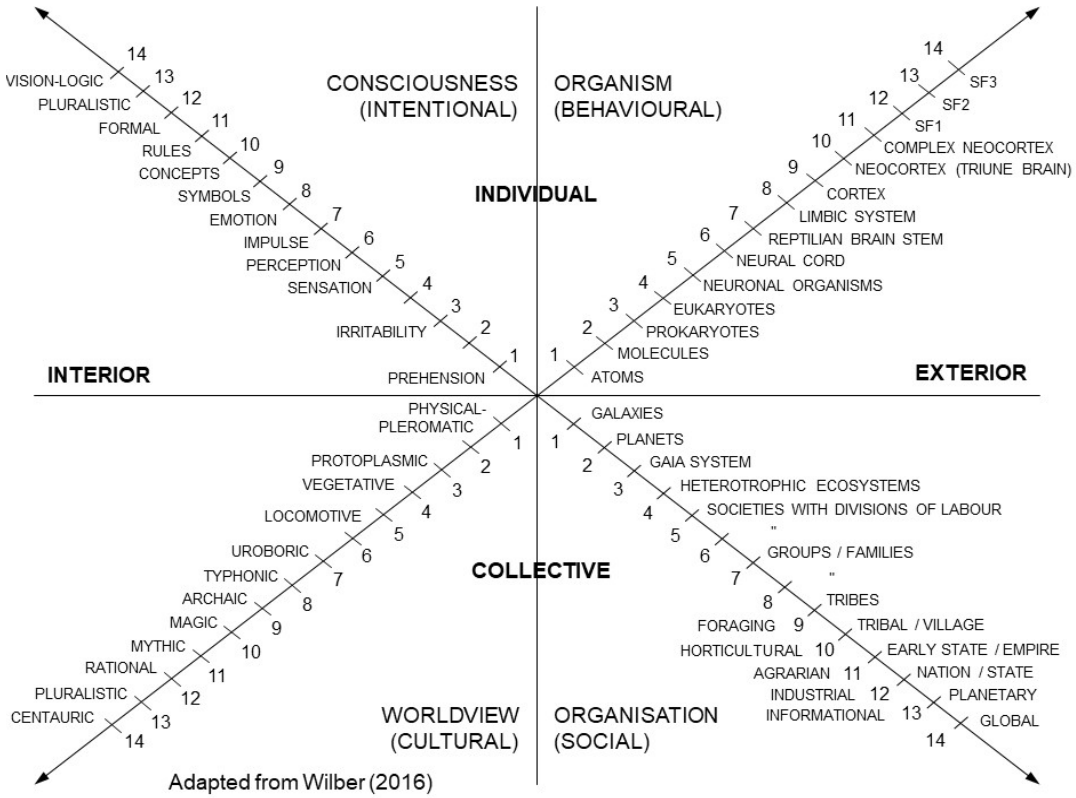

Figure 6: Further elaboration of Fig. 5, showing the two-fold divisions of an 'interior' and 'exterior' for each of both individuals and collectives. Source: adapted from Wilber (2016, Fig. 3.1, p. 139), although see also Wilber (1997) for a useful and quite accessible introductory commentary on these how these "Four Quadrants" are best viewed as a preliminary "reasonable schematic summary" of "over 200 developmental sequences recognised by various branches of human knowledge" (p.73).

pathway that may help resolve the contentious issue of whether, and if so where, 'meaning' might reside in Big History. If Big History is—as I have suggested and argued at length in this article—the story of *us* and how *we* came about through the (more general, nomothetic) processes of Cosmic Evolution, then the answer is, in this view, very clear and quite simple: *any meaning there may be in Big History resides* ***in us***, *as part of our own interior consciousness*, both as individuals and as shared with each other through our collective worldviews.

Thus, while it is perfectly legitimate for people to feel a sense of awe and wonder at the astounding beauty of the Cosmos (I mean, who *wouldn't*, right?!), and perhaps to even feel moved to seek to read a more-or-less quasi-religious or even spiritual dimension onto it, as some have done (e.g., Abrams & Primack 2011; Christopher 2013; Genet et al. 2009; Primack & Abrams 2006; Swimme & Tucker 2011), it should nonetheless be very clear that these sensibilities reside solely *within us*—i.e., they exist *at all* in the Universe simply because *we* do, as children *of* the Universe.

In other words, meaning 'exists' 'in' Big History as part of the *human* dimension of conscious interiority, which latter is an outcome of the unfolding of the (four-fold, per Jantsch/Wilber) Cosmic-Evolutionary processes that have given rise both *to* our species *as well as* to the associated interiority *of* our species.

As a consequence of this expanded 'complexity-plus-consciousness' perspective, then, it transpires that the only way that 'meaning' as such could exist 'out there' beyond ourselves would be if it existed in the consciousness and interiority of *other* sentient beings elsewhere. Anyone else out there in the wider Universe possessing sufficiently-complex interiority and sufficiently-advanced cultural evolution would therefore be another instance or version of the playing-out of the multi-phase Cosmic-Evolutionary scenario, and thus, almost of necessity, would potentially also have their own analogue of Big History. In other

the inaugural IBHA conference in Grand Rapids in August 2012 (Voros 2012).

words, in this view, meaning requires conscious interiority to contain it, and so, wherever conscious interiority exists, there too could 'meaning' potentially also exist.

Seen in this light, then, perhaps our search for life and intelligence elsewhere in the Universe (and thus for the interiority any such intelligence may possess) might just conceivably be motivated by a subconscious and ineffable search for a deeper and more profound sense of meaning—not merely that which we make for ourselves, but also one that might be brought about by meeting other distinct minds with which we might compare notes and which might also share a similar common sense of wonder and awe, as some of us here on Earth do, of even existing at all… Perhaps we are simply searching for the cognitive companionship of any far-flung cosmic-evolutionary siblings that might exist out there among the stars…

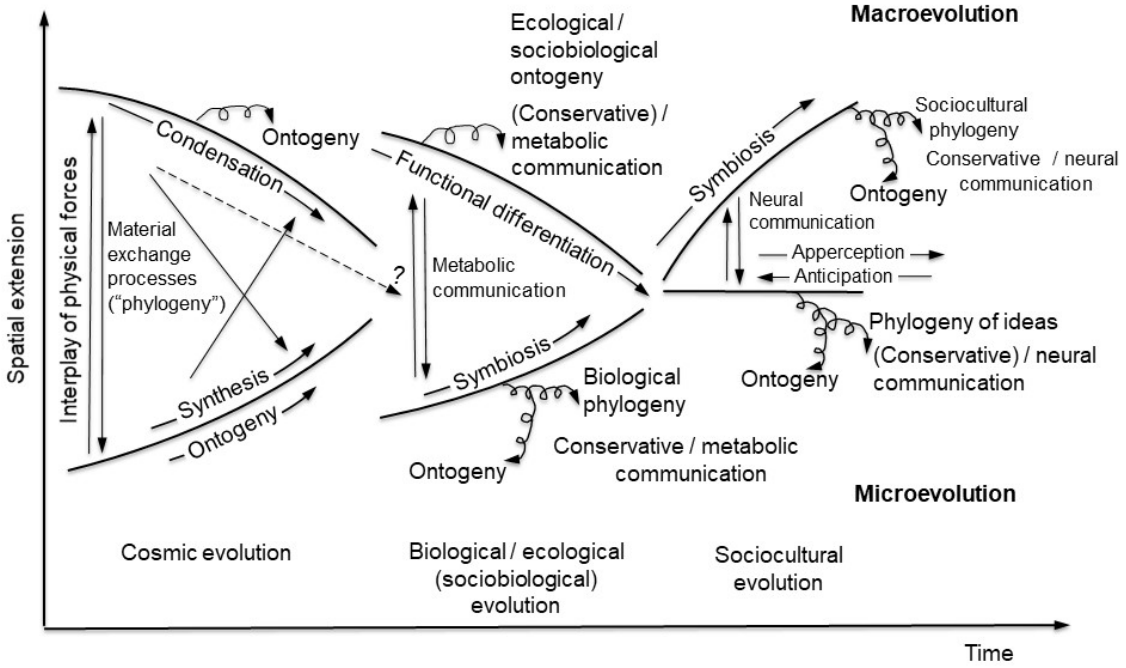

Figure 7: "The evolving role of communication in the three major phases of evolution." Source: Recreated by the author from Jantsch (1980, Fig 40, p. 208.)

Onward – The Future

The Jantsch-Wilber integrated model as presented above also allows us to consider a *third* direction of inquiry and exploration which is distinct from the 'outward' and 'inward' directions we have heretofore examined and surveyed: namely, the 'onward' direction of what future(s) may be in prospect, as the dual or "four-fold" unfolding of material complexity and interior consciousness continues through time. There are at least two ways that the future can enter in this view; one explicit, the other implicit.

Figure 7 shows another elaboration of Jantsch's formulation of the three main phases of universal co-evolution, this one dealing with the evolving role of communication, which implies an evolution in the processes yielding or governing flows of information.[6] Notably, one sees—with the arising of sociocultural evolution and neural communication in the third phase—the appearance of the dual capacities of 'apperception' and 'anticipation' with explicit and distinct directions of flow in time. These can, for our purposes here, be roughly understood as capacities for intercepting and interpreting information about the past and present (apperception), as well as about alternative potential futures (anticipation). In other words, with the arising of Humanity in the Big History sequence 'Cosmos, Earth, Life, Humanity', the Universe (through us) became able to not only

6 Indeed, information flows feature very prominently in *SOU*. Our brief comments here have not really adequately highlighted or done justice to the extent to which this is so.

perceive and understand the/its entire past—and thus the processes by which this capacity itself emerged through that very sequence—but also to imagine and anticipate the potential futures that may yet lie ahead.

Thus it happens that The Future enters Cosmic Evolution as an object of explicit awareness with the arising and emergence of sufficiently-complex interiority (although note that there are multiple degrees of complexity involved in the emergence of this capacity; see Hayward 2008). And, therefore, this new capacity allows for (as it were) 'course corrections' in the overall direction/s of the trajectory/ies of sociocultural evolution, a capability in which Jantsch was also very interested owing to what he perceived as the increasingly-urgent and especially vital necessity for it (Jantsch 1972b, 1975). Thus we need (both as individuals and as a species) to develop our capacity for anticipation and foresight as an *explicit* and *deliberate* competence in order to ensure not only humane and just futures for members of our own (and other) species, but also to ensure the coming-about of futures that will even include us *at all* (Miller 2018; Slaughter 2004, 2006). It is a quite sobering thought that, with the emergence of sociocultural evolution on Earth, there has also arisen the technological capability to *end* the three-phase process of Cosmic Evolution on this planet through either our gross negligence or abject stupidity, let alone for it to occur through sheer bad luck (Peter et al. 2004). Let us hope that our emergent capacity for anticipation allows us to chart a course through the dangerous rapids of the oncoming future with the skill and deftness required to navigate them safely and well.

The future also enters implicitly by way of what the arrows on the axes of Figs 4-6 hint at. The highest level/milestone of complexity shown in the various forms of the Four Quadrants, level 14, represents the *current* highest level of complexity of very well-elaborated structures for which a broad consensus view exists among the majority of scholars and researchers working in the respective fields drawn upon to create the ("reasonable schematic summary") quadrant diagram. Wilber's own earlier work on the LL and in particular UL quadrants shows, however, that there are several meditative and contemplative traditions which describe general contours of even more complex and subtle interior capacities than have been studied in traditional psychological research, and which have conventionally been considered the province of *transpersonal* psychology (see, e.g., Wilber 1996a, 1996b; Wilber, Engler & Brown 1986, and a more recent and highly detailed description in Wilber 2017).

These capacities are not necessarily paranormal—although the language used to describe them can be fairly opaque and often rather difficult to interpret in an unambiguous way, which can lead to this type of reading or interpretation of them. As well, the frequent 1st-person decidedly subjective descriptions given can be somewhat difficult to test and verify through correlation with the empirical results of standard 3rd-person UR objective methods, so this is a quite challenging and potentially fraught arena of research (e.g., see the individuals discussed in chapter 11 of Wright 2017). Nonetheless, even an arch-sceptic such as the cognitive neuroscientist and podcaster Sam Harris can be found concerning himself with studying the neurological (i.e., UR) basis of meditation, and offering what he calls a "spirituality without religion" based on a thoroughly secular view of some of these traditions' meditative practices (Harris 2014). The evidence for these capacities is obviously considerably sparser than for the more well-known ones detailed in the UL of Figure 6, although the claims of some traditions which foreground various forms of meditation (including mindfulness) have in recent years increasingly been investigated and tested, with some quite suggestive early results (e.g., Goleman & Davidson 2017; Wright 2017). These preliminary results intimate that, at the very least and if nothing else, *prima facie* the claims made for the existence of more complex and subtle cognitive capacities merit closer examination, and may be useful as guiding hypotheses for further more detailed and more

extensive research.

Individuals possessing these capacities are exceedingly rare, so they obviously do not appear in the diagrams representing the widespread 'broad consensus' of a majority of scholars which have been presented here, owing to the difficulties (and controversies) of verification in very small sample sizes and populations (e.g., some two-dozen or so in some of the work reported in Goleman & Davidson 2017). Nonetheless, they can be taken as tentative hypotheses of what potential *future* human-evolutionary capacities may increasingly become—in much the same way that, while formal-operational thinking was once exceedingly rare long ago, it is now considered the standard level of cognitive capacity that adolescent children are expected to attain at school. Thus, in the rising tide of evolutionary complexification, what was once rare and fleeting may eventually become widespread and commonplace.

This suggests that, as newer and more complex capacities emerge with greater frequency in the UL, and, as the individuals who possess these capacities find each other and come together, so newer collectively-shared worldviews will emerge in the LL, which will then potentially give rise to newer forms of social organisation and social structures in the LR. The cross-comparative correlations between the respective levels of complexity already shown in the Quadrants of Fig. 6 would then simply move up/out another level as these capacities and structures begin to crystallise and spread, thereby elaborating yet another milestone in the four-quadrant evolutionary view of Big History depicted there.

Therefore, continuing to study the as-yet sparsely-charted possibilities of the hinted-at higher human potentials may conceivably give us insights into possible future human cultural and social forms, including newer values, philosophies, techno-economic systems and political structures. This is potentially an enormously rich source of exceedingly interesting lines of possible inquiry to pursue, which may even give us some grounds for some qualified measure of rational hope that (with due care and a bit of luck) Cosmic Evolution on this planet may yet continue to unfold its remarkable story for some considerable period of time to come…

In closing this brief discussion of the application of the integral model to the future, I'd like to note, in this regard, that Jantsch himself remarked (1981b, p. 213)—in what appear to be his very last words in print, apropos this emerging 'evolutionary vision' of the cosmic evolutionary processes which gave rise to us—that:

> The evolutionary vision is itself a manifestation of evolution. *The reward for its elaboration will not only be a new (or partly revived) natural philosophy or an improved academic understanding of how we are interconnected with evolutionary dynamics at all levels, but also an immensely practical philosophy to guide us in a time of creative instability and major restructuration of the human world* … . With such an orientation, science will also become more realistic and meaningful for the concerns of human life. It will be not merely an end product of human creativity, but a key to its further unfolding in all domains. (emphasis added here)

Concluding Remarks

This paper sought to extend the customary increasing material-energetic complexity-based perspective of Big History in two main ways—firstly, 'outward', in the direction of 'outer space'; and secondly, 'inward', in the direction of 'inner space' (i.e., conscious interiority)—taking Erich Jantsch's pioneering work as our principal frame of reference and point of origin. Part of the motivation for this two-fold approach was to examine whether and how the (somewhat vexed) question of 'meaning' in Big History might be fruitfully tackled.

In the 'outward' direction, we sought to 'situate' Big History as part of a broader nested set of related 'sibling' multi-disciplines—SETI, Astrobiology, and Cosmic Evolution. We saw therefore how Big History

can thereby be viewed as simply 'our' instance of the unfolding of the more general universal multi-phase process of Cosmic Evolution, an unfolding process that may perhaps have occurred at other places and times elsewhere. This 'situating' of Big History in such an expanded 'cosmic' setting was done in the hope of encouraging the building of closer ties between the respective agendas of all of these knowledge fields by highlighting some of their similarities, and was intended as a contribution to broadening the growing awareness of shared interests that are becoming increasingly recognisable as Big History becomes more mainstream and begins to forge stronger connections and alliances with similarly multidisciplinary endeavours, such as Astrobiology (see, e.g., Crawford 2018), SETI, and, of course, Futures Studies.[7]

In the 'inward' direction, we sought to extend our frame of reference—along lines Jantsch himself intimated but was never able to fully attempt or ever complete—by examining how human consciousness and 'interiority' itself might also be included and integrated into the prevailing material-energetic complexity-based perspective in a natural way. The 'integral model' of Ken Wilber was then introduced and briefly discussed in outline as one possible such extension, by showing how and where some key features from Jantsch's work exist and are incorporated within the general framework. We saw then that the distinct perspectives of increasing material-energetic complexity, and of increasing complexity of consciousness and interiority, are but two 'half-views' of a more integrated whole view, both of which are needed for the full appreciation of the bigger picture. In this way, we sought to introduce a workable extended perspective on Big History; one which includes both the customary view of increasing material-energetic complexity, as well as formally recognising and incorporating the undeniable fact of our own conscious existence ("*cogito ergo sum*") as an inseparable integral part of the very structure and fabric of Big History itself.

We saw from this more-expanded framing perspective, therefore, that 'meaning' requires and subsists within (human) conscious interiority, so that any meaning that may exist in Big History does so precisely through the very fact of our own conscious existence, via the subjective human dimension of Big History, and not objectively beyond it. However, we also noted that any other instances of the playing-out of the full Cosmic-Evolutionary scenario would likely also give rise to other sentient beings with their own conscious interiority, who accordingly might perhaps have their own analogue of the Big History perspective and their own attendant forms of meaning-making, all of which would be enormously interesting to compare notes with. It was suggested that, since such 'meaning' would be outside of us in a very literal sense, perhaps SETI has been and is motivated by a subconscious search for the deeper meaning that finding and/or connecting with other cognitive beings 'out there' would represent.

Finally, we examined how the expanded framing perspective could be used to consider the 'onward' direction of 'the future', and we saw how the future can enter the frame in both an explicit (per Jantsch) and implicit (per Wilber) form. In its explicit form, we saw how the arising in us of sufficiently-complex conscious interiority brought with it the dual capacities to intercept information about the past and present (apperception) as well as about potential futures (anticipation), and we noted the increasing urgency of more fully developing this latter capacity for the sake of guiding our further cultural evolution more wisely than we have hitherto done, lest that process come to a rather unnecessary and pointless end. In its implicit form, we saw that the potentials latent in the "farther reaches of human nature"—implied by the very uppermost extents of individual interiority which have

7 As evidenced, for example, by the (at the time of writing, upcoming) *International Symposium on Life in the Universe 2019: Big History, SETI and the Future of Humankind*, to be held in the Republic of San Marino (Italy) in July 2019. https://bighistory.org/2019-life-in-the-universe-conference-information/

so far been only very partially and sparsely-mapped—hint at newer and more expanded cognitive capacities, as well as their attendant cultural worldviews and forms of social organisation. Studying the contours implied by this emerging domain of human experience may give us deeper insights and valuable clues into what and who we may yet become, as individuals and as a species, in the future which is ever-unfolding ahead of us.

We ended with a final word from Jantsch himself who foresaw that this 'evolutionary vision' would not only allow for an improved academic understanding of our deep connection to all levels of the unfolding processes of cosmic evolution (something we in the IBHA have been strongly drawn to as part of our mission), but also that it might perhaps become a useful and practical guiding philosophy that could help us navigate our way through the coming period of increasing instability and re-structuring of human civilisation itself which now, even more, lies so clearly in prospect.

I'd like to finish by dedicating this paper to the memory of Erich Janstch (1929-1980) and the work he undertook. A comment from his contemporary and colleague Milan Zeleny (1981, p. 120) suffices to make the point as clearly as can be:

[H]is ideas will be missed with an increasing intensity. He will be re-discovered, recognized, and acknowledged as one of the most original systems thinkers of recent decades.

Indeed. Erich Jantsch would have just turned 90, as I write these words in January 2019. One wonders what other incalculable treasures and profound insights we might also have received from him, had it indeed been so…

I sometimes like to imagine that Jantsch would have approved of our current efforts to share ever more widely this dawning awareness of the astonishing storyline of Big History—the evolutionary vision of how the processes of cosmic evolution played out in this corner of the Universe here on planet Earth, allowing the Cosmos (as Carl Sagan put it) "to know itself"—and that we are doing at least some justice to the deeply humanistic sentiment and fond hope he expressed in what turned out, so sadly, to be his final words to us.

Let us take up the torch of the evolutionary vision that he so brilliantly lit for us, and carry it forward with due care and responsibility, to light the way ahead for the benefit of all sentient beings who live on this planet at this point in its (big) history, as well as for all those who are yet to come after us, as cosmic evolution itself continues to unfold…

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Cosmic Perspectives and the Myths We Need to Survive

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Abstract
Big history can be defined as the attempt to understand the integrated history of the cosmos, Earth, life and humanity. Cosmic perspectives and biological evolution are the main scientific ingredients that can convert and broaden history into big history. The aim of this paper is to describe a dilemma that such a scientific, Darwinian big history must face: the inevitable incompatibility between an objective scientific search for truth and an evolutionary compulsion for brains to harbor useful fictions — the myths we need to survive. Science supports both sides of this dilemma. New and improved cosmic perspectives can't just be scientifically accurate. To be of use they must leave room for the myths we humans need to survive. But, what are those myths? I discuss and question whether the following ideas qualify as such myths: a belief in an objective meaning for human life, humanism/speciesism, human free will and stewardship of the Earth.

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Cosmic Perspectives and Darwinism

Like all organs, our brains have evolved to help us survive. They have evolved to see the world in useful ways that promoted the survival of our ancestors. This presents scientists with a dilemma: we are looking for the truth, but the Darwinian truth about evolution suggests that when useful survival-promoting fictions conflict with the truth, we can prefer the useful fictions. How can we scientists insist on the truth when the same brains that are searching for truth sometimes prefer useful fictions for perfectly legitimate scientific reasons that Darwin helped us understand.

The myths we have told ourselves for roughly two million years have helped us survive. But how much survival value do these parochial myths still contain for 8 billion people on a shrinking planet? What myths do we still need? The answers to these questions set the agenda for the construction of big history and modern cosmic perspectives.

Every human culture has a worldview (Brown 1991) – a cosmic perspective – a *weltanschauung* – a context within which the world is explained, the gods are propitiated, and believers are protected. Most traditional worldviews have been blatantly self-serving: We are "the people". We are the good Greeks. They are the bad barbarians. We are the chosen ones. The Earth has been made for us. People of my religion go to heaven – believers in other religions go to hell. For such myths to become so ubiquitous, groups who thought they were the best people on Earth and favoured by the gods, must have had an adaptive advantage. These beliefs made us proud, gave us confidence and promoted our survival.

Scientific worldviews are slowly displacing myths. Darwinian evolution continues to supplant anthropocentric creation stories. The most influential scientific revolutions are ones that change our view of ourselves – the ones that change our understanding of how we got here and how we fit in. This is because the meaning or purpose we find in life is strongly linked to who we think we are. The Copernican and Darwinian

revolutions changed our worldview and undermined traditional beliefs about our privileged place in the universe (Kuhn 1957, 1962). They removed humans from the center of the universe and reduced our traditional pride and confidence in ourselves. But at the same time, they gave us a new pride in how much we have figured out about the universe and our place in it.

When told about Darwin's idea that we evolved from ape-like ancestors (Darwin 1859, 1871), an elderly Victorian woman is reputed to have replied, "Let us hope it is not true, but if it is, let us pray it does not become widely known." If our local myths have taught us that our true position is in first class next to gods and angels, then it is painfully degrading to recognize our true place among terrestrial tetrapods.

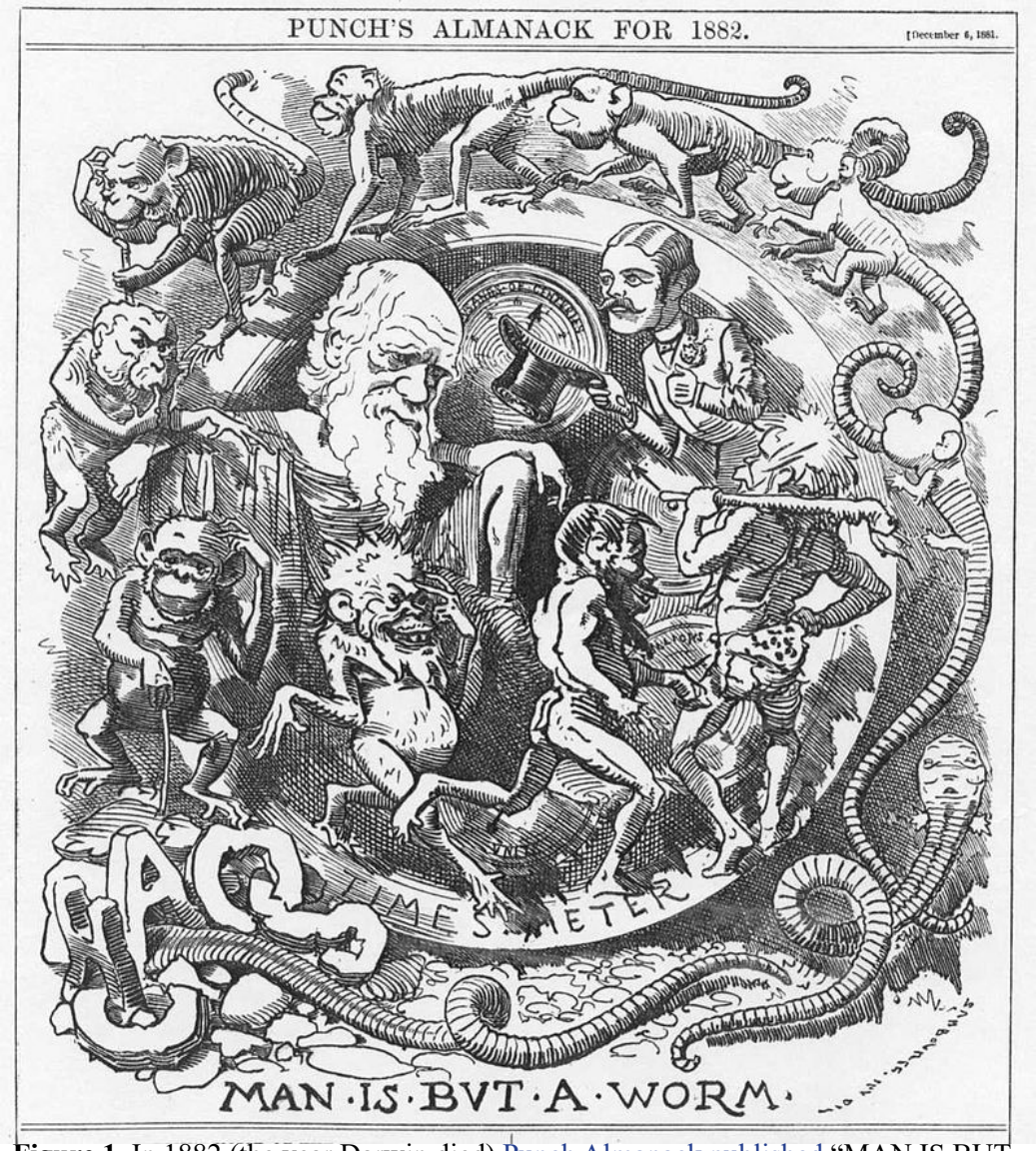

Figure 1. In 1882 (the year Darwin died) Punch Almanack published "MAN IS BUT A WORM", in which Charles Darwin, like the Christian god in the Sistine Chapel, looks on benevolently as a worm emerges from the letters C-H-A-O-S and evolves counter-clockwise into a Victorian Englishman. The word "BUT" suggests that it is bad to be a worm. This illustration was inspired by Darwin's last work: The Formation of Vegetable Mould through the Action of Worms, with Observations on their Habits (1881).

Sociobiology (Wilson 1975) is the systematic study of the biological basis of all social behavior. It can be understood as a continuation of the Darwinian reassessment of who we think we are and a challenge to human exceptionalism. Sociobiology applies Darwinism to human society and human psychology (Wilson 1978), and has provoked such fierce resistance from the humanities and social sciences, that the conflict became known as the sociobiology wars (Segerstrale 2000). The multifaceted resistance to Darwinism is described in "Darwin's Dangerous Idea" (Dennett 1995, see also Cronin 2013).

Figure 2. In 1897 (fifteen years after Figure 1) in French Polynesia, post-impressionist Paul Gauguin painted "Where do we come from? What are we? Where are we going?" These fundamental anthropocentric questions are inscribed in French in the upper left of the painting. Gauguin's images suggest that he is not looking for scientific answers to these questions. The beginning of a human life is on the right, the end of a human life is on the left. There is a blue idol of a god, maybe some worshipping going on, but there are no evolving monkeys. In debt and despair, Gauguin painted this while mourning the sudden death of his nineteen-year-old daughter Aline. After finishing this painting, Gauguin unsuccessfully tried to kill himself with arsenic. (Image from wiki Commons, Museum of Fine Arts, Boston)

Perhaps motivated by witnessing the nationalistic delusions that led to the Great War, Bertrand Russell (1919) described the prevalence and usefulness of comforting fictions,

> Every man, wherever he goes, is encompassed by a cloud of comforting convictions, which move with him like flies on a summer day.

Russell (1928) thought we should push back against this "cloud of comforting convictions":

> There is a stark joy in the unflinching perception of our true place in the world, and a more vivid drama than any that is possible to those who hide behind the enclosing walls of myth.

However, in our confident promotion of scientific perspectives in the modern world, we need to face the question: How stark can the scientific perception of our true place in the world become before our perception loses its survival value? How unflinching can we be before our stalwart behaviour becomes detrimental to our survival? Isn't flinching sometimes adaptive? If a scientific vision of our true place in the universe is too stark – if our true place is too bleak, meaningless and unable to sustain hope and optimism – no one will want that vision – and those who adopt it will probably be at a disadvantage.

Myths – like Russell's "cloud of comforting convictions" – sustain us. And sometimes we need sustaining. Our stomachs empty, our babies and children starving, our loved ones succumbing to plague and death – the worldviews of our hunting and gathering ancestors were based on beliefs that promoted survival in such conditions. If we got too weak or discouraged, if our worldview did not maintain our courage in the face of adversity, our enemies sensed our vulnerability and attacked. Comfort cannot be easily discounted or

trivialized in a mysterious, intimidating and dangerous world. Where can I get my next meal? How can I gather enough resources to attract a mate and reproduce. How can we keep our children alive? Most of our myths and morality evolved to help us successfully answer these questions – questions that have little to do with truths about the big picture, heliocentrism or our evolutionary relationship to monkeys.

Has the world become safe enough to dispense with myths? We rich, well-fed moderns, armed with antibiotics and ensured of our children's survival have other means to find comfort. Now that starvation no longer knocks at our doors, now that infectious disease is no longer due to the wrath of the gods, now that we have outsourced retribution and the enforcement of justice to the state (Diamond 2008), many of us feel comfortable discarding our culture's traditional myths and replacing them with less flattering truths that our egos can still put up with. If we are confident in who we are, we can afford to question the traditional beliefs that have given us importance and meaning. But how unflattering can the truths become and still promote our survival? Can we handle the unmythologized truth? For those of us trying to construct big history and better cosmic perspectives, the question becomes: How much truth can they contain and still perform their function?

Useful Untruths

> Whatever may be the innermost feelings of individual scientists, science itself works by rigorous adherence to objective values. There is objective truth out there and it is our business to find it. (Dawkins, 2017, p 7)

Scientists are trained to look for the truth.

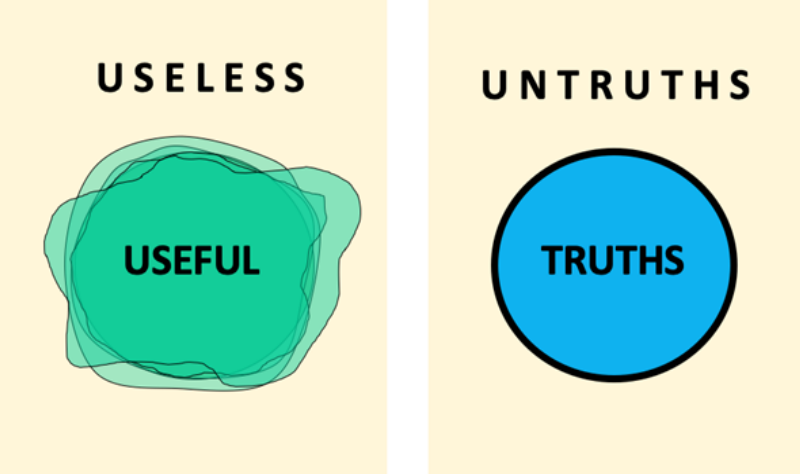

Figure 3 On the left, concepts are divided into useful (inside the green circles) and useless (outside the green circles). Since "useful" can be time- and context-dependent, we show multiple boundaries between useful and useless. On the right, concepts are divided into truths (inside the blue circle) with untruths (outside the blue circle). Scientists often say they are looking for truth and naively assume that all truths are useful. In contrast, Darwinian evolution produces the useful with no assumptions about truth. In the next figure, we combine these two concepts to show that not all truths are useful and not all useful concepts are true.

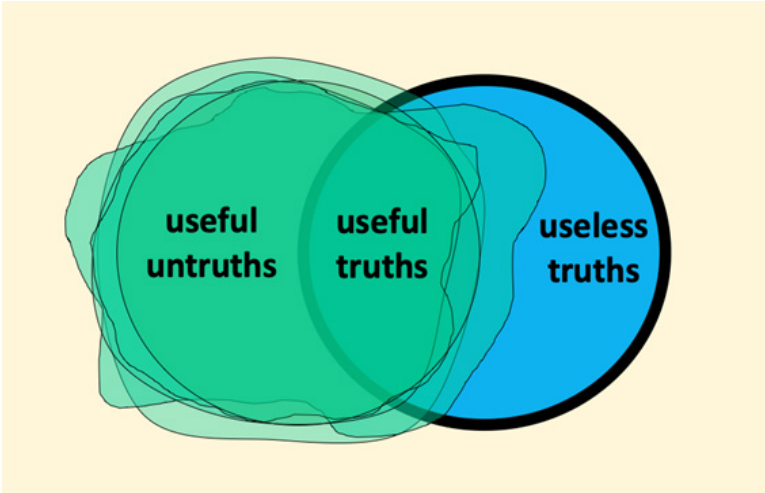

Figure 4. Here we combine the two circles from Fig. 3. The useful truths in the central overlapping region are both useful and true. Modern medicine is based on the useful truths of microbiology. Defenders of science are all about how big this overlapping region is. It is big, but it is not the only part of the diagram. There are three other parts: 'useful untruths' on the left, 'useless truths' on the right and the whole diagram is surrounded by 'useless untruths'.

When we analyze data, we try to do so dispassionately. We suppress our hopes – we fight what we want to be true, so that the truth can emerge more easily. We search for objective truth through the emotional storms and confusion of our own subjectivity. In the scientific hunt for the truth, the useful often shows up. In the Darwinian hunt for the useful, the truth often shows up. There is often a correlation between true and useful. Let's ignore this well-known and popular overlap of truth and usefulness and consider the usefulness that does not overlap with the truth (Figs. 3 & 4).

Here are some examples of the things that fall into the four categories of Figure 4:

1) Useful truths (in the middle). Modern medicine and technology are based on useful truths from biology, physics and chemistry. Useful truths underpin applied science of all kinds, e.g., the production by modern agriculture of drought-tolerant crops, cars, computers, the internet, cell phones and x-ray machines, etc.

2) Useless truths (on the right): knowledge so detailed that nobody cares, e.g. the positions and velocities of all the nitrogen molecules in your room exactly π seconds after you read this sentence, the idea that your own group, or your own children are not objectively better than other groups and other people's children. Mathematicians generate mountains of useless truths, but occasionally, a new branch of physics finds a use for some of them. Thus, occasionally useless truths are converted into useful truths by the changing boundary of what is useful.

3) Useless untruths (area surrounding both circles): incorrect data or bad information that no one cares about, or uses, or believes.

4) Useful untruths (on the left): arguably the most interesting set. These include myths, religion, self-deception (Trivers 2000), flattery of self, flattery of others, dreams, nightmares, flights of fancy, belief in the superiority of your in-group (tribalism, nationalism), dehumanization of the members of the tribes you are fighting (xenophobia and racism), self-fulfilling prophecies, placebo effects. I will argue that humanism/speciesism and our belief in human free will are also in this category.

In Wilson's 2013 "Letters to a Young Scientist" he reminds us why we do science and why science is right and religions are wrong:

> The scientific method has been consistently better than religious beliefs in explaining the origin and meaning of humanity…Colorful they are, and comforting to the minds of believers, but each contradicts all the others. And when tested in the real world they have so far proved wrong, always wrong.

Something is amiss here. Evolution (and the human brain that it produced) shouldn't care if religious beliefs are "*wrong, always wrong*" as long as they keep their believers alive preferentially over non-believers. Wilson's sociobiology is all about the idea that brains (like livers and lungs) are organs that have been selected to keep us alive and reproduce (Barkow et al. 1999). It seems strange for the founder of sociobiology to expect adaptive religious beliefs to be true. Brains and their contents have been selected to support useful cosmic perspectives (not necessarily truthful ones). If true ideas are useful, then brains that harbour them will be selected for. If false ideas are useful then brains that harbour them will be selected for. Religious beliefs have been *tested in the real world*. That is why there are so many extant believers. On this Darwinian view, we expect our cosmic perspectives (about questions such as "Who are we?", "What is our place in the universe?", "What is the origin and meaning of humanity?") to be useful, comforting, and an aid to survival, but not necessarily truthful. The new scientific light that Darwinism shines on the battle between truth and useful fictions, is that there

is no higher priority than survival. No truth-seeking mechanism, like science, can succeed if it undermines survival.

Wilson wrote "The scientific method has been consistently better than religious beliefs in explaining the origin and meaning of humanity." But Gauguin *et al* are not expecting a scientific explanation of the meaning of their lives. Scientific answers are not what they want to hear. Our traditional expectation is that truly "meaningful answers" must give the leading role to humans. But what ultimate "meaning" can science explain when there isn't any ultimate meaning? For Gauguin, the monstrous mindlessness of the cosmos is not among the acceptable explanations for the death of his nineteen-year-old daughter Aline. At such times, scientific views play second fiddle to myths, because we believe we are important and need input to support this idea that science seems unable to provide.

What are the myths we need to survive?

Weinberg's pointlessness

Is there any meaning in all the information that scientists have amassed about our place in the Universe? In one of the most cited passages in popular science at the end of his book "The First Three Minutes" (1977) about the big bang origin of the universe, Steven Weinberg (winner of the 1979 Nobel prize for physics) muses:

> It is almost irresistible for humans to believe that we have some special relation to the universe, that human life is not just a more-or-less farcical outcome of a chain of accidents reaching back to the first three minutes, but that we were somehow built in from the beginning… Below, the Earth looks very soft and comfortable – fluffy clouds here and there, snow turning pink as the Sun sets, roads stretching straight across the country from one town to another. It is very hard to realize that this all is just a tiny part of an overwhelmingly hostile Universe. It is even harder to realize that this present Universe has evolved from an unspeakably unfamiliar early condition, and faces a future extinction of endless cold or intolerable heat. The more the Universe seems comprehensible, the more it also seems pointless.

I'm sure Weinberg's expectations are to blame for making the Universe seem pointless to him. The universe is only pointless to the degree that he insists it have a point. After having attracted some criticism for his use of the word "pointless", Weinberg back-peddled and articulated his thoughts a bit more carefully (see Lightman 1990, p 466)

> If you say things are pointless, you have to ask "Well, what point are you looking for?" And that's what's needed, I think, to be explained. What kind of point would have been there that might have made it not pointless. That's what I would really have to explain.

But Weinberg didn't go on to explain. Apparently, he was unable to describe a universe with a point – a universe in which humans have some objective meaning that science could discover. This is a relief in some quarters: 'If there is no meaning in it,' said the King, 'that saves a world of trouble, you know, as we needn't try to find any' (Carroll 1865).

Chesterton's Conservatism

The removal of useful untruths from our cosmic perspective seems to be a goal of science. Chesterton (1929) has some advice for reformers who would like to displace traditional myths; don't take down a fence until you know the reason it was put it up.

> In the matter of reforming things, as distinct from deforming them, there is one plain and simple principle; a principle which will probably be called a paradox. There exists in such a case a certain institution or law; let us say, for the sake of simplicity, a fence or gate

> erected across a road. The more modern type of reformer goes gaily up to it and says, "I don't see the use of this; let us clear it away." To which the more intelligent type of reformer will do well to answer: "If you don't see the use of it, I certainly won't let you clear it away. Go away and think. Then, when you can come back and tell me that you do see the use of it, I may allow you to destroy it.

Heeding Chesterton, before we tear down more of our ~ 2-million-year-old myths, we should figure out why they are there, so we can keep the ones we still need. What myths do we still need to tell about ourselves?

Harari's Fictions

Yuval Harari's recent books about humans and big history have been hugely successful (Harari 2015, 2017, 2018). He describes the beginnings of science as the discovery of our own ignorance. He postulates that our success as a species is mostly due to our ability to tell stories and to believe them. Our advantages over other species he chalks up to our credulity and our ability to delude ourselves into believing myths and fictions.

> You could never convince a monkey to give you a banana by promising him limitless bananas after death in monkey heaven (Harari 2015)

Among our most successful fictions are concepts that most people would not consider fictions: nations, money, democracy, capitalism, corporations, religion and human rights. The important question he keeps asking is: What are the myths we humans need to survive?

Scientists are uncomfortable with this question and cannot easily address it within the confines of the scientific method. We are not necessarily looking for ideas that will help us survive. We are hunting for the truth, wherever that leads us. We are not trained to care about the survival implications of our truths. Astronomers do not request ethical clearances, or fill out health and safety impact statements before announcing their discoveries to the world. Most cosmologists are blissfully unaware of the effect their newly discovered truths will have on people. We do not know whether the idea of a multiverse will terrify us with yet another layer of anonymity, or help us become more humble and survive the next millennium. The idea of assessing the value of a scientific worldview has been limited to "Is it true?" not "Does it contribute to our survival?"

To make a scientific worldview psychologically useful and more palatable to people who need more meaning and purpose in their lives, should we include a bit of human-centered mythology in our worldview? Fantasy writer P.C. Hodgell (2000) has little sympathy for such compromises between myth and science:

> That which can be destroyed
> by the truth should be.

This attitude seems unnecessarily combative and ignores the nuances of the changing boundaries of what is "useful" (Figs. 3 & 4). Rather than seeing it as a battle, the relationship between truths and useful untruths can be seen as a symbiotic relationship that can be nudged conservatively (in Chesterton's sense): don't destroy a myth until you know why it is there.

Science and Survival

What is the purpose of life? Am I important? How hard should I fight to stay alive? How hard should I fight for my tribe? Can I find food? – or should I just give up? Scientific worldviews have effects on our answers to all these existential questions. And the effects are rarely as life-affirming as the effects of traditional myths. Science (and Darwinism in particular), erodes the trust that many people have had in their myths. This is one reason the leaders of native peoples all over the world are ambivalent about, or positively against, contributing their knowledge and

genes to modern science (Marks 2009) – an undertaking whose main result will be to undermine native traditions even faster.

> In a life short and uncertain, it seems heartless to do anything that might deprive people of the consolation of faith when science cannot remedy their anguish. Those who cannot bear the burden of science are free to ignore its precepts. But we cannot have science in bits and pieces, applying it where we feel safe and ignoring it where we feel threatened – again, because we are not wise enough to do so. (Sagan 1997, p 279-80)

Figure 5. A skirmish between two Dani tribes in the Baliem Valley of the New Guinea Highlands. Their myths are mutually exclusive. Each thinks their group is better. The nationalistic myths of nation states are also mutually exclusive. Whether national myths promote or inhibit the survival of nationalists is an on-going concern of humanity. (photograph by Karl G. Heider, Peabody Museum of Archaeology and Ethnology, Harvard University)

Sagan writes that "we cannot have science in bits and pieces"? But, isn't that the way most people have science? And if we are "not wise enough" now, can't we learn and become wiser? Can't we measure people's worldviews and then later keep track of whether they survive or not? If we want to displace traditional myopic myths, the survival value of our scientific worldview needs to outweigh the survival value of traditional self-serving worldviews. Sagan makes a similar suggestion:

> There is some cost-benefit analysis which must be applied, and if the comfort, consolation and hope delivered by mysticism and superstition is high, and the dangers of belief comparatively low, should we not keep our misgivings to ourselves? (Sagan 1997, p 281)

Telling a non-scientific, illiterate society of hunter/gatherers about their African origins can be equivalent to insulting their gods and undermining their creation stories (Larson 2006). Native peoples are having their cultural identities pulled out from under them. Many cultures and languages are disappearing (Crystal 2000, Sutherland 2003). The rapid pace of technology has now placed all of us in the same position of rapidly losing our traditional myths. Like native peoples, we are all having our identities transformed. Our regional cultures are being taken away from us and replaced by a global culture homogenized in a technological blender of mass media, modern transportation and global communication (Habermas 2001).

Old Myths in the Modern World

It is not difficult to recognize the biases and lies of our current cosmic worldviews. They are the same self-serving lies that we have been telling ourselves for several million years – that our tribe is the best – that our species is the best – that the out-group should be ignored, left to die, or be killed.

The most common form of myth creation is ignoring or being unaware of the big picture and telling only part of the story – telling the truth, but not telling the whole truth. If I am pretending to tell the story of all humanity, but I am only telling the story

of one nation, then I am creating a nationalistic myth. Even if the story of the one nation is correct in every detail, it is still a myth because it is presenting itself as something larger than it is. This is the unappreciated myth-creating power of editing, or just ignorance. The debunking of these myths – partial stories parading as the full story – is one of the biggest problems that big history has to solve.

In school, most of us were taught the history of the particular nation where we were brought up. We were taught national history. I was taught American history. The history I was taught was not incorrect, it was just that it left out other nations and other peoples. It largely ignored the native peoples of North America. The story did not explicitly state that our nation is the best. It was just that other nations were ignored. Nation states all over the world continue to indoctrinate their children with these myths created by restrictive national histories – the products of conveniently incomplete truths.

Big history tries to remove the blinkered myopia and biased legacy of such national histories by considering everyone. Big historians are trying to amalgamate national histories into the history of humanity (Harari 2015). They are also trying to include the scientific history of the universe – not only all people, but all biology. And not only all biology, but all matter (e.g. Christian 2005, 2018, Rodrigue, Grinin & Korotayev 2017). But big historians have an extra burden that scientists don't. Big historians are burdened by the adherence to a narrative structure meant for consumption by one species. Like Weinberg (1977), a human audience naturally yearns for the largest role possible for humanity.

Some scientists focus their attention largely on the science of man and ignore other species (like my history teachers ignoring other nations). They are not telling explicit lies. The details about humanity are often correct. What is incorrect is the pretense of presenting the full picture while presenting a blinkered vision in which only one species is important. Jacob Bronowski's books "The Identity of Man" and "Ascent of Man" (Bronowski 1966, 1973) are good examples of telling the story of one species and pretending it is the story of all life. Most of the facts are correct, but the exclusion of non-humans creates a flattering myth:

> For me, the understanding of nature has as its goal the understanding of human nature, and of the human condition within nature… the human being is a mosaic of animal and angel. (Bronowski 1973)

Based on such flattering myths, the "science" of human uniqueness is thriving. This biased politicized science is a good example of why science should not traffic in self-serving myths. It is biased because it doesn't ask "What kind of an animal are humans?" Rather it assumes we are better than other animals and asks, "What makes us better?" Like the myths of nationalism, it is a myth based on incomplete truths and an emotional appeal to human exceptionalism. It tells us that "Humans are unique" and ignores the more complete truth: "Humans are unique, just like every other species."

As tribes become nation states, tribalism becomes nationalism. As nations recognize other nations and our common humanity, nationalism becomes humanism. Our in-groups have gotten bigger, but having a larger in-group solves one problem and creates another – it just moves the problem to a larger scale (Diamond 1997, Harari 2015). Increasing the size of the "in-group" from a nation to include all humanity may reduce wars between nations but may increase the war between species – between humanity and the rest of the biosphere. Valuing *Homo sapiens* above all other species is leading to the environmental degradation of the planet (Rees 2003, Grooten & Almond 2018) and ultimately, this isn't good for anyone.

In more traditional self-centered myths, the "self" meant, my tribe or my ethnic group. But in

the aftermath of World War II, the idea that we are all people became a valuable new progressive myth (Harari 2015). Despite speaking different languages, and being of different religions and ethnic groups, the United Nations was created and the Charter of Human Rights was agreed to.

For Bronowski and most modern myth makers the new "self" in "self-centered myths" has become all humanity. This is a powerful antidote to tribalism and racism, but it still excludes other apes and all other species. Thus, humanism has a downside -- speciesism: the idea that my species is the best species. Unlike racism, speciesism has not yet been recognized as a self-centered prejudice harmful to the Earth. It is still seen in a positive light as a tool against racism.

From an ecological point of view, humanism is a subtle way of saying that the species *Homo sapiens* is more important than other species. Many humanists are keen on keeping chimps at arm's length. This is because, if humans are to be recognized as a first-class group, distinct and better than other species – entitled to more rights than other species – then a larger biological distance helps justify these human rights and privileges. Some of the useful untruths of speciesism have been undermined by the work of Jane Goodall (2010) and DNA sequencing of our closest cousins, chimpanzees (Mikkelsen et al 2005).

Free will and Stewards of the Earth

Scientific revolutions over the past few hundred years have changed our view of the world (Lucretius ~ 50 BC, Huxley 1863, Wallace 1904, Harari 2015). And they have changed our self-image. Many more changes are on the way. So many that Cronin (2013) thinks we have much to fear from our continued scientific attempts to understand ourselves. We are in a fight to protect human dignity and agency and free will and our speciesism. How else can we sustain the myth that our species is more important than all other species?

The scientific examination of the concept of free will is an example of something we should fear because it could have dangerous implications for our self-image:

> When we consider whether free will is an illusion or reality, we are looking into an abyss. What seems to confront us is a plunge into nihilism and despair.
>
> (Dennett 2008)

Sam Harris and Richard Oerton strongly disagree with Dennett's topography (Harris 2012, Oerton 2012, 2016). They think that the illusion of free will is a detrimental perpetuation of savagery into the modern word (see Clark's 2013 review of Oerton 2012).

The useful fiction of free will and the illusion of control has produced a "we are the stewards of the Earth" mentality (Grinspoon 2016). But, we are certainly not acting like stewards when we clear land and monopolize it with monocultures for our growing numbers (Hardin 1993), displacing and significantly reducing populations of insects, birds and other wildlife (Diamond 2010, Wikelski & Tertitski 2016, Grooten & Almond 2018). Our self-serving speciesism gives our needs higher priority than the needs of other species, and has become a justification to expropriate resources everywhere and pollute the entire planet with our waste products (Daly & Farley 2010, Lineweaver & Townes O'Brien 2015). While constructing a cosmic perspective, keeping the good parts of humanism while abandoning these speciesist implications may enable us to change and survive.

Conclusion

Cosmic perspectives and biological evolution are the main scientific ingredients that can convert and broaden history into big history. However, when adding these ingredients, there is an inevitable incompatibility between the scientific search for truth and the evolutionary compulsion to believe in adaptive useful fictions. Self-serving beliefs have

been a prominent universal feature of human cultures for sound evolutionary reasons. I point out and analyze the concept of useful untruths, and ask: What myths do we still need to survive? Following Chesterton, I suggest that before displacing a myth, we should find out what its purpose is and determine if we still need it to survive. I suggest this is the path forward for creating better cosmic perspectives. In particular, I discuss and question the potentially useful untruths of i) an objective meaning to human life, ii) a bigger in-group and the double-edged nature of humanism iii) free will and the supposed human stewardship of the Earth.

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Cosmovisões e os Mitos que Precisamos para Sobreviver

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Resumo

A macro-história pode ser definida como a tentativa de entender a história integrada do cosmos, da Terra, da vida e da humanidade. Cosmovisões e a evolução biológica são os principais ingredientes científicos que podem converter e expandir a história na direção da macro-história. O objetivo desse artigo é descrever um dilema que uma macro-história científica e darwiniana precisa encarar: a inevitável incompatibilidade entre uma busca objetiva e científica pela verdade e uma compulsão evolutiva dos cérebros para abrigar ficções úteis – os mitos que precisamos para sobreviver. A ciência apoia os dois lados desse dilema. Novas e melhoradas cosmovisões não podem apenas ser cientificamente precisas. Para serem úteis, elas precisam deixar espaço para os mitos que nós humanos necessitamos pra sobreviver. Mas quais são esses mitos: Eu discuto e questiono se as ideias a seguir se qualificam como esses mitos: uma crença em um sentido objetivo para a vida humana, humanismo/especismo, livre-arbítrio humano e a responsabilidade com a Terra.

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O darwinismo e as cosmovisões

Como todos os órgãos, nossos cérebros evoluíram para nos ajudar a sobreviver. Eles evoluíram para ver o mundo de maneiras úteis, que promovessem a sobrevivência de nossos ancestrais. Isso coloca os cientistas diante de um dilema: estamos em busca da verdade, mas a verdade darwiniana sobre a evolução sugere que quando ficções úteis para a sobrevivência entram em conflito com a verdade, nós podemos preferir as ficções úteis. Como nós cientistas podemos insistir na verdade quando o mesmo cérebro que está buscando a verdade às vezes prefere, por razões perfeitamente legítimas do ponto de vista científico, que Darwin nos ajudou a entender?

Os mitos que nós contamos sobre nós mesmos pelos últimos dois milhões de anos nos ajudaram a sobreviver. Mas quanto de valor de sobrevivência esses mitos paroquiais ainda contêm para 8 bilhões de pessoas em um planeta cada vez menor? De quais mitos nós ainda precisamos? As respostas para essas questões colocam a agenda para a construção da macro-história e das cosmovisões modernas.

Toda cultura humana tem uma visão de mundo (Brown, 1991) - uma cosmovisão - uma *Weltsanschauung* - um contexto no qual o mundo é explicado, os deuses são aplacados e os adoradores são protegidos. A maioria das cosmovisões tradicionais são descaradamente autocentradas: Nós somos "o povo". Nós somos os bons gregos. Eles são os bárbaros maus. Nós somos os escolhidos. A Terra foi feita para nós. Pessoas da minha religião vão para o céu - os que acreditam em outras religiões vão para o inferno. Para que tais mitos se tornassem tão difundidos, grupos que acreditavam que eram o melhor povo na Terra e que eram agraciados pelos deuses devem ter tido uma vantagem adaptativa. Essas crenças nos fizeram orgulhos, nos deram confiança e promoveram nossa sobrevivência.

Visões científicas de mundo estão lentamente deslocando os mitos. A evolução darwiniana continua a suplantar histórias de criação antropocêntricas.

As revoluções científicas mais influentes são as que mudam nossa visão sobre nós mesmos - as que mudam nosso entendimento sobre como chegamos aqui e como nos encaixamos nisso tudo. Isso ocorre porque o sentido ou propósito que encontramos na vida está fortemente ligado a quem nós pensamos ser. As revoluções copernicana e darwiniana mudaram nossa cosmovisão e minaram crenças tradicionais sobre nosso lugar privilegiado no universo (Kuhn 1957, 1962). Elas removeram os humanos do centro do universo e reduziram nosso orgulho tradicional e a confiança em nós mesmos. Mas, ao mesmo tempo, elas nos deram um novo orgulho baseado no quanto nós descobrimos sobre o universo e nosso lugar nele.

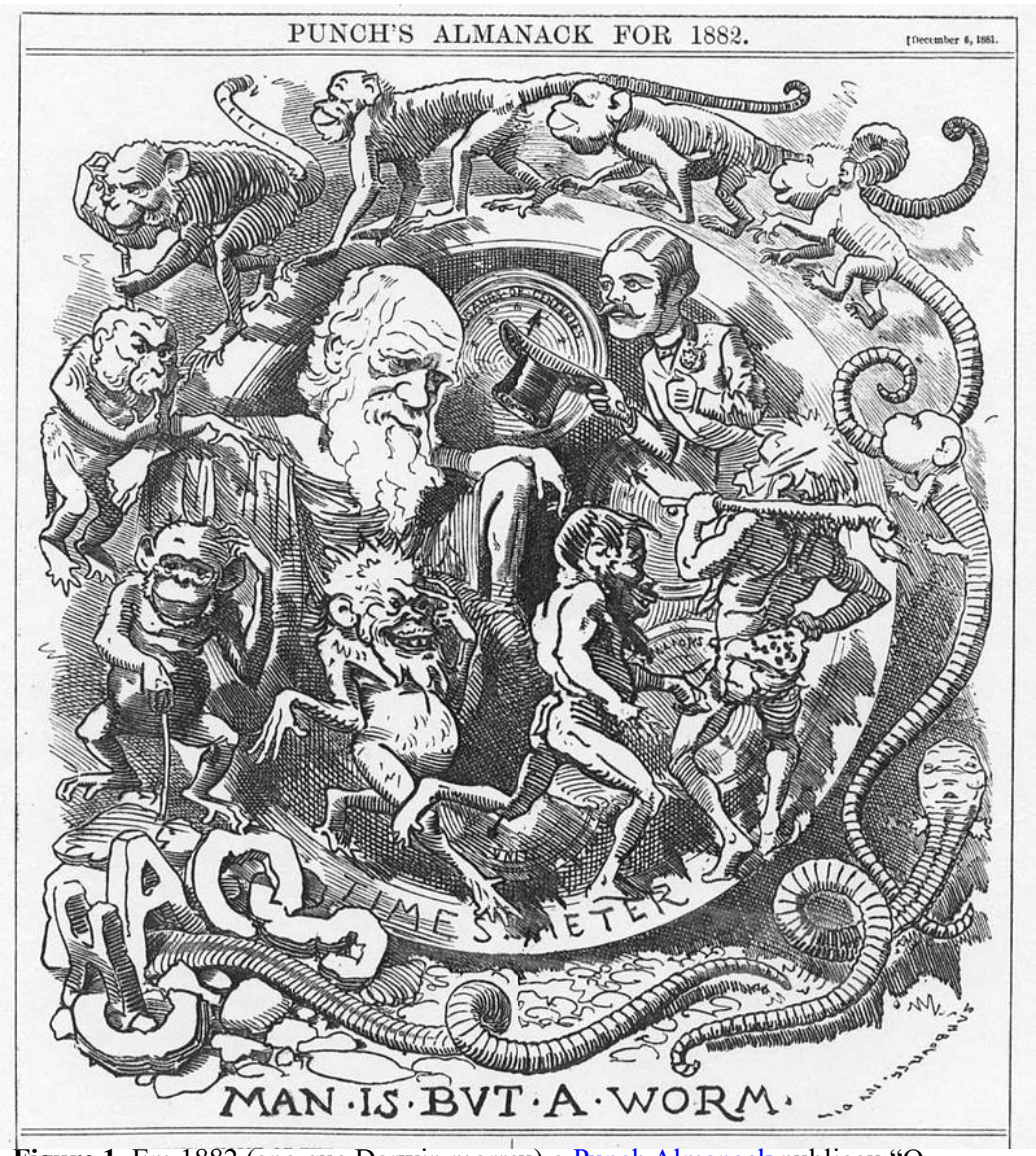

Figure 1. Em 1882 (ano que Darwin morreu) o Punch Almanack publicou "O HOMEM É APENAS UM VERME", no qual Charles Darwin, como o Deus cristão na Capela Sistina, observa de maneira benevolente enquanto uma minhoca sai das letras C-H-A-O-S (Caos) e evolui no sentido anti-horário para um inglês vitoriano. A palavra "apenas" (but) sugere que é ruim ser um verme. Essa ilustração foi inspirada no último trabalho de Darwin: The Formation of Vegetable Mould through the Action of Worms with Observations on their Habits (A Formação da Terra Vegetal Através da Ação de Vermes, com Observações sobre seus Hábitos) (1881).

Quando contada sobre a ideia de Darwin de que nós evoluímos de um ancestral parecido com os macacos, uma senhora vitoriana teria replicado: "Vamos esperar que não seja verdade, mas se for, vamos rezar para que não se torne muito conhecida". Se nossos mitos locais nos ensinaram que nossa posição verdadeira é na primeira classe, ao lado dos deuses e dos anjos, então é dolorosamente degradante reconhecer nosso verdadeiro lugar entre os tetrápodes terrestres.

A sociobiologia (Wilson, 1975) é o estudo sistemático da base biológica de todo o comportamento social. Ela

Figure 2. Em 1897 (15 anos após a Figura 1) na Polinésia Francesa, o pós-impressionista Paul Gauguin pintou "De onde nós viemos? O que nós somos? Aonde estamos indo?" Essas questões antropocêntricas fundamentais estão inscritas em francês no canto superior esquerdo da pintura. As imagens de Gauguin sugerem que ele não está buscando por respostas científicas para essas perguntas. O começo da vida humana está à direita, o fim da vida humana está à esquerda.Há um ídolo azul de um deus, talvez alguma adoração esteja acontecendo, mas não há nenhum macaco evoluindo. Endividado e desesperado, Gauguin pintou esse quadro enquanto passava pelo luto pela morte súbita de sua filha de 19 anos, Aline. Depois de terminar essa pintura, Gauguin tentou se matar, sem sucesso, com arsênico.
(Imagem retirada de Wiki Commons, Museum of Fine Arts, Boston)

pode ser entendida como a continuação da reavaliação darwiniana de quem nós pensamos ser e um desafio ao excepcionalismo humano. A sociobiologia aplica o darwinismo à sociedade humana e à psicologia humana (Wilson, 1978), e provocou tamanha resistência das humanidades e das ciências sociais, que o conflito ficou conhecido como as guerras sociobiológicas (Segestrale, 2000). A resistência multifacetada ao darwinismo é descrita em "Darwin's Dangerous Idea" (Dennett 1995, ver também Cronin, 2013).

Talvez motivado pelo testemunho das ilusões nacionalistas que levaram à Grande Guerra, Bertrand Russell (1919) descreveu a prevalência e utilidade das ficções reconfortantes,

> "Todo homem, onde quer que vá, está envolto por uma nuvem de convicções reconfortantes que se move com ele como moscas em um dia de verão."

Russel (1928) pensava que devíamos lutar contra essa "nuvem de ficções reconfortantes."

> "Existe uma alegria crua na percepção inabalável de nosso verdadeiro lugar no mundo, e um drama mais vívido do que qualquer um que é possível para aqueles que se escondem atrás dos muros do mito."

Entretanto, em nossa confiante valorização das perspectivas científicas no mundo moderno, nós precisamos encarar a questão: quão crua pode ser a percepção científica do nosso verdadeiro lugar no mundo antes que nossa percepção perca seu valor de sobrevivência? Quão inabalável podemos ser antes que nossa firmeza se torne prejudicial à sobrevivência? Abalar-se não seria, em alguns casos, adaptativo? Se nossa visão científica acerca de nosso verdadeiro lugar no universo é muito crua - se nosso verdadeiro lugar é muito desolador, sem sentido e incapaz de sustentar esperança e otimismo - ninguém vai querer

essa visão - e aqueles que a adotarem estarão, provavelmente, em desvantagem.

Os mitos - como a "nuvem de convicções reconfortantes" de Russell - nos sustentam. E algumas vezes nós precisamos de sustentação. Com nossos estômagos vazios, nossos bebês e crianças passando fome, nossos entes queridos sucumbindo a pragas e à morte - as visões de mundo de nossos ancestrais caçadores e coletores eram baseadas em crenças que promoviam a sobrevivência nessas condições. Se ficássemos fracos ou desencorajados demais, se nossa visão de mundo não mantivesse nossa coragem face à adversidade, nossos inimigos perceberiam nossa vulnerabilidade e nos atacariam. O conforto não pode ser levianamente descartado ou trivializado em um mundo misterioso, intimidador e perigoso. Onde eu posso conseguir minha próxima refeição? Como eu posso coletar recursos o suficiente para atrair um parceiro e reproduzir? Como eu posso manter nossos filhos vivos? A maioria dos nossos mitos e da nossa moralidade evoluiu para nos ajudar a responder de maneira bem-sucedida a essas questões - questões que têm pouca relação com as verdades sobre a cena maior, o heliocentrismo ou a nossa relação evolutiva com os macacos.

Teria o mundo se tornado seguro o bastante para não precisarmos mais dos mitos? Nós, os modernos ricos, bem alimentados, armados com antibióticos e seguros sobre a sobrevivência de nossas crianças temos outros meios de encontrar o conforto. Agora que a fome não bate à nossa porta, agora que as doenças infecciosas não são mais resultado da fúria dos deuses, agora que nós repassamos o castigo e a justiça para o Estado (Diamond, 2008), muitos de nós nos sentimos confortáveis descartando os mitos tradicionais da nossa cultura e substituindo-os pelas verdades menos

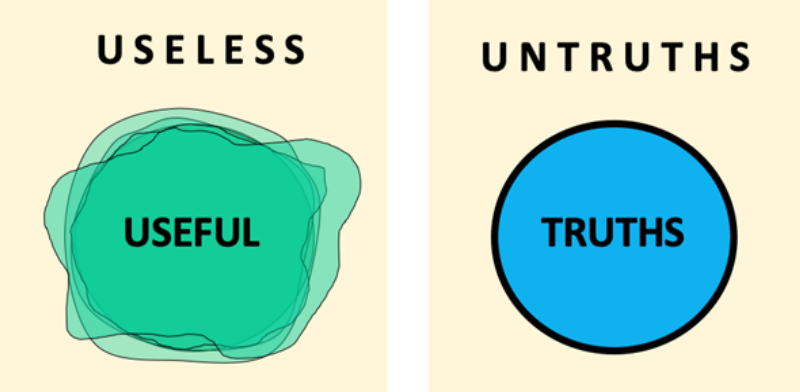

Figure 3 Na esquerda, os conceitos são divididos entre úteis (useful) (dentro dos círculos verdes) e inúteis (useless) (fora dos círculos verdes). Como "útil" pode depender do tempo e do contexto, nós mostramos várias fronteiras entre útil e inútil. Na direita, os conceitos são divididos entre verdades (truths) (dentro do círculo azul) e inverdades (untruths) (fora do círculo azul). Cientistas frequentemente dizem estar buscando pela verdade e assumem inocentemente que todas as verdades são úteis. Em contraste, a evolução darwiniana produz o útil sem pré-suposições sobre a verdade. Na figura seguinte, nós combinamos esses dois conceitos para mostrar que nem todas as verdades são úteis e nem todos os conceitos úteis são verdadeiros.

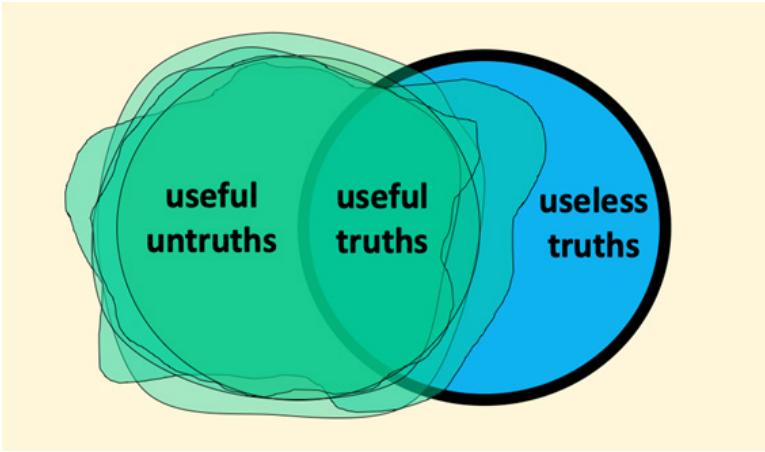

Figure 4. Aqui nós combinamos os dois círculos da Figura 3. As verdades úteis (useful truths) estão na região de interseção central e são tanto úteis (useful) quanto verdades (truths). A medicina moderna é baseada nas verdades úteis da microbiologia. Os defensores da ciência se dedicam a mostrar o quão grande essa área de interseção é. Ela é grande mas não é a única parte do diagrama. Existem três outras partes: as "inverdades úteis" (useful untruths) À esquerda, as "verdades inúteis" (useless truths) à direita e o diagrama é todo cercado pelas "inverdades inúteis" (useless untruths)

lisonjeiras que nossos egos consigam aguentar. Se nós estamos confiantes em quem nós somos, podemos nos permitir questionar as crenças tradicionais que nos têm dado importância e significado. Mas o quanto as verdades podem se tornar desagradáveis e ainda promoverem nossa sobrevivência? Para aqueles entre nós tentando construir a macro-história e cosmovisões melhores, a questão se torna: quanta verdade elas podem conter e ainda servir a sua função?

Inverdades úteis

> "Qualquer que seja o sentimento interior dos cientistas, a ciência funciona por uma aderência rigorosa a valores objetivos. Existe uma verdade objetiva lá fora e o nosso trabalho é encontrá-la." (Dawkins, 2017, p.7)

Cientistas são treinados para procurar a verdade. Quando analisamos informações, nós tentamos fazer isso de maneira desapaixonada. Nós suprimimos nossas esperanças, nós lutamos contra o que queremos que seja verdadeiro para que a verdade possa emergir mais facilmente. Nós buscamos a verdade objetiva através de tempestades emocionais e da confusão de nossa própria subjetividade. Na caçada científica pela verdade, o útil aparece frequentemente. Na caçada darwiniana pelo útil, a verdade aparece frequentemente. Vamos ignorar essa interseção conhecida e popular entre a verdade e a utilidade e considerar a utilidade que não está relacionada com a verdade (Figuras. 3 & 4).

Aqui temos alguns exemplos de elementos que recaem e uma das quatro categorias da Figura 4:

Verdades úteis (no meio): a medicina e a tecnologia modernas são baseadas em verdades úteis vindas da biologia, da física e da química. Verdades úteis sustentam ciências aplicadas de todos os tipos, por exemplo, a produção de culturas resistentes a seca para a agricultura moderna, carros, computadores, a internet, celulares e máquinas de raio-x etc.

Verdades inúteis (na direita): conhecimento tão detalhado que ninguém se importa, por exemplo, a posição e velocidade de todas as moléculas de nitrogênio na sua sala a exatamente π segundos depois de você ter lido essa frase, a ideia de que o seu próprio grupo ou os seus filhos não são objetivamente melhores que outro grupo ou que os filhos de outras pessoas. Matemáticos geram montanhas de verdades inúteis, mas, ocasionalmente, um novo ramo da física encontra algum uso para alguns deles. Assim, ocasionalmente, verdades inúteis são convertidas em verdades úteis pela mudança da fronteira do que é útil.

Verdades inúteis (área que cerca ambos os círculos): dados incorretos ou informação ruim com os quais ninguém se importa ou usa ou acredita.

Inverdades úteis (na esquerda): possivelmente o conjunto mais interessante. Aqui estão os mitos, as religiões, a autoilusão (Trivers, 2000), os elogios de si ou dos outros, sonhos, pesadelos, caprichos, crença na superioridade do seu grupo (tribalismo, nacionalismo), desumanização de membros das tribos com as quais você está lutando (xenofobia e racismo), profecias autorrealizáveis, efeitos placebo. Eu defendo que o humanismo/especismo e nossa crença no livre-arbítrio humano também estão nessa categoria.

No livro de Wilson (2013), "Cartas a um jovem cientista", ele nos lembra porque nós fazemos ciência e porque a ciência está certa e as religiões estão erradas:

> "O método científico tem sido consistentemente melhor que as crenças religiosas ao explicar a origem e o significado da humanidade… Ainda que sejam variadas e empolgantes além de reconfortarem a mente dos que acreditam, cada uma contradiz todas as outras. E quando testadas no mundo real todas se mostraram, até agora, erradas, sempre erradas."

Algo está fora do lugar aqui. A evolução (e o cérebro humano que ela produziu) não deveriam

se importar se as crenças religiosas são "erradas, sempre erradas" desde que elas privilegiem a vida dos que nelas acreditam frente aos que não acreditam. A sociobiologia de Wilson se estrutura na ideia de que os cérebros (como os fígados e os pulmões) são órgãos que foram selecionados para nos manter vivos e reproduzir (Barkow et al., 1999). Parece estranho que o fundador da sociobiologia espere que as crenças religiosas adaptativas sejam verdadeiras. Cérebros e seus conteúdos foram selecionados para sustentar cosmovisões úteis (não necessariamente verdadeiras). Se as ideias verdadeiras são úteis, então os cérebros que as acolham serão mais selecionados. Se ideias falsas são úteis, então os cérebros que as acolham serão mais selecionados. Crenças religiosas foram *testadas no mundo real*. É por isso que existem tantos crentes extantes. Nessa visão darwiniana, nós esperamos que nossas cosmovisões (sobre questões como "Quem somos nós?", "Qual o nosso lugar no universo?", "Qual a origem e o sentido da humanidade?") sejam úteis, reconfortantes e que nos ajudem a sobreviver, mas não necessariamente que sejam verdadeiras. Essa nova luz científica que o darwinismo lança sobre a batalha entre a verdade e as ficções úteis que não existe maior prioridade do que a sobrevivência. Nenhum mecanismo de busca pela verdade, como a ciência, pode ser bem-sucedido se atrapalha a sobrevivência.

Wilson escreveu: "O método científico tem sido consistentemente melhor que as crenças religiosas em explicar a origem e o sentido da humanidade." Mas Gauguin *et al* não esperam uma explicação científica para o significado de suas vidas. Respostas científicas não são o que eles querem ouvir. Nossa expectativa tradicional é que "respostas significativas" devem dar o protagonismo para os humanos. Mas qual "significado" definitivo a ciência pode explicar quando não existe um significado definitivo? Para Gauguin, a monstruosidade cega do cosmos não está entre as explicações aceitáveis para a morte de sua filha de 19 anos, Alina. Nesses momentos, as perspectivas científicas ficam em segundo plano para os mitos, porque nós acreditamos que somos importantes e precisamos de elementos que apoiem essa ideia, o que a ciência parece incapaz de prover.

Quais são os mitos que precisamos para sobreviver?

A inutilidade de Weinberg

Existe algum significado em toda a informação que os cientistas reuniram sobre nosso lugar no universo? Em uma das passagens mais citadas na ciência popular, no fim de seu livro "The First Three Minutes" (1977), sobre a origem do universo no Big Bang, Steven Weinberg (vencedor do prêmio Nobel e física em 1979) devaneia:

> "É quase irresistível para os humanos acreditar que temos alguma relação especial com o universo, que a vida humana não é apenas um resultado mais ou menos farsesco de uma cadeia de acidentes que volta até os primeiros três minutos, mas que nós estávamos, de alguma maneira, presentes desde o começo… De baixo, a Terra parece muito tenra e confortável - nuvens macias aqui e acolá, a neve ficando vermelha quando o Sol se põe, estradas que se estendem pelos campos de uma cidade a outra. É difícil aceitar que isso tudo é apenas uma parte minúscula de um universo esmagadoramente hostil. É ainda mais difícil aceitar que esse universo atual evoluiu de uma condição inicial indescritivelmente estranha, e encontrará uma extinção futura de frio sem fim ou de calor insuportável. Quanto mais o universo parece compreensível, mais ele também parece sem sentido."

Tenho certeza que as expectativas de Weinberg são as culpadas por fazerem o universo parecer sem sentido para ele. O universo só pode não ter sentido na medida em que ele insiste para que tenha. Depois de ter recebido críticas por seu uso da expressão "sem sentido", Weinberg voltou atrás e articulou seus pensamentos de forma um pouco mais cuidadosa (ver Lightman 1990, p. 466):

"Se você diz que as coisas são sem sentido, você deve se perguntas "bem, que sentido você está buscando?" E é isso que precisa, eu acho, ser explicado. Que tipo de sentido poderia dar sentido ao universo. É isso que eu realmente teria que explicar."

Mas Weinberg não explica. Aparentemente, ele foi incapaz de descrever um universo com sentido - um universo em que os humanos têm algum tipo de significado objetivo que a ciência pudesse descobrir. Isso é um alívio para alguns: "'Se não há sentido', disse o rei, 'isso poupa o mundo de um problema, você sabe, nós não temos que tentar achar nenhum sentido.'" (Carrol, 1865)

O conservadorismo de Chesterton

A remoção de inverdades úteis de nossa cosmovisão parece ser o objetivo da ciência. Chesterton (1929) tem alguns conselhos para os reformadores que gostariam de deslocar os mitos tradicionais: não derrube uma cerca até você saber a razão pela qual ela foi erguida.

> "Quando o assunto é reformar as coisas, o que é diferente de deformá-las, existe um princípio simples; um princípio que provavelmente será apontado como um paradoxo. Existe nesses casos uma certa instituição ou lei, digamos, por uma questão de simplicidade, uma cerca ou portão no meio de uma estrada. O tipo mais moderno de reformados diz alegremente: 'Eu não vejo utilidade para isso, vamos tirar isso do caminho.' Ao que o tipo mais inteligente de reformador fará bem em responder: 'Se você não vê a utilidade disso, certamente eu não vou deixá-lo tirar isso daqui. Vá e pense. Quando então você puder voltar e me dizer que você vê a utilidade disso, eu poderei permitir que você o destrua."

Seguindo Chesterton, antes de derrubarmos nossos mitos de aproximadamente 2 milhões de anos, nós devemos entender porque eles existem, de modo que possamos manter os que ainda precisamos. Quais mitos nós ainda precisamos contar sobre nós mesmos?

As ficções de Harari

Os livros recentes de Yuval Harari sobre os humanos e a macro história têm sido muito bem sucedidos (Harari, 2015, 2017, 2018). Ele descreve o princípio da ciência como a descoberta de nossa própria ignorância. Ele postula que nosso sucesso com espécie é mais devido a nossa habilidade de contar histórias e de acreditar nelas. Ele credita nossa vantagem sobre outras espécies à nossa credulidade e nossa habilidade de nos iludirmos com mitos e ficções.

> "Você jamais convenceria um macaco a lhe dar uma banana prometendo a ele bananas ilimitadas depois da morte no céu dos macacos." (Hararia, 2015)

Entre nossas ficções mais bem-sucedidas estão os conceitos que a maior parte das pessoas não considera ficções: países, dinheiro, democracia, capitalismo, corporações, religiões e direitos humanos. A questão importante que ele insiste em perguntar é: Quais mitos nós humanos precisamos para sobreviver?

Cientistas ficam desconfortáveis com essa questão e não podem abordá-la dentro do método científico. Nós não estamos necessariamente procurando ideias que nos ajudem a sobreviver. Nós estamos caçando a verdade, aonde quer que ela nos leve. Nós não somos treinados para nos importarmos com as implicações das nossas verdades para a nossa sobrevivência. Astrônomos não precisam receber aprovação ética, ou preencher formulários de impacto sobre a saúde ou segurança das pessoas antes de anunciar suas descobertas ao mundo. A maioria dos cosmologistas não compreende os impactos que suas recém descobertas verdades terão sobre as pessoas. Nós não sabemos se a ideia de um multiverso vai nos assustar com mais uma camada de anonimidade ou nos ajudar a nos tornarmos mais humildes e a sobreviver o próximo milênio. A ideia de valorar uma visão de munda científica tem se limitado a perguntar: "Isso é verdade?" e não "Isso contribui para a nossa sobrevivência?"

Nós deveríamos incluir um pouco de mitologia centrada no humano para fazer uma visão de mundo científica psicologicamente útil e mais palatável às pessoas que precisam de mais significado e propósito em suas vidas? O autor de fantasia P.C. Hodgell (2000) tem pouca simpatia por essa concessão entre a ciência e os mitos:

> "Aquilo que puder ser destruído pela verdade, deve sê-lo."

Figure 5. Uma escaramuça entre duas tribos Dani no vale de Baliem nas terras altas da Nova Guiné. Seus mitos são mutuamente exclusivos. Cada grupo pensa que o seu grupo é melhor. Os mitos nacionalistas dos estados-nações também são mutuamente exclusivos. Se um mito nacional promove ou inibe a sobrevivência dos nacionalistas é uma preocupação constante da humanidade. (fotografia de Karl G. Heider, Peabody Museum of Archaeology and Ethnology, Harvard University).

Essa atitude parece desnecessariamente combativa e ignora as nuances de uma fronteira móvel entre o que é útil (Figuras 3 e 4). Ao invés de vermos como uma batalha, podemos encarar a relação entre a verdade e as inverdades úteis como uma relação simbiótica que pode ser conduzida conservadoramente (no sentido de Chesterton): não destrua um mito até você saber porque ele está lá.

Ciência e sobrevivência

Qual o propósito da vida? Eu sou importante? Quanto eu devo lutar para continuar vivo? Quanto eu devo lutar pela minha tribo? Consigo encontrar comida? - ou eu devo desistir? Perspectivas científicas sobre o mundo têm efeitos sobre nossas respostas sobre todas essas questões existenciais. E os efeitos são raramente tão positivos em relação à vida quanto os efeitos dos mitos tradicionais. A ciência (e o darwinismo em particular) erode a confiança que muitas pessoas têm em seus mitos. Isso é uma das razões pelas quais os líderes de povos nativos de todos os lugares do mundo serem ambivalentes ou enfaticamente contrários em oferecer seus conhecimentos e genes para a ciência moderna (Marks, 2009) - uma tarefa cujo principal resultado será a destruição ainda mais veloz de suas tradições nativas.

> "Em uma vida curta e incerta, parece uma atitude sem coração fazer qualquer coisa que prive as pessoas do consolo da fé quando a ciência não pode remediar sua aflição. Aqueles que não podem suportar o fardo da ciência são livres para ignorar seus preceitos. Mas nós não podemos ter a ciência em pedaços, colocando-a em prática quando nos sentimos seguros e a ignorando quando nos sentimos ameaçados - porque nós somos sábios o bastante para fazê-lo. (Sagan, 1997, p.279-80)

Sagan escreve que "não podemos ter a ciência em pedaços", mas não é esse o jeito que a maior parte das pessoas tem a ciência? E se nós não formos "sábios o bastante" agora, não podemos aprender e nos tornar mais sábios? Não podemos computar as visões de mundo das pessoas e então ver se elas sobrevivem ou não? Se nós queremos deslocar os mitos tradicionais e sua miopia, o valor de sobrevivência de uma visão de mundo científica deve ser superior ao valor de

sobrevivência de uma visão de mundo tradicional e autocentrada. Sagan faz uma sugestão similar:

> "Existe uma análise de custo-benefício que deve ser aplicada e se o conforto, o consolo e a esperança derivadas do misticismo e da superstição é alta e os perigos dessa crença são comparativamente baixos, não deveríamos manter nossas apreensões para nós mesmos? (Sagan, 1997, p.281)

Falar para uma sociedade não científica, sem escrita de caçadores e coletores sobre sua origem africana pode ser o equivalente a insultar seus deuses e minar sua criação de histórias (Larson, 2006). Povos nativos têm suas identidades culturais puxadas de debaixo de si. Muitas culturas e línguas estão desaparecendo (Crystal, 2000; Sutherland, 2003). A rápida velocidade da tecnologia tem nos colocado na mesma posição de perdermos rapidamente nossos mitos tradicionais. Como os povos nativos, nós estamos todos tendo nossas identidades transformadas. Nossas culturas regionais estão sendo tiradas de nós e substituídas por uma cultura global, homogeneizada em um liquidificador tecnológico de mídia de massa, transportes modernos e comunicações globais. (Habermas, 2001).

Velhos mitos no mundo moderno

Não é difícil reconhecer os vieses e as mentiras de nossa cosmovisão atual. Elas são as mesmas mentiras autocentradas que nós temos contado a nós mesmos por vários milhões de anos - que nossa tribo é a melhor - que nossa espécie é a melhor - que o grupo estrangeiro deveria ser ignorado, deixado para morrer ou morto.

A forma mais comum de criação de mitos é ignorar ou não prestar atenção à cena maior e contar apenas parte da história - contar a verdade, mas não toda a verdade. Se eu finjo contar a história de toda a humanidade, mas eu conto apenas a história de um país, então eu estou criando um mito nacionalista.

Mesmo que a história desse país específico esteja correta em todos os detalhes, ainda será um mito, porque se apresenta como algo maior do que é. Isso é o poder de criação de mitos pouco apreciado da edição, ou apenas da ignorância. A derrubada desses mitos - histórias parciais que posam de histórias completas - é um dos grandes problemas que a macro-história tem para resolver.

Na escola, muitos de nós fomos ensinados a história do país específico onde nascemos. Eu fui ensinado a história americana. A história que eu fui ensinado não estava incorreta, só que ela deixa de lado outros países e povos. Ela quase sempre ignorava os povos nativos da América do Norte. A narrativa não explicitava que nosso país é o melhor. É apenas que os outros eram ignorados. Estados-nações de todo o mundo continuam a doutrinar suas crianças com esses mitos criados pelas histórias nacionais restritivas - o produto de verdades convenientemente incompletas.

A macro-história tenta remover a miopia intermitente e o legado enviesado dessas histórias nacionais ao considerar todo o mundo. Os macro-historiadores estão tentando amalgamar as histórias nacionais na história da humanidade (Harari, 2015). Eles também estão tentando incluir a história científica do universo - não apenas de todas as pessoas, mas de toda a biologia. E não apenas toda a biologia, mas toda a matéria (por exemplo, Christian, 2005, 2018; Rodrigue, Grinin & Korotayev, 2017). Mas o macro-historiadores têm um fardo extra que os cientistas não têm. Os macro-historiadores carregam o peso de aderir a uma estrutura narrativa a ser consumida por uma espécie. Como Weinberg (1977),uma audiência humana naturalmente anseia pelo maior papel possível para a humanidade.

Alguns cientistas focam suas atenções majoritariamente nas ciências do homem e esquecem outras espécies (como meus professores de história ignorando os outros países). Eles não estão mentindo explicitamente. Os detalhes sobre a humanidade estão

frequentemente corretos. O que está incorreto é a pretensão de apresentar o quadro geral quando se está apresentando uma visão estreita na qual apenas uma espécie é importante. Os livros de Jacob Bronowski "The Identity of Man" e "Ascent of Man" (Bronowski, 1966, 1973) são bons exemplos de contar a história de uma espécie e fingir que é a história de toda a vida. A maior parte dos fatos está correta, mas a exclusão dos não-humanos cria um mito elogioso:

> "Para mim, a compreensão da natureza tem como sua meta a compreensão da natureza humana e da condição humana dentro da natureza… o ser humano é um mosaico de animal e anjo." (Bronowski, 1973)

Baseado em tais mitos elogiosos, a "ciência" do caráter único do ser humano está prosperando. Essa ciência enviesada e politizada é um bom exemplo de porque a ciência não deveria comerciar em mitos autocentrados. Ela é enviesada porque não se pergunta "Que tipo de animais são os humanos?" Antes ela assume que nós somos melhores que os outros animais e pergunta "O que nos faz melhores?" Como os mitos do nacionalismo, este é um mito baseado em uma verdade incompleta e um apelo emocional ao excepcionalismo humano. Este mito nos diz que "humanos são únicos" e ignora a verdade mais completa: "humanos são únicos, assim como qualquer outra espécie".

Conforme as tribos se transformam em estados-nações, o tribalismo se torna nacionalismo. Conforme as nações reconhecem outras nações e nossa humanidade comum, nacionalismo se torna humanismo. Nossos grupos se tornam maiores, mas ter um grupo maior resolve um problema e cria outro - isso só move o problema para uma escala maior (Diamond, 1997; Harari, 2015). Aumentar o tamanho do "*ingroup*" de uma nação para incluir toda a humanidade pode reduzir as guerras entre nações, mas pode aumentar a guerra entre espécies - entre a humanidade e o resto da biosfera. Valorar o *Homo sapiens* sobre todas as outras espécies está levando a uma degradação ambiental do planeta (Rees 2003, Grooten & Almond, 2018) e no limite, isso não bom pra ninguém.

Em mitos autocentrados mais tradicionais, o "auto" significava a minha tribo ou meu grupo étnico. Mas, depois da Segunda Guerra Mundial, a ideia de que nós somos todos pessoas se transformou em um valioso novo mito progressista (Harari, 2015). Apesar de falarmos línguas diferentes e sermos de grupos religiosos e étnicos diferentes, as Nações Unidas foram criadas e a Declaração dos Direitos Humanos foi acordada.

Para Nronowski e a maioria dos criadores dos mitos modernos o novo "auto" nos "mitos autocentrados" tem se tornado toda a humanidade. Isso é um antídoto poderoso contra o tribalismo e o racismo, mas também exclui os outros macacos e todas as outras espécies. Assim, o humanismo tem um lado perverso - o especismo: a ideia de que minha espécie é a melhor espécie. Ao contrário do racismo, o especismo ainda não foi reconhecido como um preconceito autocentrado prejudicial à Terra. Ele ainda é visto como sob uma luz positiva como instrumento contra o racismo.

De uma perspectiva ecológica, o humanismo é um jeito sutil de dizer que a espécie *Homo sapiens* é mais importante que as outras espécies. Muitos humanistas gostam de manter os chimpanzés a uma distância segura. Isso porque, se os humanos devem ser reconhecidos como um grupo de primeira classe, distinto e melhor que as outras espécies - com direito a mais direitos que as outras espécies - então uma distância biológica maior ajuda a justificar esses direitos e privilégios humanos. Algumas das inverdades úteis do especismo foram minadas pelo trabalho de Jane Goodall (2010) e o sequenciamento do DNA nos nossos primos mais próximos, os chimpanzés (Mikkelsen et al, 2005).

Livre-arbítrio e os guardiães da Terra

As revoluções científicas nos últimos séculos têm mudado nossa visão do mundo (Lucrécio, 50 AEC; Huxley, 1863; Wallace, 1904; Harari, 2015). E elas têm mudado nossa autoimagem. Muitas outras mudanças estão a caminho. Tantas que Cronin (2013) pensa que temos muito o que temer de nossas tentativas científicas de entender a nós mesmos. Nós estamos em uma luta para proteger a dignidade e a agência humanas, além do nosso livre-arbítrio e do nosso especismo. De que outra forma podemos sustentar o mito de que nossa espécie é mais importante que todas as outras?

O exame científico do conceito de livre-arbítrio é um exemplo de algo que devíamos temer porque pode ter implicações perigosas para nossa autoimagem:

> "Quando consideramos se o livre-arbítrio é uma ilusão ou realidade, estamos olhando para o abismo. O que aparece para nos confrontar é um mergulho no niilismo e no desespero." (Dennett, 2008)

Sam Harris e Richard Oerton discordam fortemente da topografia de Dennett (Harris, 2012; Oerton, 2012, 2016). Eles pensam que a ilusão do livre-arbítrio é uma perpetuação nociva da selvageria no mundo moderno (ver a resenha feita por Clark, 2013, de Oerton, 2012).

A ficção útil do livre-arbítrio e a ilusão de controle produziu uma mentalidade de que "nós somos os guardiães da Terra" (Grinspoon, 2016). Mas nós certamente não estamos agindo como tais quando limpamos a terra e a monopolizamos com monoculturas dedicadas a nossa população crescente (Hardin, 1993), deslocando e reduzindo de maneira significativa populações de insetos, aves e outra fauna (Diamond, 2010; Wikelski & Tertitski, 2016; Grooten & Almond, 2018). Nosso especismo autocentrado confere uma prioridade maior às nossas necessidades do que às de outras espécies e tem se tornado uma justificativa para expropriar recursos em todos os lugares e poluir o planeta inteiro com nossos resíduos (Daly & Farley, 2010, Lineweaver & Townes O'Brien, 2015). Ao construirmos uma cosmovisão, mantendo as partes boas do humanismo e abandonando essas implicações especistas, podemos mudar e sobreviver.

Conclusão

Cosmovisões e a evolução biológica são os principais ingredientes científicos que podem expandir e converter a história na macro-história. Entretendo, quando adicionamos esses ingredientes, existe uma inevitável incompatibilidade entre a busca científica pela verdade e a compulsão evolucionária para acreditar em ficções adaptativamente úteis. Crenças autocentradas têm sido uma característica universal proeminente nas culturas humanas por razões evolucionários sólidas. Eu aponto e analiso o conceito de inverdades úteis e pergunto: quais mitos nós ainda precisamos para sobreviver? Seguindo Chesterton, eu sugiro que antes de tirar um mito de seu lugar, nós devemos primeiro descobrir qual o seu propósito e determinar se ainda precisamos dele para sobreviver. Eu sugiro que esse é o caminho para avançarmos na criação de cosmovisões melhores. Em especial, eu discuto e questiono as potencialmente úteis inverdades de i) um sentido objetivo para a vida humana, ii) um grupo maior e a natureza dupla do humanismo e iii) livre-arbítrio e a suposta responsabilidade humana sobre a Terra.

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The Biological Overview Effect: Our Place in Nature

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Abstract
While gazing at the Earth from orbit, some astronauts have described a cognitive shift known as the overview effect. Here we describe an analogous biological overview effect produced by looking at the tiny twig of humanity on the tree of life. We describe the increasingly precise phylogenetic tree of all life on Earth and how it shows us our place in nature. We discuss problems with this tree including the assumption of sexual isolation, purely vertical gene transmission and the dependence of LUCA (Last Universal Common Ancestor) on the completeness of the tree. We compile and present the most concise taxonomic overview of the evolution of our lineage from Archaea to humans.

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Overview Effects

> The overview effect is a cognitive shift in awareness reported by some astronauts during spaceflight, often while viewing the Earth from outer space. It is the experience of seeing firsthand the reality of the Earth in space, which is immediately understood to be a tiny, fragile ball of life, "hanging in the void", shielded and nourished by a paper-thin atmosphere. From space, national boundaries vanish, the conflicts that divide people become less important, and the need to create a planetary society with the united will to protect this "pale blue dot" becomes both obvious and imperative. (O'Neill 2008)

Broadly speaking, the overview effect is a new larger perspective that shifts our ideas of where we think we are (White 2014, 2019). The effect can be induced by the awe-inspiring vista from a mountain top, or by mind-broadening experiences in foreign lands. It can come when a peasant farmer visits Paris for the first time, or when a renaissance explorer peruses a new, more comprehensive map of the world. The overview effect involves a new perspective that turns fanciful labels for the unknown ("here be dragons", "terra nullius", "sphere of the gods") into meaningful labels, and for the first time, embeds these regions into the rest of the known world or universe.

The overview effect can be personal and private, or it can be the transformation of an entire culture's weltanschauung. Seeing the Earth from orbit transformed astronauts (e.g. White 2014). Images such as Apollo 8's "Earthrise" and Sagan's "Pale Blue Dot" have helped transform a civilization (Brand 1968, Sagan 1994).

The Spatial Overview Effect

The original spatial overview effect of astronauts is a re-conceptualization of where we are, based on new spatial or astronomical information about the space

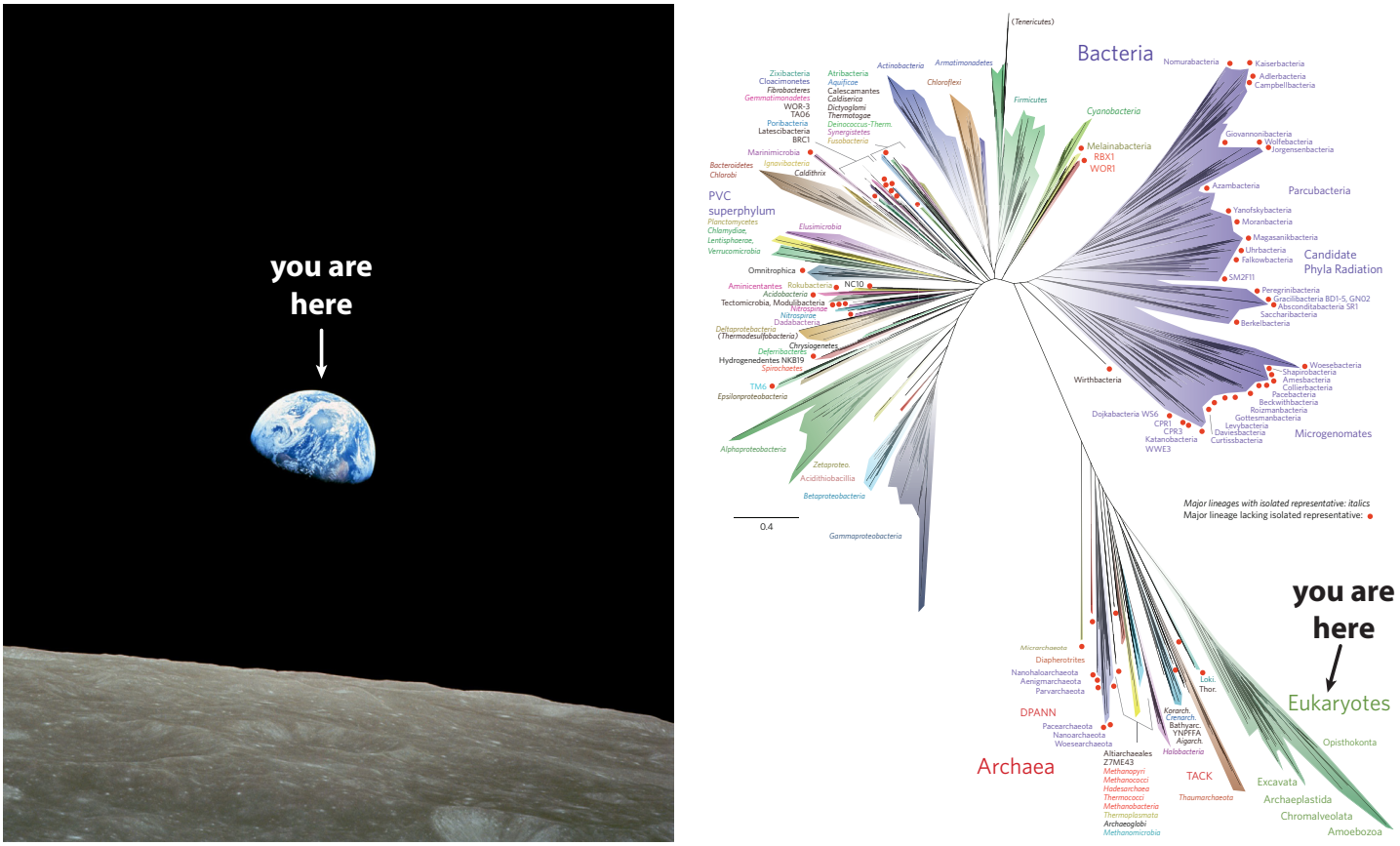

Figure 1. Comparison of Overview Effects. Left: the astronomical overview effect evoked by "Earthrise" taken on 24 December 1968 by astronaut William Anders during Apollo 8. This was the first time humans travelled beyond low Earth orbit and saw their own home planet rising above the horizon of the Moon. Right: the biological overview effect evoked by a new more comprehensive tree of life including metagenomic sampling (Hug et al. 2016). The pale green sliver in the lower right corner is our genetic home and encompasses all eukaryotes.

around us. A spatial or astronomical overview effect comes from understanding the size of the universe and our place in it. One hundred years ago the size of the known universe was thousands of light years. Now it is billions of light years – an increase of about six orders of magnitude.

Figure 2 gives us a feeling for the enormous size of the universe compared to our tiny home planet. The comparison makes our bodies, homes, countries, planet, Solar System and even our Milky Way galaxy seem small and insignificant. Everything that was previously unimaginably large, becomes unimaginably small. We become more anonymous, trivial and humble – and we haven't even broached the topic of the multiverse.

We can make images of the universe and map the space around us to distances of billions of light years. The ability to produce such images and to understand how small we are is an achievement that few species can boast about. Apollo, Voyager, astronomy, cartography, GPS and Google Maps offer us a broader and richer spatial map of where we are. However, overview effects are not limited to a spatial re-conceptualization of where we are. They can be categorized into three classes: spatial, temporal and biological. All of these overview effects contribute to big history: the attempt

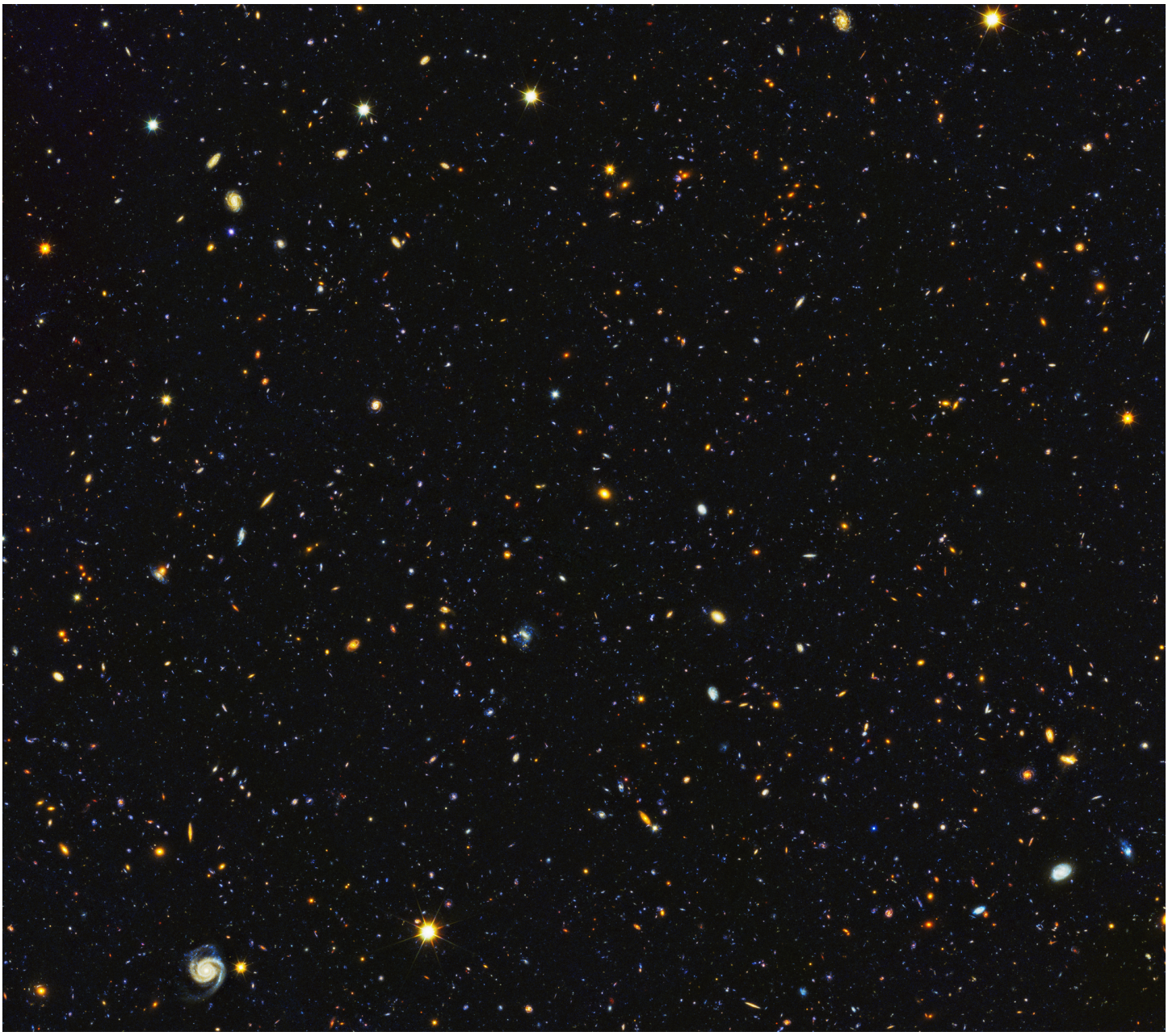

Figure 2. Hubble Space Telescope image of a patch of sky about the size of a sheet of paper seen from 100 meters away. The ~15,000 galaxies in this image are millions and billions of light years away. A dozen stars from our galaxy are in the foreground. All the other points of light are other galaxies – each having hundreds of billions of stars. Hubble Deep UV (HDUV) Legacy Survey (Oesch et al. 2018).

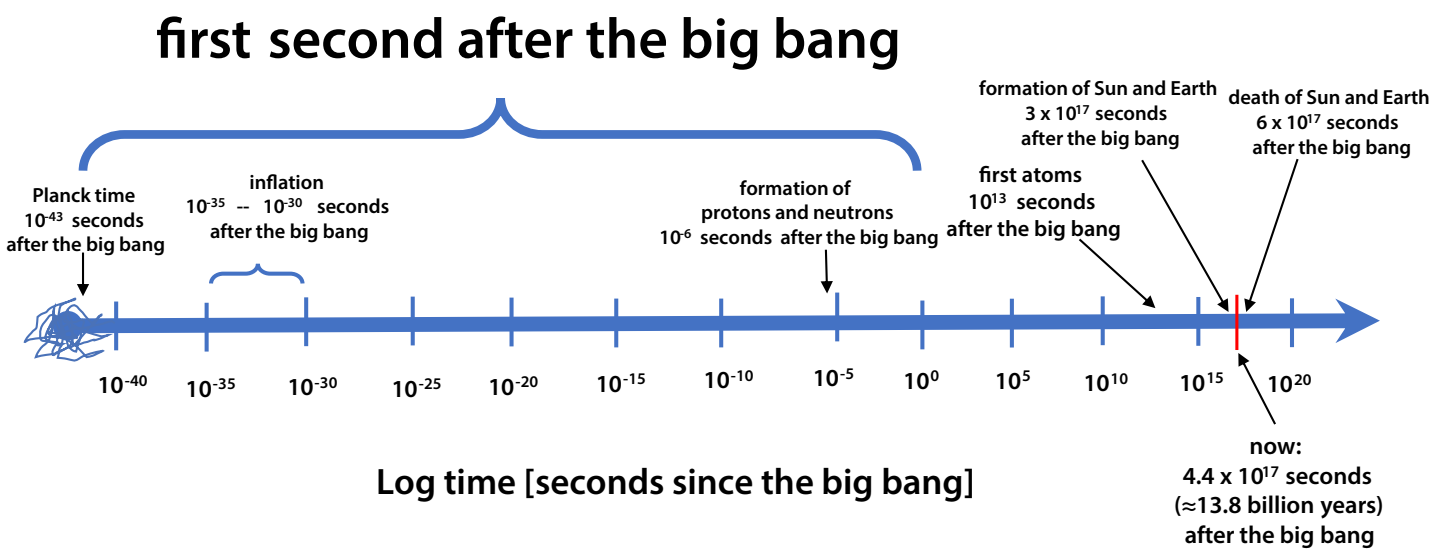

Figure 3. The first second after the Big Bang. The cosmological clock ticks logarithmically. The biological clock probably also ticks logarithmically. For example, the earliest events of embryogenesis are paramount; "It is not birth, marriage or death, but gastrulation which is truly the most important time in your life" (Wolpert 1991). The heat death of the universe is off the plot to the right at ~ 10^{207} seconds after the Big Bang (Lineweaver & Egan 2007, Adams & Laughlin 1997)

to understand the integrated history of the cosmos, Earth, life and humanity (Rodrigue et al. 2017, Christian 2004, 2018). The combination of modern geology, paleontology, biology, primatology and anthropology gives us a broader picture of where we have come from, how we got here, who we are – and maybe even where we are going and why?

Kuhn (1962) has coined the term "paradigm shift" to describe a re-conceptualization intrinsic to scientific revolutions: Copernican, Darwinian, Einsteinian and Quantum Mechanical. The overview effect involves a rapid paradigm shift, in which previous ideas and fundamental assumptions are undermined, rejected, and replaced by a larger, more accurate perspective.

For astronauts, the Earth was no longer a map divided into different coloured nations. Warring religions, ideologies and economic doctrines cannot be seen from space. The Earth is a blue marble hanging in the black void. This new bigger picture challenges our identity and offers us a better answer to the question: What is our place in nature?

The Temporal Overview Effect

The temporal overview effect is a re-conceptualization of when we are, based on new temporal information such as: the universe is ~13.8 billion years old; Earth is ~4.5 billion years old; life on Earth is about 4 billion years old; and our species, *Homo sapiens*, is about 100,000 years old, or 2 million years old – depending on how one defines our species.

Big history is arguably best presented as a series of events viewed through the lenses of different sciences as one progresses chronologically from the Big Bang (cosmology) to the formation of the Sun and Earth (astronomy, planetary science, earth science), to the origin and evolution of life (biochemistry, microbiology and evolutionary biology), to the evolution of humans (archaeology, anthropology, history). For example, in Christian (2004), the sections are listed chronologically, starting with the Big Bang; "the inanimate universe", then "life on Earth", "early human history", "the Holocene", "modern era" and finally "future". Christian (2018) also has chronologically arranged sections beginning with the

ancient "cosmos", then the more recent "biosphere", and finally the most recent "us".

Logarithmic scales of space and time are often used to encompass and understand processes that have a large dynamic range (e.g. Adams & Laughlin 1997, 1999). For cosmologists interested in the origin and evolution of the universe, the cosmological clock ticks logarithmically (Figure 3 above). Every order of magnitude of time is examined for important events. Starting at the highest energy and earliest time possible (the Planck time 10^{-43} seconds after the Big Bang), the interval 10^{-43} of a second to 10^{-42} of a second is studied. Then the interval 10^{-42} of a second to 10^{-41} of a second is examined, etc. Equal attention is given to each such interval. The particle physicist Rocky Kolb (2006) explains:

> In this presentation, I will describe events that occurred in the first second of the life of the universe. There have been approximately four-hundred-thousand-million-million seconds since the beginning of the universe, so to concentrate on only one of them might seem the ultimate degree of overspecialization. But the very first second was really something special.

The Biological Overview Effect

The biological overview effect is a cognitive shift in identity that occurs while viewing the phylogenetic tree of all life on Earth. It is the experience of recognizing how small our tiny human twig is among the vast genetic diversity of life. Our twig on the tree of life can be seen as just another species, hanging in the phylogenetic void. Our human twig is unique, just like the twig of every other species.

A large part of big history is the integrated history of life. Figure 4 is the best current map of our integrated biological history. The tree of life is constructed from the conserved and recognizably related sequences of DNA base pairs inside almost every cell of extant organisms. Our biological identity can be read from the hierarchy of taxonomic divergences in which we are embedded, along with every other living organism (Figure 4 and Table 1).

Only the twigs of the tree of life are alive. The branches holding up the twigs represent the past lives of millions of ancestors and cousins. Our branch has grown as the bodies of our dead ancestors have piled up chronologically. The tree of life is principally arranged using the chemical fossils of conserved genomes in all extant life forms. The tree has been put together from the chemical footprints that our parents and earlier ancestors left inside us.

Here and there, the tree has been calibrated by the petrified remains of fossilized distant cousins. Since the vast majority of species that have ever lived have gone extinct, dead fossilized individuals with no extant descendants vastly out-number the dead individuals who are our ancestors. Thus, when we find a fossil who looks remarkably like what we imagine our ancestors to have looked like, it is usually a dead distant cousin, not a great-great-great-great-…-grandparent (Dawkins & Wong 2016, Fournier et al. 2009).

In this tree of life, ours is a small voice in a chorus of hundreds of millions of voices. We often think we are the soloist, but in the tree of all life, we are a small new voice in an ancient choir of prokaryotes. New landscapes of biological diversity show us our little lonely eukaryotic valley. In the most recent phylogenetic trees, our peripheral twig reminds us of Sagan's pale blue dot (Sagan 1994). Ours is a tiny trivial twig amongst the enormous diversity of life. This new, comprehensive genetic landscape gives us an overview of biology – how we relate to other species – how we shared ancestors with mushrooms for ~3 billion years and only in the last ~1.1 billion years diverged from them. Like astronauts recognizing the common humanity of all people, this new deeper

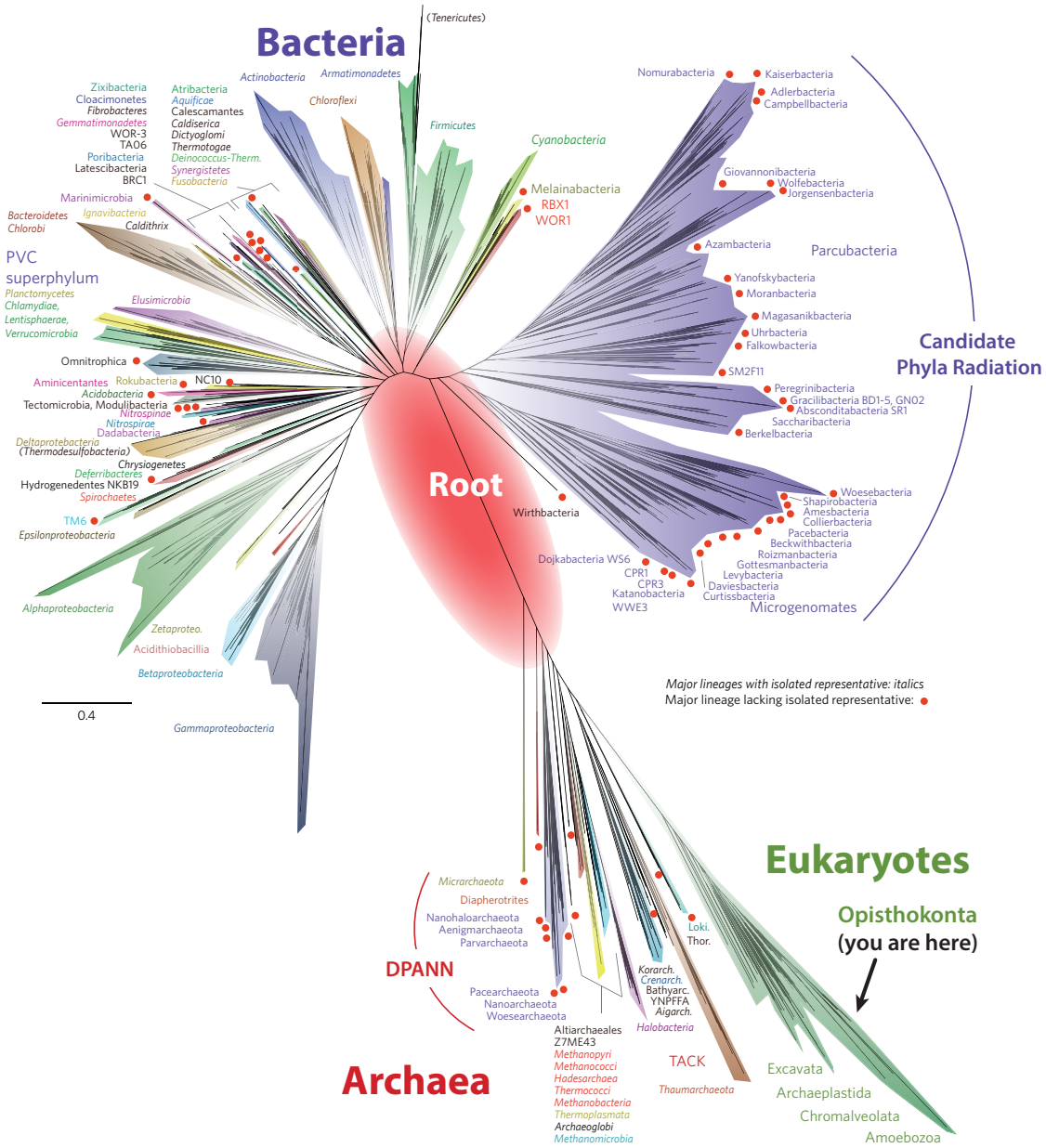

Figure 4. The tree of life (modified from Hug et al. 2016). The diversity of all eukaryotes is represented by the green sliver in the lower right. On the right side of the green sliver, the small branch labelled "Opisthokonta" encompasses all animals and fungi (see node 35 of Table 1). The twigs with red dots are organisms that have been identified with metagenomics and have not been cultured. Whether through cultures or metagenomics, the microbial diversity on Earth is still far from complete. Also, viruses are not shown. The red oval in the center is an estimate of where the root of the tree lies. The "root" is another name for LUCA (Last Universal Common Ancestor). The large purple group in the upper right is the new "Candidate Phyla Radiation" (CPR). In the archaeal lower half of the tree, the very early branching organisms (closest to the red oval in the middle) have also been only metagenomically identified and therefore have a red dot at the end of their branches. Notice that most of the organisms with branches that emerge from the red oval are Candidate Phyla Radiation (CPR), DPANN and/or have red dots.

genealogy has us welcoming new members to our family. Now we can talk about "our close cousins the mushrooms".

Our position in the lower right of Figure 4 can be described by paraphrasing Sagan's description of our pale blue dot (Sagan, 1994 – excerpt in Planetary Society, 2019)

> Look again at this pale green sliver. That's home. That's us. Within its genetic boundaries every organism you have ever seen, every vertebrate you have ever loved, lived out their lives. The aggregate of our breaths, heartbeats, and sexual desires, every human and non-human eukaryote, every playful puppy and petunia, every meerkat and mite, every mammal, reptile, amphibian and fish, every mushroom and mayfly, every dandelion and dragonfly, every blade of grass and every innocent wasp larvae eating its way out of a caterpillar, every parrot and paramecium, every oak tree and antelope, every kookaburra and cuttlefish, every deuterostome and protostome, every ant and anteater, every poisonous snake and harmless tadpole, every orca and ostrich, every salamander and sardine, every top predator and bottom feeder, every amoeba and armadillo, every loving octopus mother guarding her eggs and every predator trying to eat them, every dinosaur and dinoflagellate, and every tree fern and trilobite, every elephant and eel, every jawed fish and every jawless fish, and every life form with a rib or a jaw or a brain, every vertebrate and invertebrate in the history of eukaryotes lived there – in a pale green genetic sliver that emerged ~3 billion years ago from a small branch of the Archaea.
>
> Eukaryotes are a very small genetic afterthought on the giant prokaryotic stage. Think of the rivers of blood and cytoplasm spilled by all those predators and parasites so that in glory and triumph they could become the momentary masters of a eukaryotic corpse. Our posturings, our imagined self-importance, the delusion that we have some privileged position in the genetic universe, are challenged by this trivial triangle. Our eukaryotic domain is a pale green sliver among the huge genetic diversity of life on Earth. The extent of our genetic diversity will fade even further if we can compare it to the diversity of life that may exist elsewhere. In the great enveloping genetic unknown – in our obscure sexually-isolated eukaryotic corner, among enormous diversity, there is no hint that help will come from elsewhere to save us from our swollen brains and multicellular megalomania. There is perhaps no better demonstration of the folly of human conceits than this green sliver of genetic space. To us, it underscores our responsibility to deal more kindly with other species, to preserve and cherish the diversity of life – the only life we've ever known.

Where is the Root of the Tree of Life?

The branches in Figure 4 show the extent of genetic diversity. We have inserted the large red oval to indicate the most likely position of the root. As we follow the eukaryotic branch back in time, we rendezvous with the Asgard group (represented in Figure 4 by Lokiarchaeota ("Loki.") and Thorarchaeota ("Thor.") and then with the TACK group and then with DPANN and the rest of the Archaea (see nodes 42-45 and caption of Table 1). Notice that most of the basal or shortest branched Archaean lineages are in DPANN and have a red metagenomic dot at their tips. They have not been cultured.

If we want to know about the origin of life, and more specifically about the metabolism of the last universal common ancestor (LUCA) of all known life, we need to make sure we can identify where LUCA is. LUCA is located where the two deepest branches merge into one branch, but there is some ambiguity about which two those are. Hence, the relatively large size of the red oval. LUCA is sometimes called the root of the tree of life, but "trunk" is a better word. LUCA (or the root of the tree) should not be confused with the origin of life

which precedes LUCA by some significant amount – perhaps by a few hundred million years.

As we find shorter branches in the tree of life such as the Candidate Phyla Radiation (CPR) and DPANN, estimates for the time of LUCA become earlier and come closer to the time of the origin of all life. This is shown in Figure 5 as "LUCA" (in small font higher up in the tree) becomes "LUCA" (in larger font lower in the tree) after the inclusion of CPR and DPANN.

Hierarchy of Taxonomic Divergences Along Our Lineage

Inspired by Dawkins & Wong (2016) to get a better overview of our evolutionary identities, in Table 1 we

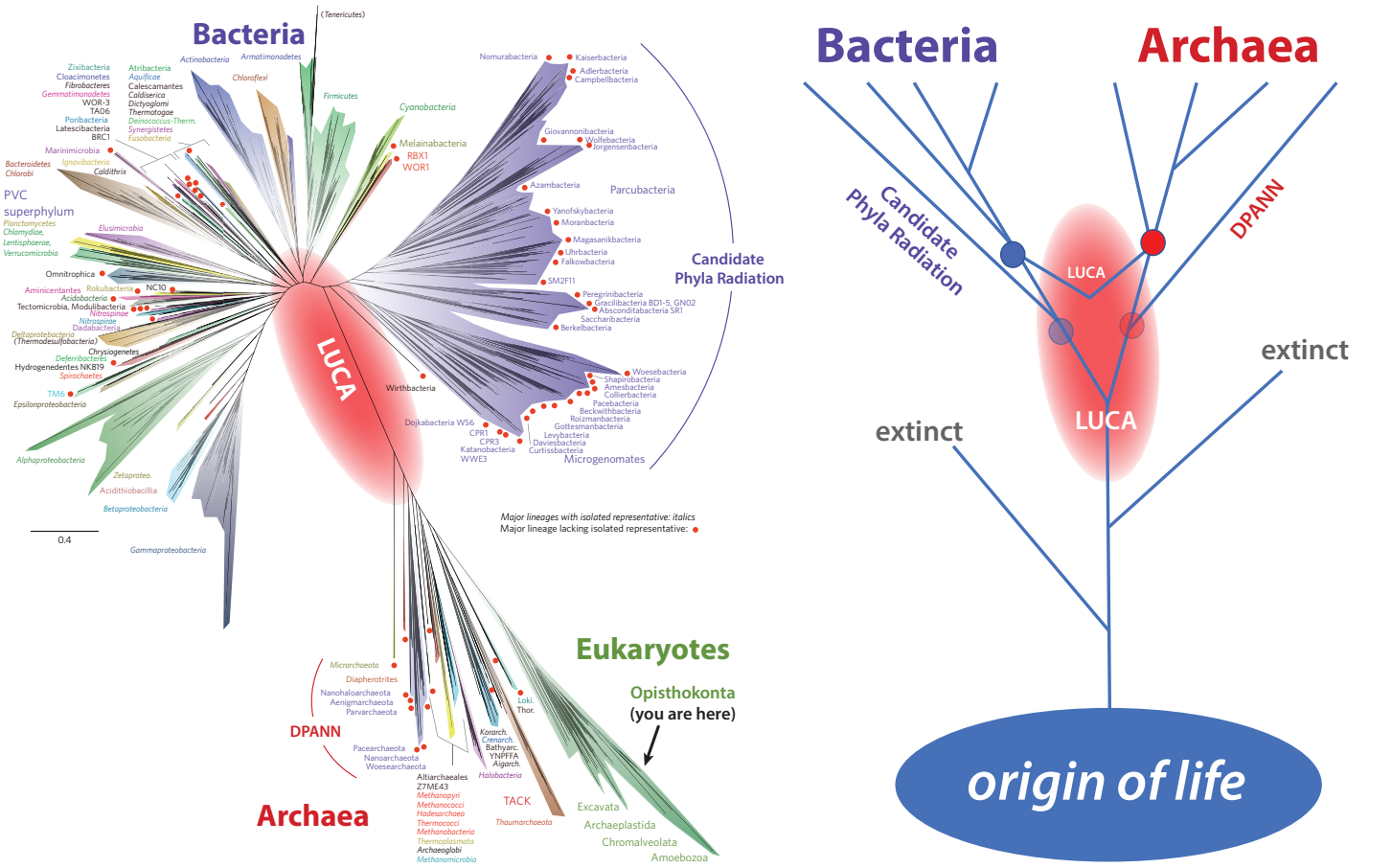

Figure 5. Where is the Last Universal Common Ancestor (LUCA)? Left: Hug et al. (2016) identified many new short branches on the tree of life. The shortest branches extending out of the red oval labelled "LUCA", are the best representatives of what LUCA was like. Weiss et al. (2016) did not use these short metagenomically identified twigs when looking for the metabolisms of LUCA. If they had, LUCA would have been deeper and LUCA's metabolisms at least slightly different. The illustration on the right shows how the position of LUCA depends on the deepest, shortest branches. Before the discovery of CPR and DPANN, LUCA was in the position of the LUCA label in small font. After the discovery of CPR and DPANN, LUCA is now earlier in the tree at the position of the LUCA label in a larger font. As long as we have an incomplete sampling of the deepest shortest branches on the tree of life, LUCA will appear more recent than it really is. We have the same problem with sub-branches. For example, the discovery of DPANN moves the common ancestor of all Archaea from the red filled circle down to the transparent red circle.

have compiled the most concise taxonomic overview of the evolution of our lineage. The divergences seen in phylogenetic trees (e.g. Figure 4) become convergences or rendezvous when we imagine travelling backwards in time along our lineage. In Table 1, the numbers in the first column are rendezvous numbers (also known as phylostratigraphic nodes, cf. Domazet-Lošo & Tautz 2010, Trigos et al. 2017). These rendezvous are when our closest relatives merge with us at the time of the common ancestor. We start our voyage backward in time at node 1, 6.5 million years ago where we meet our most recent common ancestor with chimpanzees. At node 12, 96 million years ago we meet our common ancestor with dogs and cats. At node 40, about 2 billion years ago we meet our common ancestor with apple trees and bananas.

Numbers (1 – 37) in the first column are the rendezvous numbers from Dawkins and Wong (2016) with the name of the new group that is joining our lineage at each rendezvous in the second column. The third column is the name of our lineage before being joined by the group in the second column. The fourth column is the name of our group after being joined by the group in the second column. Notice that there is redundancy in that the name in the fourth column in rendezvous N, is the same as the name in the third column for rendezvous N+1.

For some of the less well-understood, recently proposed branches, we have adopted the nomenclature of Cavalier-Smith and co-authors (e.g. Cavalier-Smith et al. 2014, Ruggiero et al. 2015). This was necessary because Dawkins & Wong (2016) gave the name of the new group that was joining our group, but sometimes ignored the name of our group before and after the rendezvous. For a given node N, the uncertainties on its date can sometimes overlap with the dates of nodes N+1 or N-1. The larger this overlap, the more uncertain is the order of the nodes.

Problems with Phylogenetic Trees

The powerful perspective and simplicity of Figure 4 and Table 1 are based on the vertical transmission of the most conserved core genes. Such trees are very useful as a reference for the vertical transmission of genes, but not as a full picture of evolution. More realistic network-like evolution can be informatively compared to this vertical-transmission-only tree (Doolittle & Bapteste 2007, Bapteste et al. 2009).

There are many well-known problems with such "vertical-only", "divergence-only" approaches to the evolution of life. What happens when two organisms from different parts of the tree merge? Where in the tree does the new chimeric organism belong? Some horizontal convergences have been well-documented as endosymbiotic events. Mitochondria and plastids in eukaryotes have endosymbiotic origins but many other organelles could have such endosymbiotic origins (Sagan 1967, Margulis et al. 2000, 2006). Deeper in the tree and even more prevalent is the horizontal gene transfer (HGT) between bacteria and archaea. A vertical-transmission-only tree should be based on genes that have not been horizontally transferred, but as we explore deeper and earlier in evolution, such non-HGT genes become rarer. Another problem is the discrete nature of the branches. The sexual isolation of most eukaryotic species is legitimately represented by discrete branches, but bacteria exchange genes with other bacteria, near and far – indiscriminately and promiscuously. This HGT undermines the genetic isolation of bacterial and archaeal "species" (Doolittle & Papke 2006).

Linnaeus, Darwin and modern biology have gradually shown us our place in nature. We know our position among the apes and primates and vertebrates and eukaryotes – but the deeper we go into the tree of life, the more uncertain the nodes of the phylogenetic tree become. As sexual species, it made sense to pretend that all life forms are sexually isolated and

node	the group that is joining our lineage	our lineage before rendezvous	our lineage after rendezvous	rendezvous age (MYA)
1	*Pan* (chimpanzees)	Homo (humans)	Hominini	6.5 ± 0.5
2	*Gorilla* (gorillas)	Hominini	Homininae	9.1 ± 0.5
3	*Pongo* (orangutans)	Homininae	Hominidae (great apes)	16 ± 1
4	Hylobatidae (gibbons)	Hominidae	Hominoidea (apes)	20 ± 2
5	Cercopithecoidea (old world monkeys)	Hominoidea	Catarrhini	29 ± 2
6	Platyrrhini (new world monkeys)	Catarrhini	Simiformes	43 ± 3
7	Tarsiiformes (tarsiers)	Simiformes	Haplorhini	67 ± 4
8	Strepsirrhini (lemurs, lorises, bushbabies)	Haplorhini	Primates	74 ± 3
9	Dermoptera (colugos)	Primates	Primatomorpha	76 ± 11
10	Scandentia (tree shrews)	Primatomorpha	Euarchonta	82 ± 7
11	Glires (rodents, rabbits)	Euarchonta	Euarchonoglires	90 ± 5
12	Laurasiatheres (bats, whales, lions, dogs, horses)	Euarchonoglires	Boreoeutheria	96 ± 5
13	Xenarthrans (anteaters)+ Afrotheres (elephants)	Boreoeutheria	Eutheria (placentals)	105 ± 5
14	Marsupials (kangaroos, opossums)	Eutheria	Theria	160 ± 10
15	Monotremes (platypuses, echidnas)	Theria	Mammalia	175 ± 15
16	Sauropsids (reptiles, birds)	Mammalia	Amniota	310 ± 15
17	Amphibians (frogs, salamanders, caecilians)	Amniota	Tetrapoda	350 ± 5
18	Dipnoi (lungfish)	Tetrapoda	Sarcopterygii (lobe-finned fish)	395 ± 25
19	Actinistia (coelacanths)	Sarcopterygii	Dipnomorpha	415 ± 10
20	Actinopterygii (ray-finned fish)	Dipnomorpha	Euteleostomi (bony vertebrates)	435 ± 10
21	Chondrichthyes (sharks, rays, chimaeras)	Euteleostomi	Gnathostomata (jawed fish)	475 ± 25
22	Cyclostomata (lampreys, hagfish)	Gnathostomata	Vertebrata	615 ± 90
23	Urochordata (sea squirts)	Vertebrata	Olfactores	675 ± 130
24	Cephalochordata (lancelets)	Olfactores	Chordata	680 ± 90
25	Ambulacrarians (starfish, acorn worms)	Chordata	Deuterostomia	685 ± 130
26	Protostomia (arthropods, nematodes, molluscs)	Deuterostomia	Nephrozoa (coelomates)	795 ± 120
27	Acoelomorpha (acoel flatworms)	Nephrozoa	Bilateria (triploblasts)	820 ± 330
28	Cnidaria (hydra, jellyfish, anemones, corals)	Bilateria	Parazoa	825 ± 210
29	Ctenophores (comb jellies)	Parazoa	ParaHoxozoa	945 ± 220
30	Placozoans (trichoplax)	ParaHoxozoa	Eumetazoa (diploblasts)	950 ± 180
31	Porifera (sponges)	Eumetazoa	Metazoa	955 ± 200
32	Choanoflagellates	Metazoa	Choanozoa	1025 ± 330
33	Filasterea (*Ministeria, Capsapora*)	Choanozoa	Filozoa	1050 ± 90
34	Mesomycetozoea or Ichthyosporea (DRIPs)	Filozoa	Holozoa	1080 ± 90
35	Fungi (mushrooms, moulds, nucleariids)	Holozoa	Opisthokonta	1110 ± 360
36	Apusomonads + Ancyromonads + Breviatea	Opisthokonta	Obazoa	1420 ± 290
37	Amoebozoans (*Amoeba,* slime moulds)	Obazoa	Unikonta or Amorphea	1480 ± 350
38	Collodictyonids + Rigifilids + *Mantamonas*	Unikonta or Amorphea	Podiata	1600 ± 350
39	Metamonada + Malawimonas (*Trichomonas, Giardia*)	Podiata	Scotokaryotes	1750 ± 350
40	Bikonts (plants, algae, diatoms)	Scotokaryotes	Neokaryotes	2000 ± 260
41	Excavata (*Euglena, Trypanosoma*)	Neokaryotes	Eukaryota	2100 ± 260
42	Asgard (Loki-, Thor-, Odin-archaeota)	Eukaryota	Asgard + Eukaryota	2720 ± 370
43	TACK superphylum	Asgard + Eukaryota	Proteoarchaeota + Eukaryota	2940 ± 400
44	Euryarchaeota (methanogens, halobacteria)	Proteoarchaeota + Eukaryota	Eury- + Proteo- + Eukaryota	3150 ± 410
45	DPANN superphylum	Eury- + Proteo-archaeota + Eukaryota	Archaea	3300 ± 430
46	Eubacteria + Candidate Phyla Radiation	Archaea	Known Life on Earth	3950 ± 550
47	Second Life + Dark Life?	Known Life on Earth	All life on Earth	4150 ± 350

Table 1. Hierarchy of Taxonomic Convergences Along Our Lineage (rendezvous with sister taxa)*

*Names in parentheses are common names. Estimated dates for nodes 1- 40 are from Kumar et al. (2017). Dates for nodes 41-47 are from Betts et al. (2018). Kumar et al. (2017) do not have the same branching order and dates for some rendezvous points listed in Table 1. Thus, the dates for nodes 24, 29-31, 33-34, 37-40 are our estimates based on the catalogued divergence dates associated with the closest lineages described by Kumar et al. (2017). Uncertainties on rendezvous ages for nodes 1-40 are our estimates that account for the upper and lower range of divergence dates catalogued by Kumar et al. (2017). Uncertainties on rendezvous ages for nodes 41-46 are estimates reported by Betts et al. (2018). Some estimated dates reported in the table have been rounded to the nearest five Myr (nodes 14-32) or nearest ten Myr (nodes 32-47). We used the age of the Moon-forming impact ~4.5 Gyr (Stevenson & Halliday 2014) and the date associated with the putative earliest evidence for life on Earth ~3.8 Gya (Dodd et al. 2017, Nutman et al. 2016) to set the uncertainty associated with node 47. Branching orders and group names for lineages joining at: nodes 1-31 are based on Kumar et al. (2017); nodes 32-41 are based on Cavalier-Smith et al. (2014) and Shalchian-Tabriz et al. (2008); nodes 42-47 are based on Betts et al. (2018). TACK superphylum (Node 43) consists of Thaum-, Aig-, Cren- and Kor-archaeota. DPANN superphylum (Node 45) consists of Diapherotrites, Micr-, Parv-, Aenigm-, Nano-, Nanohalo-, Woese- and Pace-archaeota.

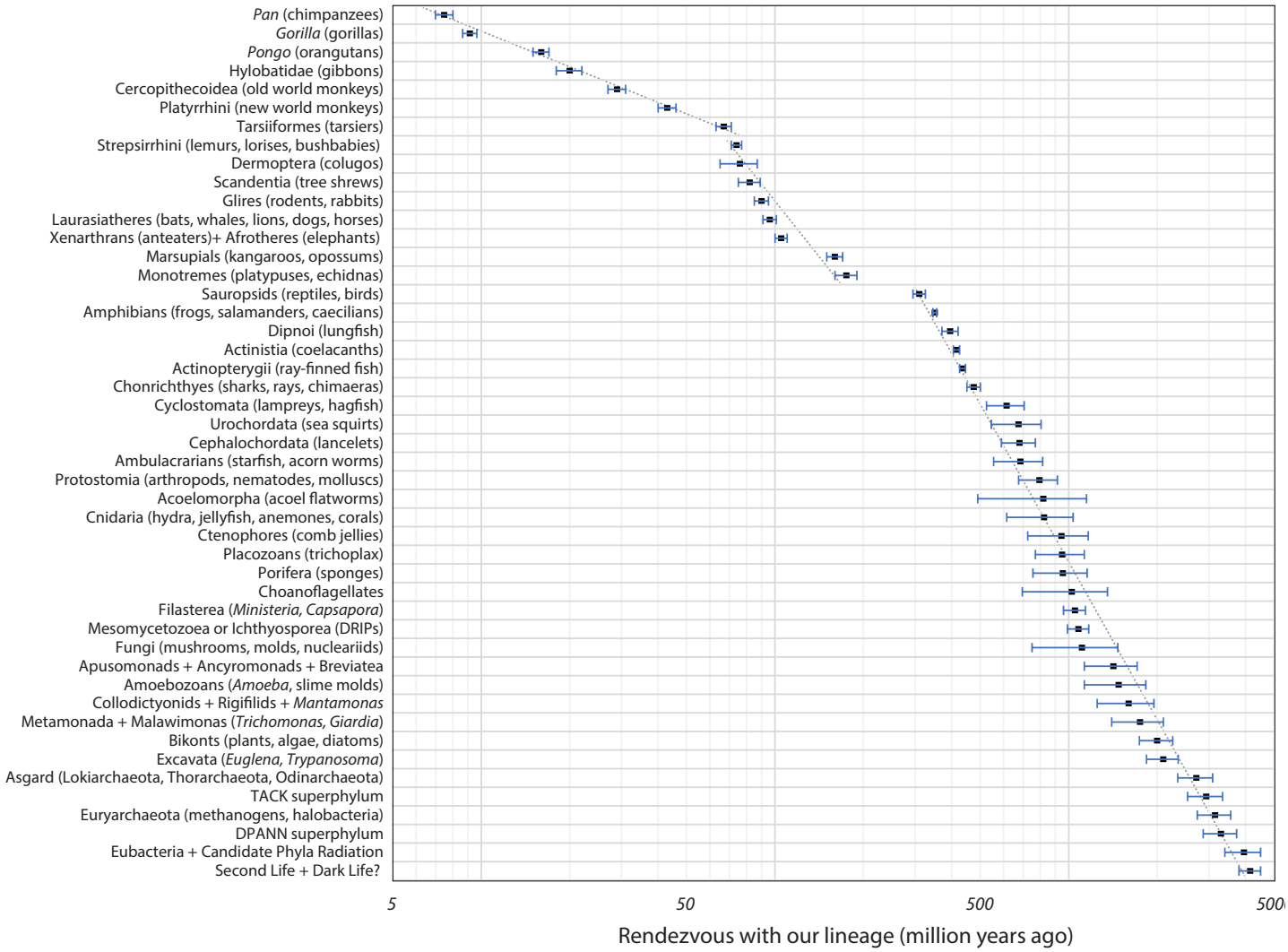

Figure 6. Plot of the dates of the 47 nodes in Table 1. We have superimposed notional lines over three sections of the plot.

therefore uniquely identified as a lineage or a branch on the tree of life.

The branches of almost all sexual species diverge nicely like the branches of a real tree. But the tree of all life, especially as we get closer to the root, is not so simple. The earliest branches are vague. Without sex, bacterial species are not isolated and so aren't branches (Doolittle & Papke 2006). They are networks of molecules and genes and endosymbiotic unions – perhaps as many convergences as divergences. There are groupings on many scales. Overlay a few thousand gene-trees and an average species-tree will emerge, but the prevalence of endosymbiotic events during the origin of the eukaryotic cell, and the increasing prevalence of HGT as we go deeper into the prokaryotic tree produces a complex network of divergences and convergences that we are still trying to unravel.

As more genomes are sequenced, the resulting phylogenetic trees reveal more about who we are and our humble sliver of genetic space. These sequences have also become the most fertile sources

of information about the Last Universal Common Ancestor (LUCA) and the origin of life on Earth.

Summary

Just as the Apollo and Voyager missions showed us spaceship Earth as a pale blue dot (the spatial overview effect), we propose a biological overview effect produced by looking at the tiny twig of humanity on the phylogenetic tree of life. Modern genome sequencing shows us our humble, pale green eukaryotic island among the ocean of genetic diversity of life on Earth. Based on increasingly precise phylogenetic trees and molecular clocks, we compile and present the most concise taxonomic overview of our lineage as we evolved over the past ~4 billion years, from Archaea into humans. This biological overview can help us understand and navigate the integrated history of life and humanity.

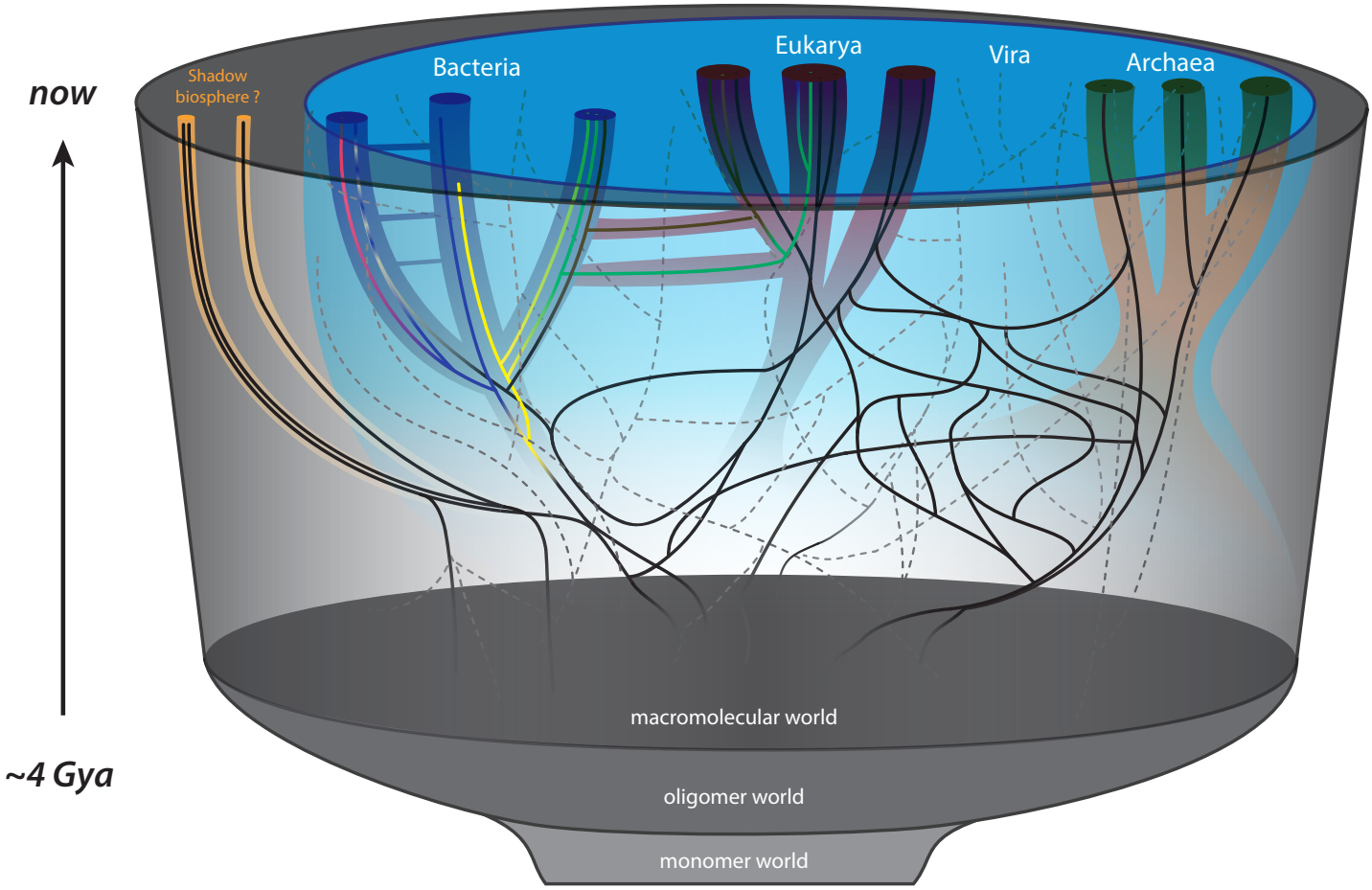

Figure 7. Our attempt to improve on the divergence-only tree in Figure 4 and Table 1. We have schematically added endosymbiotic convergences (horizontal solid lines) and the ubiquitous evolution and exchange of viruses and genes (dashed lines).

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Is the Universe Enough? Can It Suffice as a Basis for Worldviews?

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Abstract
The modern scientific cosmic perspective is unique and compelling, but it is not for everyone. Modern cosmology can be humbling and awe-inspiring, even motivating It can also be overwhelming, even scary. The extent to which the universe we know today can form the basis of satisfactory worldviews rests largely on human psychology, preferences, and needs, as well as on what we mean by "worldview". This essay will explore some ways to think about worldviews and the universe, with an emphasis on exploring relationships between cosmic evolution and cultural evolution (Dick and Lupisella), including what might be called "cosmocultural evolution" – the coevolution of cosmos and culture (Lupisella 2009). We will touch on a few cosmocultural evolutionary perspectives as well as broader underlying "cosmological theories of value". With an eye toward psychology, we will consider if and how such perspectives might inform, or possibly suffice as worldviews, suggesting generally that the universe may suffice for some people some of the time, but probably not for most people most of the time.

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1. Introduction

"*The Cosmos is all that is, all that was, and all that ever will be.*"

- Carl Sagan [1]

"*If the universe isn't enough, what are we to do?"*

- Ian Crawford [2]

The modern scientific cosmic perspective is unique and compelling. But it is not for everyone. It may only be compelling to a small fraction of people. Modern scientific cosmology can be humbling and awe-inspiring, even motivating to some. But it can also be overwhelming and even scary. The extent to which the universe we know today can form the basis of satisfactory worldviews rests largely on human psychology, preferences, and needs, as well as on what we mean by "worldview".

When I first learned of the Australian National University Symposium on "*Expanding Worldviews: Astrobiology, Big History, and the Social and Intellectual Benefits of the Cosmic Perspective*" (summarised by Crawford 2018), I was immediately struck by the explicit reference in the title to "social benefits of the cosmic perspective." Much effort has gone into our modern understanding of the universe, but there appears to be a relative lack of attention given to the question of how such pursuits truly benefit society (Race et al 2012, Dick 2018).[3] Maybe that is because the benefit is obvious enough since much of

1 Sagan, C. 1980. *Cosmos*. New York: Random House. P 4.

2 Personal email, 24 April 2018.

3 A NASA workshop on the societal implications of astrobiology was held in 1999 (NASA Technical Memorandum 1999), and there have been subsequent efforts to explicitly explore the connections between astrobiology and society (e.g., Race et al 2012 and Dick 2018).

the human population seems to deeply value learning about our world – including learning about our broader universe even though it is extremely old and vast and largely detached from everyday human life.

Indeed, even with some perceived detachment of human life from the larger universe, many societies still seem to be willing to conduct extensive exploration of our cosmos even though it does not have much, if any, operational impact on our daily lives. This says something about the human species – many of us are compelled to learn about almost anything, and society provides resources to engage in what are often time-consuming, life-long, multi-generational, expensive endeavours to learn about things we suspect will not have near-term practical relevance for our lives.

We like to learn because we are interested. We are presumably interested for at least evolutionary reasons since there have likely been strong selective pressures to be curious about our wider world, which would lead to a better understanding for practical living, which can then lead to better individual and group fitness. But many modern humans, who arguably now have more time and cognitive processing power to pursue "impractical" questions, are also intrigued by the often vexing philosophical questions regarding value, meaning, and purpose, and why we observe the universe we do, or why the universe exists at all.

I am personally charmed and awed by our universe (even more so by the possibility of a multiverse!), and by wondering if it is "about something" and why it exists in the first place. I have spent a good amount of mental energy on such things (perhaps an irrational amount), but my fascination and intrigue is not necessarily widely shared by others – some of who presumably think they already have answers in forms of religions or other philosophies and worldviews that have been around for thousands of years. And my interest arguably has something to do with personal psychological predispositions that do not benefit others that much, if at all. But given the importance of worldviews and the bewildering variety that complicates our ability to know what is true, and given the sometimes deeply problematic adverse affects that can result from many worldviews, it does seem worth asking whether the scientific universe we know today, or may know in the future, can at least help inform and/or form the basis of satisfactory worldviews.

It would seem that any hope for building satisfying cosmological worldviews would need to entertain some degree of integration, if not full integration, between physical cosmic evolution and the emerging meaningful powerful cultural evolution occurring here on earth and perhaps elsewhere in the universe. Fortunately, our modern scientific understanding of cosmology provides a significant amount of that integration. Modern cosmology tells us that stars, planets, life and humanity are the results of a long process of micro-scale and large-scale cosmic evolution, including biological and cultural evolution – at least in our little corner of the cosmos. "The Cosmos is within us. We are made of star stuff." – as Carl Sagan famously proclaimed.[4]

Taking a cue from our emerging integrated scientific story of the universe, this paper will explore a few ways to think about worldviews and the universe, with an emphasis on exploring relationships between cosmic evolution and cultural evolution, including what might be called "cosmocultural evolution" – the coevolution of cosmos and culture (Lupisella 2009). We will touch on a few cosmocultural evolutionary perspectives as well as broader underlying "cosmological theories of value" being developed for an upcoming book, *Cosmological Theories of Value: Science, Philosophy, and Meaning in Cosmic Evolution*. We will address if and how cosmic perspectives might inform, or provide a basis for, alternative "cosmological worldviews."

4 Sagan, C. 1980. *Cosmos.* Random House. P. 244.

This short treatment cannot include the myriad details of cosmic evolution and all the relevant details regarding the philosophy and psychology of belief and worldviews and how they impact human behavior, but we will certainly draw from some of that work, much of which can be found in academic and popular treatments, e.g.: Aerts et al 1994 and 1999, Babbage and Ronan 2000, Wilson 2002, Shermer 2002, Koltko-Rivera 2004, Gershenson et al 2007, Bulbulia et al 2008, Johnson et al 2011, Henriques 2011, Vidal 2012, Nilsson 2013, 2014, 2015, Hedlund de-Witt et al 2014, Saucier 2013, 2015).

2. The Universe and Worldviews

2.1 Why Care About Worldviews?

"*A belief is a lever that, once pulled, moves almost everything in a person's life.*"

– Sam Harris (2005, p 12)

Beliefs and worldviews are different from each other, but they are usually intimately related. Many, but not all worldviews can include beliefs that are not necessarily grounded in much evidence or careful investigation or reasoning. But worldviews can also be evidence-driven. They can be highly complex and diverse, but there tend to be some common underlying drivers, motivations, and themes associated with the psychology and content of many worldviews that can be used to help assess the extent to which our universe can serve as, or at least inform potentially satisfying worldviews.

We can start with a relatively simple definition of 'worldview', which is to define it essentially like it sounds: *a view of the world*. 'View' often implies particular perspectives and beliefs. 'World' often implies everything (or almost everything). A worldview, then, is a kind of "view of everything" that may matter in a person's life or a group's functioning, e.g., survival, human affairs, facts and values, meaning and purpose, death and afterlife, epistemology and ontology, transcendent realities, etc. This is not different in its essence from characterizations offered by others, and given this kind of characterization, we can see why worldviews can drive very specific details of what we believe, how we think, and why we act in certain ways (Koltko-Rivera 2004, Johnson et al 2011, Vidal 2012). Worldviews can be comforting and inspiring, but also dangerous.[5]

Strictly scientific narratives and worldviews, including those based on our present state of physical cosmology, can be limited or even misguided, and perhaps dangerous as well, so we should be mindful of potential pitfalls, including what might be called "oppressive universalism"[6] or "over-foundationalizing" (Rockmore and Singer 1992). These are not just legitimate psychological concerns about the misuse of worldviews, but they are also legitimate intellectual concerns that are particularly important when engaging in speculative worldview building – especially when that worldview building is driven by contemplations of our entire universe and the associated complexities of modern cosmology. Keeping these sensitivities in mind (Denning 2009), we can explore "cosmological worldviews", which can be thought of as worldviews that are heavily informed by cosmology, i.e. by modern scientific cosmic evolution that includes fundamental physics such as relativity and quantum mechanics (that drives much cosmic evolution), as well as biological evolution, including the evolution of intelligence and culture.

5 Juergensmeyer (2003) looks closely at the links between violence and a number of religions, but its important to note that while worldviews are often associated with religions and theology, they are not limited to those orientations.

6 I use the phrase "oppressive universalism" here as a way to capture to the idea that "universe narratives" can be misguided and oppressive, including to the extent that they may deemphasize individualism in favor of very broad narratives (Marshall 2002).

2.2 Theology

The universe and worldviews have been intimately connected for thousands of years. Ancient and modern religions have found many ways to integrate concepts of the larger universe into their worldviews. Western religions such as Judaism, Christianity, and Islam have tended to emphasize the universe as God's creation. Hinduism has proffered notions of a very long-lived, if not eternal, cyclical universe. Pantheism has generally equated the universe with divinity or "God", and *panen*theism has viewed the universe as imbued with divine spirit that also transcends the universe. More generally and more recently, some have referred to "cosmotheology" as an attempt to capture the idea that notions of spirit or divinity or God should tightly integrate — if not be fully constituted by — details of modern scientific cosmic evolution (Dick 2000).[7] Some eschatological treatments have tended to emphasize "end-points" of cosmic evolution, for example, leading to a super advanced intelligent "God-like" being, or state, at the end of cosmic evolution (e.g. Teilhard de Chardin 1955, Tipler 1994).

2.3 Speculative Cosmology

There are numerous scientific treatments, or what could perhaps be thought of as more "secular" speculative philosophical treatments, that have potential relevance for the universe and worldview building – at least by way of informing alternative worldviews, if not having the potential to fully constitute worldviews in and of themselves. There have been articulations of cosmic evolution that emphasize a kind of "spiritual" embrace of our universe without necessarily explicitly emphasizing theological or divine dimensions or heavy philosophical treatments that explicitly invoke metaphysics or value theory (e.g. Swimme and Berry 1992, Barlow 1997, Goodenough 1998). "Big History" treatments emphasize a cosmic-scale view of history and some level of comprehensive integration that includes the evolution of life and humanity (Christian 2004).

Anthropic views emphasize the idea that our observed universe appears as it does because is it consistent with the evolution of beings that can eventually observe it. Multiverse concepts posit the existence of many, possibly infinite, universes and is often used to explain our particular cosmic details (e.g. laws and constants) by noting that the existence of many other universes makes our particular universe less improbable than it may otherwise appear to be. Cosmological Natural Selection suggests that as universes give "birth" to other universes (possibly via black hole production), a kind of selection process would tend to produce relatively stable and long-lived universes such as ours (Smolin 1997).

Information-based views of the universe have been proposed noting that the universe can be seen as a kind of computational system (Lloyd 2006). Ideas such as the "evolutionary developmental universe" (Smart 2009), taking cues from biological evolution, emphasize how the evolution of intelligent beings can lead to highly computational systems such as a "developmental singularity", perhaps in the form of a "black hole computing system" that can give rise to similar universes with incremental changes. Related to ideas of an information-based universe, it has been suggested that our universe may actually be a simulation (Bostrom 2003).

James Gardner (2005), leveraging ideas from John Wheeler who suggested some degree of "retro-causation" might be possible, proposes a kind of participatory or "co-created" evolutionary model of the universe as a "closed time-like curve", which can provide a theoretical explanation for a "self-synthesized" origin and evolution of the cosmos.

7 Kant appears to have coined the term "cosmotheology" in *Critique of Pure Reason* to capture the idea that a "supreme being" might be inferred by experience of the world. Steve Dick's (2002) more contemporary use is different in that it does not require a "supreme being".

Paul Davies (2009) goes further, speculating that the universe and its specific bio-friendly laws might be "self-synthesizing" via cultural evolution leading to cosmic-scale "retroactive" observer-participancy in which the whole universe, eventually "saturated by mind", essentially "retro-actively" brings itself and its specific laws into being (at least by constraining "past" possibilities, in which case it can be thought of "retro-constraining").

2.3 Cosmophilosophy

For lack of a better phrase, I would like to also add "cosmophilosophy" as a category that overlaps with much of what has been touched on prior, but adds a more explicit and systemic treatment on relationships between contemporary cosmology (scientific cosmic evolution) and an explicit emphasis on philosophical questions of value, meaning, agency, epistemology, and metaphysics. Cosmophilosophy asks, in part, questions having to do with what value might be associated with the universe and its evolution, whether there is any meaning or purpose in the cosmos, why it has evolved in the way we think it has, or why the universe exists at all. Here, we will very briefly touch on three "cosmological theories of value" (*cosmological reverence*, *cosmocultural evolution*, and the *connection-action principle*) taken from a past book chapter (Lupisella 2016) and an upcoming book (Lupisella in-press). In the next section we will assess to what extent these theories of value and other related ideas touched on previously might provide a basis for worldviews.

Cosmological Reverence

Similar to what was noted in the speculative cosmology section above (without the stronger "spiritual" invocations), cosmological reverence can be seen a sub-category of cosmophilosophy that captures ideas suggesting we can deeply revere the universe for a variety of reasons, including that we are intimately related to, and dependent on the universe since we arose from a long complex process of cosmic evolution and rely on the universe's material and energy for our existence and future evolution. We can revere the universe for purely scientific reasons, as well as any awe and majesty we might have in the face of the universe's magnitude, mysteries and complex evolution (Carroll 2016). The definition of cosmological reverence suggested here is a kind of one-way relationship in the sense that it is limited to the cosmos being significant for us, but not the reverse. Cosmological reverence recognizes that we are a product of, and sustained by the universe, but does not claim that we have any particular significance for the universe at large.

Cosmocultural Evolution

Cosmocultural Evolution stresses the idea that physical cosmic evolution and emerging cultural evolution are co-evolving and will continue to more tightly co-evolve in the future, with both having significance for each other – both are evolutionary dynamics that are in some sense on par with each other in terms of significance. One way to think about culture is as the "collective manifestation of value" – where value is that which is valuable to "sufficiently complex" agents, from which meaning, purpose, ethics, and aesthetics can be derived. Culture manifests value in many varied forms, from thoughts and knowledge to symbolic abstractions to social norms and organizations to mass movements and large-scale creations (Lupisella 2009).

We should avoid such a strong distinction between cosmic evolution and cultural evolution that they are thought of as completely distinct from each other. Cultural evolution is ultimately a part of cosmic evolution in the broad sense that culture has emerged as part of the physical evolution of the universe. However, we can make a useful distinction to the extent that culture is a different enough evolutionary phenomenon from the rest of physical cosmic

evolution. It can be a useful distinction to the extent that it can help address the interesting question of how significant cultural evolution may be in a cosmic context.

One version of a cosmocultural evolution perspective can be thought of as "bootstrapped cosmocultural evolution" which suggests the universe has "bootstrapped" itself into the realms of value, meaning, and purpose via culturally evolving beings like ourselves – but for no particular reason other than the physical characteristics of the universe allowed for life and intelligence to emerge and evolve naturally. Stronger versions suggests that cultural evolution could become a very significant, if not dominant form of evolution with possibly infinite potential and significance – similar to ideas touched on previously. Cosmocultural evolution suggests that cultural beings may become, and perhaps already are, a kind of cerebral cortex for the universe – a source of self-awareness and intentional creators and arbiters of value, meaning, and purpose (Lupisella 2009). It seems we are a way for the universe to not only know itself, but to *value* itself.

Connection-Action Principle

Treading deeper into the stormy waters of what is arguably at least part metaphysics, we can ask why the universe exists at all and why its evolution appears to have been a very long-lived, highly dynamic and creative process. What is its "source", if any? A brute-fact explanation would generally refer to the laws of physics and/or initial conditions of the universe as facts to accept without cause or explanation, and those laws and conditions explain why and how the universe evolves and creates. More specifically, a purely scientific explanation would suggest that an initial high-energy, low entropy state naturally gave rise to expansion,[8] with cooling and "clumping" emerging over time, consistent with the second law of thermodynamics, gravity, and other physical forces, causing the aggregation or "creation" of objects like atoms, stars, galaxies and planets.

But we can still ask: why those initial conditions? Why these laws? Even more challenging, why any "order" or laws to begin with? Why an origin at all, and was it truly from "nothing" as some have suggested?[9] Merely being able to ask these questions does not mean they are well-posed or have answers, let alone scientific answers, but there have been many suggestions, some of which overlap heavily with what was touched on prior, including, for example: (1) design by a God or gods or some kind of entity or beings, including the possibility that our universe is a simulation of sorts (Bostrom 2003), (2) anthropic principles (e.g. Barrow and Tipler 1986), (3) an eternally oscillating universe, going back to the Greeks and forms of eastern worldviews such as Hinduism and now by some in modern cosmology (e.g. Steinhardt and Turok 2002), (4) cosmological natural selection (Smolin 1997), (5) a metaverse or multiverse that suggests the possibility of many universes (Tegmark 2003), to (6) even more provocative versions of anthropocentric thinking that suggest conscious beings in some sense create the universe and possibly even its laws via extreme interpretations of quantum mechanics – as touched on previously (von Neumann 1932, Wheeler 1990, Davies 2009).

Regardless of the kind of explanation for our universe's origin and its particular laws and initial conditions, most suggestions seem to rest on, assume, or at least imply that our universe is dynamic. It appears we live in a universe of *action* – and action is central to our understanding of our universe (Turchin 1993,

8 The expansion may have included an extremely rapid and unusually accelerated "inflationary" expansion suggested by inflationary theory (Guth and Steinhardt 1984, Linde 1994, Guth 1998)

9 See Krauss (2012) for a recent scientific exploration of an origin from nothing, but which nevertheless seems to fall short of explaining the emergence from truly "nothing" – at least in the traditional philosophical sense of truly nothing (itself a premise Krauss appears to challenge).

Mermin 2017).[10] Even contemplations of an origin as a quantum fluctuation from a quantum vacuum state or quantum "foam" (a realm of virtual particles which are wavelike fluctuations in the quantum vacuum at "absolute zero") seems to imply there is still "something" that is "dynamic". The quantum vacuum state appears to at least posit, if not be in actuality, a realm of action, or at least a realm that gives rise to some form action – as if the quantum vacuum state itself is unstable and must produce action. We seem to live in a fundamentally action-laden universe. But why should there be any action all?

The connection-action principle (CAP), in its simplest form, makes the conceptual suggestion that *the universe's property of connectedness is manifested as action* – perhaps in ever-increasing degrees and perhaps necessarily so in stronger versions that might be something more like: the universe's necessary property of connectedness is necessarily instantiated as relations and actions and increasing degrees thereof (Lupisella 2016, Lupisella 2019 forthcoming) as indicated by the simple graphic below (Figure 1).

This admittedly speculative suggestion leverages the old idea of the connectedness of the universe (Sciama 1959, Bohm and Hiley 1993), but goes further and suggests that for the property of connectedness to be realized, something needs to happen, some action or event needs to instantiate and realize any connectedness or relationship, where relations can be thought of as slightly more specific and more concrete forms of connectedness. In that conceptual sense, the property of connectedness is a source of action, a kind of "cause" for action. An action occurs to help realize connectedness and relations, i.e. to make connectedness and relationality *real* or *actual*, to manifest and instantiate what can be thought of as a kind of "relational potential" of the universe.

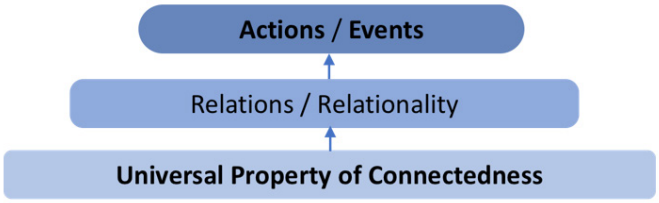


***Figure 1**: Graphical Representation of the Connection-Action Principle*

The connection-action principle is arguably consistent with relational metaphysics in general and process philosophy more specifically (for which Whitehead's "actual events" are a critical element of his ontology (Whitehead 1929) and may provide a conceptual explanation for why there should be relations, processes, actions, and events at all. CAP is arguably consistent with a number of ideas such as Action Ontology (Turchin 1993) and other ideas such as Relational Quantum Mechanics (Rovelli 1996), quantum entanglement (potentially revealing an additional form of deep connectedness), and information-based ontologies (Lloyd 2006, Davies and Gregersen 2010), including Bohm's notion of "active information" (Bohm and Hiley 1984, 1987, 1993; Bohm 1989)[11] – where information can be thought of as the details that characterize and specify relations.

Even quantum field theory (QFT), an increasingly prevalent and successful practical framework for quantum mechanics which leverages field constructs, can also be viewed as suggesting deep degrees of connectedness and relationality in the sense that

10 Valentin Turchin (1993) explicitly, and seemingly necessarily, links the epistemological criticality of action with an action ontology. Mermin (2017, p 89) emphasizes the importance of action when he writes of QBism: "in QBism, on the other hand, a measurement can be *any* action taken by any user on her external world. The outcome of the measurement is the experience the world induces back in that particular user, through its response to her action." This is very similar to Relational Quantum Mechanics which is touched on subsequently.

11 There are a number of speculative and far-reaching applications of active information to psychology and mind, including connections to value and meaning (e.g. Pickering 1995, Pylkkänen 2016).

the notion of a field is a singular seamless "*intra*-connected" construct that fundamentally drives and manifests physical dynamics. Notably, the field construct can arguably be traced back to Newton who speculated about some "action at a distance" between bodies to help explain gravitational forces. QFT can also be traced more recently to a third major early formulation of quantum theory (the first two coming from Schrodinger and Heisenberg) which was first developed by Paul Dirac and has been called , notably, the *Interaction* Picture (Sakurai and Napolitano 2017) – arguably consistent with some interpretations of the Connection-Action Principle.

A stronger version of the connection action principle suggests that the universe increasingly manifests its property of connectedness through increasing degrees of action (and hence increasing degrees of diversity and complexity, etc.). The connection - action principle is arguably consistent with (a) Many Worlds interpretations of quantum mechanics, (b) the multiverse concept, and (c) the temporal version of the Principle of Plenitude (Lovejoy 1936) in the sense that they can all be seen as examples of robust realizations of CAP because they produce increasing degrees of action in the form of complexity, extreme diversity, and creativity more generally.

This kind of theoretical conceptual proposal can be interpreted to suggest that the universe is "about something" – something admittedly general and perhaps highly open-ended and even vague, but if the universe is about something like realizing connectedness through action, we can further interpret that to suggest there is a kind of value associated with the universe's action-laden evolution – a value "intrinsic" to the nature of universe. In this view, cosmic evolution can be generally seen as a realization of the universe's potential, and specifically, the more "action" in the universe (where, again, action can be interpreted very broadly, including creating new relations, "objects", complexity, diversity, etc.), the more its nature is realized. This can then lead us to ask if and how this kind of speculative metaphysics might directly or indirectly inform worldviews, values, meaning, purpose, etc.

3. Can The Universe Be Enough?

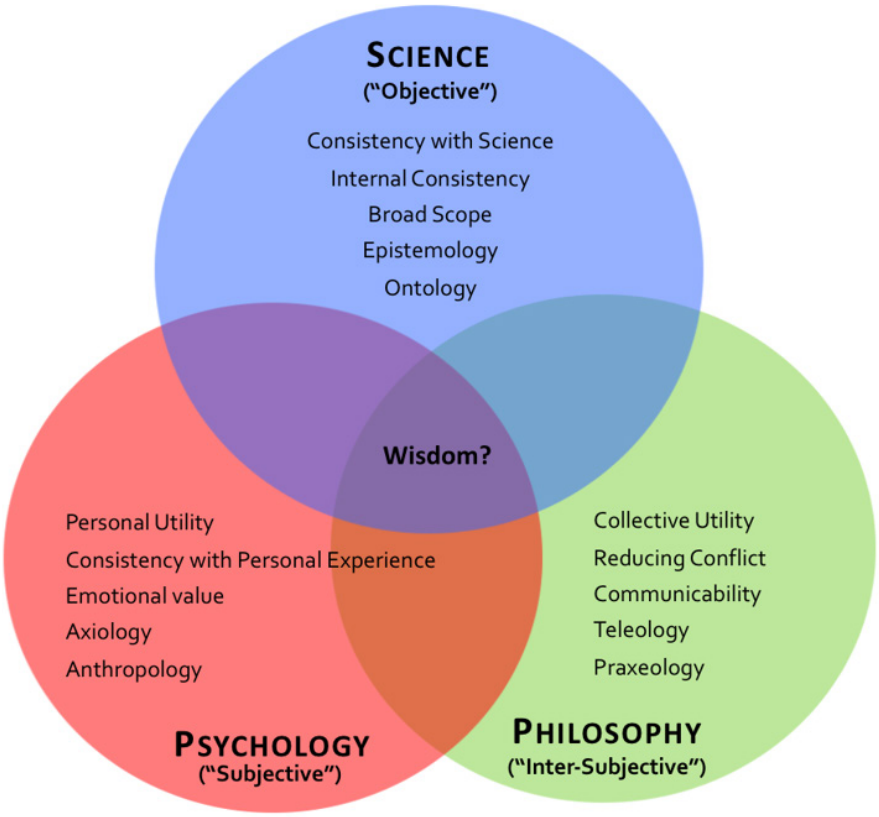
Here we will consider a slightly different question from the title and ask: *can* the universe be enough? This will allow for a more general, theoretical, and future-oriented assessment. Whether the universe can be enough to provide a sufficient basis for worldviews depends on many details – including details of the worldview itself and the needs of the individuals and groups holding the worldview(s). There are many ways we can go about addressing questions regarding if and how the universe can suffice as a basis for worldviews. We will draw from a few sources to develop some lenses through which to assess the utility of the cosmological worldview ideas touched on prior, with an emphasis on the cosmophilosophy ideas that attempt to explicitly address philosophical questions of value, meaning, and purpose in the context of modern cosmology.

3.1 Assessment Methods

We can start by considering three general lenses through which to analyze the worldviews touched on in this essay: science, psychology, and philosophy – all of which overlap and inform each other as indicated in Figure 2. Clement Vidal (2012) offers a comprehensive and detailed framework for evaluating worldviews, particularly in the context of modern cosmology (Vidal 2014), consisting of: (A) 6 philosophical dimensions (descriptive , normative, practical, critical, dialectical, synthetic), (B) a philosophical agenda for defining what a worldview is, (C) several "objective", "subjective", and "inter-subjective" evaluation criteria, and (D) a set of tests, including "first order" tests of is-ought, ought-act, and is-act. This paper will loosely apply the evaluation criteria from item C above: objective criteria of *internal consistency*, *consistency with*

science, *broad scope*; subjective criteria of *utility*, *consistency with personal experience*, *emotional value*; and inter-subjective criteria that address social factors such as *collective utility*, *reducing conflict*, and *communicability*.

Interestingly, as suggested in Figure 2, while not a perfect mapping, Vidal's worldview evaluation criteria categories (objective, subjective and inter-subjective) map reasonably well to the categories of science, psychology and philosophy in the sense that science attempts to pursue objectivity, psychology is more about subjective personal experience (with increasingly powerful scientific methodologies), and philosophy has a lot to do with how people think, value and act with respect to each other (also subject to scientific investigation, e.g. including via social psychology). The philosophy lens we will use here may differ from Vidal's inter-subjective category in the sense that his inter-subjective category is arguably a bit more pragmatic for group functioning, while the philosophy lens I have in mind is more aspirational, speculative, and theoretical (but with potentially important practical consequences). So, while there is critical overlap between these three lenses,[12] to simplify the usage in this essay, we might summarize by saying that science attempts to understand what is real about the world, psychology is more about how people actually operate, and philosophy is more aspirational and speculative.



"Figure 2: Three Worldview Evaluation Lenses"

While Vidal's framework is closest to the 3 kinds of lenses I would like to use for this essay, Figure 2 also includes key elements from other frameworks for how to think about worldviews. Johnson et all (2011) suggest 6 general areas for worldviews that interrelate and can help integrate between culture and religion. I list 5 of those in Figure 1: ontology, epistemology, axiology (proximate goals and values), teleology (ultimate goals), and praxeology (codes of behavior). Hedlund-de-Witt (2012) builds on previous work and constructs a 5-part "integrated worldview framework", two of which are "anthropology" and "social vision" (the other 3 are ontology, epistemology, axiology – similar to Johnson et al). "Anthropology" is described as a perspective on who and what the human being is and any potential roles and positions we might have in the universe. This articulation is helpful for the purposes of this essay and is arguably different enough from other factors to list explicitly.[13] Hedlund-de-Witt's

12 Psychology is obviously informed by science, empirical study, etc., including via emerging fields such as evolutionary psychology. Philosophical, speculative, normative explorations should be informed by science, but not limited by science.

13 Hedlund-de-Witt's "anthropology" is also related to teleology and other areas shown under science and philosophy, but

"social vision" is arguably captured by other elements listed such as collective utility and praxeology.[14]

Worldview evaluations would likely come out differently depending on any number of factors regarding how we think about the categories and criteria, including how they are weighted, but we can keep this overall kind of evaluation framework in mind as we briefly assess if and how the universe might suffice as a basis for worldviews. It is notable for our assessment that Vidal suggests twice as many subjective criteria than objective criteria, which is important for evaluating worldviews since they often need to address a range of complex subjective human needs and interests.

3.2 Cosmological Worldview Assessments

Most of the cosmological worldviews noted previously are arguably strong on the scientific/objective criteria (e.g. internal consistency, consistency with science, broad scope, etc.) with the exception that depending on the interpretation of traditional theological views (e.g. whether modern science is significantly incorporated), those views can be seen as weaker on the objective and scientific criteria. Indeed the point of most of the cosmological worldviews noted here is to be more consistent with modern science and modern cosmology specifically. However, most of the views noted prior are arguably relatively weak on most of the subjective psychological and philosophical criteria, much of which are presumably driven by natural selection and evolutionary psychology, including group selection – e.g. coping with uncertainty and death, maintaining group cohesion and efficacy, etc. (Wilson 2002, Haidt 2012).

Cosmological Reverence suggests we can value the universe because we emerged from it and are intimately bound up in it, but we do not have any particular significance for the universe at large. So while there can be some emotional value as well as personal and collective utility (including communicability), presumably the emotional value would be limited, not just because we are not significant for the universe and cannot discern important future-oriented implications, but also in part because it is arguably difficult for many people to personally or collectively identify with our immensely old, large, and seemingly impersonal and indifferent universe. More specifically, such a view does not have much, if any, specific practical consequence or utility for dealing with social challenges such as reducing conflict – with the possible exception that revering the universe can help us revere each other as products of cosmic evolution and hence deal with each other more respectfully. Cosmological reverence is primarily a kind of one-way "passive reverence" for the cosmos, but it can nevertheless inspire and inform certain ethical views such as how we might value certain cosmic creations, including each other and other life-forms more generally (Lupisella 2013).

Cosmocultural Evolution is a stronger view in the sense that it can suggest a certain amount of responsibility (perhaps a kind of "cosmic" responsibility?) for intelligent beings since cultural evolution has the potential to have much, perhaps unlimited, significance for the cosmos – but again, for no other reason other than cultural agents arose via physical processes and now have agency and can choose and act on forms of cosmocultural evolution value systems or worldviews. On this view, we can see not only the kind of significance noted by Paul Davies and others that "Somehow, the universe has engineered not only its own self-awareness, but its own self-comprehension" (Davies 2009, 385), but

since it is somewhat narrow in the sense of having an important individualistic component and being limited to anthropocentric views, I have included it in the psychology lens.

14 Obasi (2002) develops a 41 item "Worldview Analysis Scale" targeted primarily for people of African and European descent. Project Worldview is an online collection of many different facets of worldviews and provides diverse guidance for thinking about and analyzing worldviews: http://www.projectworldview.org/welcome.htm.

also, as noted prior, that the universe has "engineered" its own *self-valuing*. This might have some emotional value in the sense that it can be seen to provide compelling cosmic significance specifically for beings like ourselves. We may see ourselves as a source of cosmic value where there otherwise may have been none prior. Such a view might have more social inter-subjective philosophical value in that it can provide groups of people, or perhaps all intelligent/cultural beings in general, with a common/collective sense of meaning and purpose within what may be the largest shared context possible – the universe.

The Connection-Action Principle goes much further and can be interpreted to imply value based on a claim about the nature of the universe. As touched on prior, while the suggestion is arguably supported by a number of lines of philosophical reasoning and has some consistency with scientific and philosophical ideas, it is nevertheless essentially speculative metaphysics that arguably lacks sufficient physical commensurate evidence or sufficient predictions and tests needed to be persuasive and adopted as a convincing worldview. Its value-based implications are not likely to be something many people could easily identify with or defend. Manifesting the connectedness of the universe through myriad forms of relations and actions may have some appeal and moderate practical consequence in the sense that our connections with others and our wider world might motivate us to act on behalf of those connections and relationships, but details beyond that may not ring true for many people given the highly speculative, conceptual, and abstract nature of the claims.[15]

Cosmocultural evolution, particularly *bootstrapped cosmocultural evolution*, seems like it might be a tenable "meaningful" cosmological worldview for beings like ourselves because while it may seem somewhat speculative, it does appear to be defensible to say that the universe has essentially "bootstrapped" itself into the realms of value, meaning, and purpose – at least in the form of human minds, if not in others as well. This realm of value, meaning, and purpose has then emerged in the universe through cosmic evolution, through the evolution and emergence of our minds and perhaps other minds that may exist throughout the universe. And the potential for this valuing capacity, for the meaning-making and purpose-seeking we do with our cultural evolution, may have unlimited potential for the universe as a whole. We may be a way for the universe to value itself and find many different, perhaps infinite, evolutionary paths forward.

There may be other forms of value independent of beings like ourselves, but it does nevertheless appear that beings like us are at least one means by which the universe is finding or "discovering" forms of value, meaning, and purpose in what may be an extremely large, if not infinite, possibility space of those qualities. If there is no broader objective meaning and purpose in the universe beyond that which is created by cultural beings, then that realization may help us value each other more.

The claim that value, meaning, and purpose have emerged in the universe as a product of cosmic evolution is in some sense a minimalist view (some may say it is trivially true), but it is potentially significant nonetheless. It is intellectually and philosophically minimalist in the sense there is no need to invoke some other kind of dynamic or force or substance in the world such as spirit or God. There is no appeal to a wholly other "transcendent" reality. However, the implications and significance are still notable in the sense that if value, meaning, and purpose has emerged in the universe through us, then we are arguably "responsible" for it. We are creators and arbiters of value that not only makes the universe valuable, but we also pursue very specific forms of value, e.g. having to do with morality and

15 We should also be sensitive to concerns that in the worst case, tying a speculative form metaphysics to human affairs can be dangerously problematic depending on how certain details are developed and used.

ethics and endless forms of creativity. Indeed, if we choose, we can make the universe "purposeful" in the sense of enabling trends and choosing "directions" for the universe. It is up to us to decide, to choose. Presumably there will be many such diverse pursuits which call for careful deliberation and pluralistic meaning-making with each other.

4. Synthesis and Summary

If our worldviews need to be comprehensive and include specific guidance for human behavior and address most of our complex subjective needs, then the universe is probably not enough for most people most of the time – more would be needed to help address, and perhaps compel, certain kinds of human expectations and behavior. Also, there are broader questions such as why the universe exists at all, or more generally, why there is something rather than nothing, that modern cosmology arguably does not provide satisfying answers for – and "brute fact" scientific explanations often don't suffice for many – partly because they do not personally resonate for most people.

From a more philosophical perspective, even if the universe is "about something", if there is some fundamental cosmic nature to be realized (e.g. as suggested by the connect-action principle, which in theory allows us to "derive" "intrinsic" value from something we think the universe may be about) it is still arguably too non-specific and abstract for most people to identify with. Further, it is not clear that intelligent beings must adhere to, or adopt, pursuits consistent with what think our universe is about. We may of course be wrong about what we think the universe is about, and even if we are right about the "facts", the science, or whatever metaphysics is relevant, the old philosophical fact-value or "is-ought" distinction (including the "naturalistic fallacy" (Moore 1903)) still arguably gives us an option to freely pursue aspirations beyond our understanding of how the world is.

Nevertheless, for some people some of time (possibly all the time for some people), the universe could suffice as a basis for a worldview depending on certain details of the worldview and the needs of the individuals and groups. If a person or group can sufficiently identify with the universe then the universe might be a sufficient overall worldview construct – particularly if some value or meaning, however loose and high-level it might be, can be inferred from cosmic evolution (e.g. forms of cosmocultural evolution). Those who do not need a worldview with many, or any, prescriptive details for guiding human behavior, might also see the universe as a sufficient basis for a worldview to the extent that they do not need it to bridge into details of human life – e.g. to provide some sense of caring or how to deal with death, etc.

We might infer from some of the above reasoning that any "single" worldview might not be able to address the full breadth of human needs that many individuals or groups have. The universe can be a big part of a worldview or be one of a few simultaneously operating worldviews (inter-related or not). We can revere the universe, and maybe even see ourselves as integral to its evolution (e.g. cosmocultural evolution), but how we choose to guide our human actions can be independent of any broader cosmological worldview. We can have a kind of hybrid worldview, or a 2-part worldview – one for the universe and one for the details of human life – for which there can be important overlap and relationships, but for which neither completely informs, determines, or depends on the other. As touched on prior, our broader scientific knowledge about the universe can lead us to see ourselves as having randomly evolved from cosmic evolution without any larger cosmic purpose, but with a potential implication that we can see ourselves as needing each other to make our way in an otherwise indifferent universe.[16]

16 Secular humanism is arguably a minimalist science-based worldview that informs human ethics and can be added to more explicit cosmological perspectives that provide a broader sense of reverence and meaning beyond secular

We can also be sensitive to the idea that we might be asking too much of our worldviews if we expect them to provide answers to everything. We should be mindful of the possibility that no combination of worldviews would necessarily provide complete and irrefutable answers or satisfying sources of comfort, meaning, and purpose for all of our questions and needs. We may be misguided, or at least unsatisfied – and possibly deeply disappointed and adversely psychologically affected – if we expect our worldviews to provide too much. Living with uncertainty is challenging for many, but we do it. Indeed, there appear to be many people who do not require worldviews that provide answers to everything. Those who claim they are "unaffiliated" with any religion make up the third largest group in the world – about 16% as of 2015 (Pew Research Center 2017). This does not mean the unaffiliated do not have any theistic, deistic, or spiritual beliefs, but it does arguably imply that a large number of people do not need traditional "comprehensive" religious worldviews that prescribe details for human living and answers to many other questions. However, many of those who are unaffiliated with religion almost certainly have some kind of worldview(s).[17]

So for now, a reasonable conjecture as to whether the universe can be enough to suffice as a basis for worldviews is that while it might suffice for some people some of the time, it is not likely sufficient for most people most of the time.[18] However, one might further postulate that over time, many of the needs people have for worldviews could change or be reduced, perhaps increasing the receptiveness for the kinds of cosmophilosophical/cosmological views explored here (for example, including a kind of "secular bootstrapped cosmocultural evolution" worldview). A proxy, or analog, for this suggestion is research that shows the more socially stable, comfortable, and educated people are, the less religious they apparently are (Barro and McCleary 2003, Gill and Lundsgaarde 2004), perhaps further implying less need for comprehensive worldviews that definitively address uncertainties and fears to adequately meet human needs.

As we become more knowledgeable about human emotions, and how to better deal with fear, uncertainty, fairness, and human relations more generally, we may find an increasing receptiveness to alternative worldviews that may be less specific, less prescriptive, less personal, less comprehensive, less definitive.[19] As our knowledge and "caring capacity" improves, we may be able to care for each other better (Lupisella 2013) and perhaps then increasingly tolerate a variety of uncertainties.[20] Decreases in religiosity in many parts of the world may be an indicator that this kind of trend is already underway. Our descendants may be better equipped to be more receptive to alternative worldviews, including cosmological worldviews.

Speculating further, forms of artificial intelligence may have very different needs regarding worldviews – including that they may not need any at all (at least in the way we think about worldviews today). Presumably, however, artificial intelligence will need

humanism, perhaps then giving rise to a more complete worldview for some.

17 A Pew Research Center report (2012), "The Global Religious Landscape", notes that many unaffiliated people still hold religious or spiritual beliefs such as believing in God or a "higher power" (68% in the United States)

18 If it has not already been, this question can probably be empirically addressed with psychological research.

19 Van den Bos (2009) suggests that cultural worldviews are a way to cope with personal uncertainty. Van den Bos and Lind (2009) suggest that the way people assess fairness has much in common with the social psychology involved in defending worldviews. Related, Henriques (2011) suggests that humans are "the justifying animal" – uniquely powerful creators of justification systems. This seems consistent with the idea that one of the functions of worldviews is to help justify many aspects of the human condition – e.g. what we value and why, why we are here and do what we do, what our aspirations ought to be, etc.

20 A significant challenge that many intelligent beings may face is to at least tolerate, if not ultimately accept, the enduring uncertainty of an apparently objectively "pointless" universe (Lupisella 2009).

something to guide actions, but such entities may not have the kinds of human needs we see today that are, at least in part, if not completely the result of Darwinian evolution. The more capable a species becomes, the more choices there are, the more values there can be, the more philosophy matters (Lupisella 2015). Artificial intelligence, or superintelligence more generally, will presumably be able to explore broad possibility spaces very quickly and have a high tolerance for uncertainty and indifference regarding a lack of broader "objective" meaning or purpose, or the need to be cared for, or to exist forever, etc. For our descendants, or for other advanced beings, either biological or "post-biological" (Dick 2003, Schneider 2015), the universe may indeed "be enough".[21]

The working hypothesis from this brief examination suggests that the universe, in the form of "cosmological worldviews" that focus on scientific cosmic evolution, are probably not enough for most people most of the time, but could be enough for some people some of the time to suffice as a basis for worldviews. However, as we evolve further, the universe may increasingly suffice – particularly as more advanced intelligence evolves. If we are not satisfied with worldviews we see today, then we can keep working on new ones. Our Cosmos seems to be a good place to start.

21 Bell (2016) explicitly treats questions regarding the relationships between superintelligences and worldviews.

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The Trajectory of Evolution and Its Implications for Humanity

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Abstract:
Does the Big History of life on Earth disclose a trajectory that has been driven by selection? If so, will the trajectory continue to apply into the future? This paper argues that such a trajectory exists, and examines some of its key implications. The most important consequence is that humanity can use the trajectory to guide how it evolves and adapts into the future. This is because the trajectory identifies a sequence of adaptations that will be favoured by selection. If humanity intentionally evolves its social systems and psychological capacities so that they follow the trajectory, humanity can avoid negative selection and instead survive and thrive indefinitely into the future. This would enable humanity to make a positive contribution to the future evolution of life in the universe. But it turns out that immediate selection will not drive the evolution of life on Earth further along this trajectory. Instead, intentional action by humanity is necessary. It is as if the evolution of life on any planet is a developmental process that has a very unusual characteristic: evolution will continue to develop successfully beyond a certain point only if it produces a sentient organism that: (i) awakens to the possibility it is embedded in a developing process; (ii) realizes that this developing process will continue successfully only if it chooses to intentionally drive the process forward; and (iii) commits to doing whatever is necessary to achieve this. On this planet, humanity is that sentient organism. The existence of such a key evolutionary role for humanity is capable of providing humanity with meaning and purpose in a larger scheme of things. For individuals who commit to driving the process forward, the nature of the trajectory has immediate consequences for what they should do with their lives, here and now.

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1. Introduction

Until the emergence of humanity, evolution on Earth searched for adaptive improvements through the production of variation that was generated primarily by blind trial and error. Complex adaptations were discovered by the production of genetically variant offspring. These either flourished in competition with others, or more often were out-competed and became failed evolutionary experiments. The process which produced this exploratory variation had neither foresight nor any capacity to plan ahead. The process was not guided by any understanding of what might work in the future. As a consequence, it was a very wasteful process: in order to achieve a small improvement in any given adaptation, huge numbers of variant organisms were produced and failed. Nevertheless, given sufficient numbers of generations, complex adaptations could be discovered by this trial-and-error searching of possibility space.

But with the emergence of humanity, all this changed. It took humans only a few thousand years to discover the means to fly through the air, while dinosaurs and birds took many millions. The development of two capacities in humans enabled this great leap forward in evolvability (the ability to discover effective adaptations). First, humans evolved the ability to construct mental models of how their environment would be impacted by their actions. They could then use these models to work out what particular actions would enable them to achieve their goals. No longer were adaptations discovered primarily

by the actual production of variant offspring that were subject to selection. Instead, the initial production of variants and their selection was carried out mentally, within the heads of humans. This enabled humans to anticipate negative selection and adapt in ways that avoided it. The evolutionary process was internalized within the minds of humans. As the great evolutionary philosopher Karl Popper put it, this capacity "permits our hypotheses to die in our stead." (see Popper 1972; Dennett 1995)

The second capacity that enabled this significant enhancement of human evolvability was collective learning and other forms of cultural evolution (see Christian 2004; Boyd and Richerson 1985). This enabled mental models and other learning acquired by an individual to be passed on to others. Until this capacity emerged, what an individual learnt during its lifetime died with it. Each individual had to begin afresh to learn about its environment and how to manipulate it. But once such a capacity emerged, this learning could be passed on to others and could be transmitted across the generations as an accumulating culture of knowledge and skills. This could be used to generate better mental models of the environment and how it could be manipulated.

These two capabilities, powered by enhancements such as language and writing, progressively enabled humans to develop increasingly complex models of their past, present and future. This led to the emergence and growth of science and technology. Eventually it enabled the development of models of the evolution of life on Earth, including human evolution. A further significant development was the integration of various models across disciplines to produce Big History. These included models of the birth and evolution of the universe as well as life within it, up until the present.

However, humans have only just begun to use mental modelling for a purpose which is perhaps of greatest significance from a larger evolutionary perspective. This involves developing models of the possible evolutionary futures of humanity. These models could be used by humanity to identify actions and technologies that are essential for its future evolutionary success. Once humanity knows what characteristics are needed to avoid being selected against in the future, it can take the steps needed to adopt these characteristics.

Humanity may, for example, be able to identify a trajectory in evolution that extends into the future. Evolution exhibits a trajectory when one or more characteristics of organisms change in a particular direction as evolution unfolds. For example, there may be a progressive increase in the size or complexity of organisms or in the the scale of cooperative organization, or a population of organisms may evolve into a super-organism. Such a trajectory identifies a sequence of adaptive changes that would not be eliminated by selection and that would enable future survival. If such a trajectory exists, humanity could use its mental models to locate itself along the trajectory and to identify what actions it needs to take to align with the trajectory. Rather than having to be subject to actual selection in-the-world for evolution to proceed, humans could anticipate and avoid actual selection by using the less-destructive selection that occurs in mental and cultural processes. Aligning its development with evolution's trajectory in this way would enable humanity to adapt and survive indefinitely into the future. Humanity could avoid becoming a failed evolutionary experiment. Such a shift in which an organism begins to use the trajectory of evolution to guide its intentional adaptation and evolution constitutes a major evolutionary transition. I will refer to it as the transition to intentional evolution.

But is this possible? Does evolution have a trajectory that is driven by selection and that will continue into the future? Section 2 of this paper outlines the arguments and evidence that have been advanced in the past against the view that evolution has a driven trajectory. Section 3 demonstrates that these previous objections to directionality have been overcome by a relatively new hypothesis: that evolution embodies a driven trend towards increasing integration and

cooperation. Section 4 outlines key implications of this trajectory for humanity. It demonstrates that given near-universal human goals, the trajectory has immediate consequences for what humans need to do to achieve their goals.

2. The Case Against the Existence of a Driven Trajectory

2.1 *The intentional exclusion of directionality from the Modern Evolutionary Synthesis*

Mainstream evolutionary biology takes the position that overall, evolution is not directional or progressive. In part, this position still prevails because of decisions made by the founders of what has become known as the Modern Evolutionary Synthesis (the body of theory and beliefs that came to underpin evolutionary science as it developed in the second half of the 20th century). As outlined by evolutionary philosopher Michael Ruse in his book Monad to Man (Ruse 1996), in a series of meetings in the 1940s, the founders of the Synthesis set out to place the academic study of evolution on a firm scientific footing. With this goal in mind, they decided that ideas about direction and progress should be excluded from the discipline of evolution. As Ruse recounts, the main reason for this was profession building: the founders were concerned that controversies surrounding the implications of evolutionary directionality and progress would undermine their attempts to establish the study of evolution as a rigorous scientific discipline. These controversies included, for example, attempts to use evolutionary criteria to rank human races and cultures. Ruse outlines how the founders enforced their decision through their influence over the editorial policies of scientific journals and as respected peer reviewers of papers submitted for publication. Ironically as Ruse points out, the founders made this decision despite most of them considering that evolution is directional. Against this background, it is clear that the initial exclusion of directionality and progress from scientific studies of evolution did not result from any scientific case against these ideas.

2.2 *The absence of any 'impossibility proof'*

Furthermore, the case against directionality has never been buttressed by any kind of general 'impossibility proof' i.e. by any demonstration that the nature of the evolutionary process is such that overall directionality cannot emerge and has not done so. The nearest to such a proof has been the suggestion that natural selection only favours local adaptation to local conditions, and therefore cannot drive any overall advance across species (e.g. Gould 1996). But while it is true that natural selection generally favours only local adaptation, this obviously does not preclude the existence of adaptations that provide general fitness benefits as well as local benefits. This would include adaptations that tend to produce fitness advantages across many or all environments. For example, meta-adaptive adaptations such as improvements in evolvability can be advantageous in many environmental circumstances. So the local nature of adaptation does not itself preclude general improvements across species, or any overall trend or direction to evolution.

2.3 *The big poverty of Big Historicism*

Popper (1957, 1959) and more recently Taleb (2007) have mounted general arguments against the use of historical patterns and explanations to predict future trends and trajectories. Their arguments apply equally to the extrapolation of Big Historical and evolutionary patterns into the future. First they caution against the extrapolation of trajectories and other patterns in the absence of evidence that: (i) the patterns are causally driven rather than accidental emergences or other kinds of artefacts; and (ii) the causal micro-foundations will operate into the future, continuing to drive the pattern. They are right to argue that the elucidation of such causal micro-foundations is essential if any hypothetical extrapolated pattern is to be taken seriously.

Second, they argue that historical 'just so' stories which can explain all relevant past events and all that might arise in the future, cannot provide reliable predictions of future trends. They are like the 'just so' stories that enable financial newspapers to explain everything that happened in the stock market yesterday, but are next to useless at predicting trends in tomorrow's market. Because they cannot make specific predictions, the hypotheses that are embedded in these historical stories are untestable and are not derived from testable theories. Their failure to be testable and falsifiable means that they should not be considered as scientific, according to Popper's widely accepted criteria for distinguishing science from non-science.

These two fatal deficiencies bedevil attempts to extrapolate evolutionary and Big Historical trends into the future. To be taken seriously, any claim that a trend can be extrapolated into the future must satisfy these two criticisms. It must be accompanied by: (i) identification of the particular causal micro-foundations that drive the trend; and (ii) a demonstration that the claim is testable and falsifiable, and/or derived from hypotheses that are.

2.4 A trend towards increasing complexity?

Although the mainstream has continued to reject directionality, there is some support for the view that selection has driven an increase in the complexity of living processes as evolution unfolded (e.g. see Wilson 1992; Shanahan 2004; Christian 2004; Spier 2010; Vidal 2014). There is evidence for such a pattern: both the highest level of complexity and the average level of complexity of living processes have tended to increase progressively during the evolution of life on Earth. However, the hypothesis that these apparent patterns have been actually driven by selection has been heavily criticized for a number of reasons. In particular, it is clear that selection does not favour increases in complexity per se. There are many ways of becoming more complex that are not advantageous for any given organism, and selection often favours adaptations that decrease complexity. These difficulties are compounded by the fact that there is no agreed-upon definition of complexity that reflects intuitions about what it is that has increased (e.g. see Lineweaver et al. 2013).

Furthermore, Gould (1996) has demonstrated that even if selection did not drive increases in complexity, both the average and the highest complexity would be expected to increase in any event as evolution unfolds. The trend would arise passively, without being driven. This is because the evolution of life on Earth necessarily began with the simplest and least complex forms. The only way it could go from there was to explore more complex possibilities. Gould further pointed out that this drift to increasing complexity would not be countervailed by a drift towards decreasing complexity because life began with minimal complexity. Adopting his metaphor, life began near a 'left wall' of complexity.

Gould buttressed his argument against a driven trend toward increasing complexity with evidence that many lineages of organisms have not increased in complexity over many millions, and sometimes billions, of years. In particular he notes that bacteria have remained at the same level of complexity for billions of years and yet appear to be highly successful in evolutionary terms (they have survived and thrived, dominating life on Earth by mass and numbers). If there was an overall trend toward increasing complexity driven by selection, the complexity of bacteria and these other lineages would be expected to have increased significantly as evolution unfolded, Gould argues.

Proponents of a driven trend towards increasing complexity have not been able to counter these arguments by identifying the all-important causal micro-foundations that would drive such a trend.

3. The Mounting Case in Favour of a Trajectory towards Increasing Integration and Cooperation

3.1 *An evident trend towards increasing integration*

Various versions of another large-scale pattern that is evident in the evolution of life on Earth has been identified by a number of evolutionary thinkers over the past century (e. g. see Teilhard de Chardin 1965; Corning 1983; Blitz 1992; Crawford 1992; Maynard Smith and Szathmáry 1995; Stewart 1995, 2000; Last 2017). This pattern resulted from a step-wise process in which living processes have been progressively integrated into organizations of increasing scale. It began with the integration of self-reproducing molecular processes into organizations that became the first simple cells; then organizations of these simple cells eventually formed the more complex eukaryote cell; this was followed by the integration of some of these cells into larger-scale organizations of cells, eventually emerging as multi-cellular organisms. In a further repetition of this process, organizations of multi-cellular organisms produced animal societies.

Importantly, this progressive integration of living processes has not been limited to evolution driven by gene-based natural selection. The trend has continued in human evolution where cultural evolutionary processes now predominate: small kin groups were integrated into bands, bands were integrated into tribes, these formed the constituents of kingdoms and city states, and these in turn have been integrated into nation states (Stewart 2000).

More abstractly, this step-wise process resulted from the integration of smaller-scale living entities into larger-scale entities as evolution proceeded. The larger-scale entities then repeated the process, becoming integrated into yet larger-scale entities. And so on, repeatedly. At each step, the larger-scale entities underwent an entification process, developing the capacity to evolve and adapt as coherent, organized individuals. Each step was also generally accompanied by increases in evolvability. Overall, the trajectory evident in the history of life on Earth has been toward the emergence of cooperative organizations of ever-increasing scale, hierarchical depth and evolvability. The result of this stepwise process of successive integrations is the nested hierarchical structure of living processes: if we look down into our bodies we see that we are a society of cells which in turn are organizations of the ancestors of simple cells which in turn are organizations of self-producing molecular processes. If we look above and beyond us we see that we are, for example, members of corporations and other organizations which are in turn members of nations, and these in turn are in some cases members of supra-national organizations such as the European Union.

3.2 *Is the trend towards increasing integration driven or passive?*

But has this apparent trajectory been driven by selection? A number of evolutionary researchers have argued that it has. They suggest that it has been driven by the potential advantages of cooperation between living entities (Corning 1983; Maynard Smith and Szathmáry 1995; Stewart 1995, 2000). These advantages result from the ability of cooperative organizations to take advantage of synergies, including those associated with division of labour and specialization. Furthermore, cooperatives are of larger scale than individuals and therefore can have greater command over resources, act effectively over larger scales, and have increased power and control over other living processes and their environment. These advantages enable effective cooperative organizations to out-compete isolated individuals in many situations. However, the hypothesis that the advantages of cooperation have driven evolution in the direction of increasing integration has been slow to attract mainstream support (Ruse 1996; Gould 1996; Shanahan 2004). First and foremost, this is because a central theme of mainstream evolutionary theory is that selfishness predominates in evolution, not cooperation (Williams 1966; Dawkins 1976). This is founded on the certainty that selfish individuals who take benefits produced

by co-operators but who do not contribute anything in return will always tend to outcompete co-operators (selfish individuals include thieves, cheats and other free-riders). And altruistic co-operators who invest their resources in providing cooperative benefits to others but who do not receive cooperative benefits in return will always tend to be less fit.

A huge literature reports research which attempts to find special circumstances in which cooperation will predominate. But if anything, this research confirms that only in particular, constrained situations will co-operators be more competitive (for a brief overview see Stewart 2014). In general, this occurs only where special circumstances just happen to be present that guarantee that co-operators will capture sufficiently more of the benefits of cooperation than non-co-operators. The research has not identified a general mechanism that can account for the emergence of the complex cooperation found, for example, amongst cells in multicellular organisms, between molecular processes within a eukaryote cell, and amongst participants in modern human societies.

This widely-accepted view about the difficulties facing the emergence of complex cooperation appears to provide a strong case against the claim that selection drives evolution in the direction of increasing integration and cooperation. It is unlikely the claim will attract mainstream acceptance until it has been demonstrated that plausible evolutionary processes can drive the emergence of complex cooperation at all levels of organization, despite the evolutionary advantages that otherwise can accrue to free-riders and other non-co-operators.

3.3 *The causal micro-foundations of a trend towards increasing cooperation*

Arguably, this has been accomplished over the last two decades: Stewart (1995, 2000, 2014) has shown that what he calls 'management' can enable the emergence of complex cooperative organization amongst self-interested entities that previously competed against each other. The management within an organization is comprised of processes that have the power to reward cooperative entities and to suppress free-riding entities. Within an organization that is managed effectively, it is therefore in the interests of entities to contribute cooperatively to the success of the organization as a whole, and against their interests to free ride. Useful cooperation pays, and the interests of members of the organization are aligned with the interests of the organization as a whole. 'Consequence-capture' will apply to all members of the organization: i.e. individuals will capture the benefits (or harms) produced by the impact of their actions on the organization (Stewart 2018). As a consequence, complex cooperation will tend to emerge and flourish where it benefits the organization.

Examples include: the management of proto-cells by RNA managers which support the production of cooperative enzymes and suppress free-riding side reactions; the management of a modern human corporation which remunerates cooperative employees who meet performance targets and fires free-riding employees who under-perform; and the government of a nation state which funds a defence force that cooperatively protects the nation, and punishes free-riding citizens who steal and break contractual obligations.

These three examples are instances in which management is external to the entities that are being managed. But management can also be internal to the entities and distributed across the organization. For example, management in early multicellular organisms and in insect societies is constituted by a cluster of genetic predispositions which are reproduced in each individual member across the organization. The predispositions can, for instance, predispose members to provide resources to co-operators. They can also organize the punishment of free riders. Distributed internal management is just as controlling and coercive as external, centralized management. However, the control exercised by distributed internal management is not readily visible. As a consequence, instances where it operates are often mistaken to be

cases in which cooperative organization has somehow emerged spontaneously, in the absence of any form of control.

In general, the emergence of management is driven by its ability to promote cooperation within an organization and its capacity to capture sufficient of the extra benefits this produces. This tends to ensure a degree of 'consequence-capture' for management and therefore tends to align the interests of management with those of the organization as a whole. Selection operating at the level of the organization as a whole will tend to increase this coincidence of interests (e. g. see Wilson and Wilson 2007).

This theory of management supplies the piece that was missing from previous attempts to identify the causal micro-foundations that drive the trajectory of evolution towards increasing integration. It demonstrates how complex cooperative organization can emerge and flourish despite the forces that seem to favour selfishness and individualism. It identifies the causal mechanisms that enable isolated entities at one level to be organized into cooperatives that eventually become entities in their own right at the next level.

By providing comprehensive causal micro-foundations, the supply of this missing piece also enables the trajectory to be validly extrapolated into the future. Broadly, it follows from the model that the step-wise process of integration into larger-scale organizations will repeat itself indefinitely. This is because, irrespective of the scale of entities that emerge at the highest level that exists at any point in evolution, there will be benefits that can be realized from cooperation between these entities of the largest scale (unless there is some absolute upper limit, such as the scale of a finite universe).

More specifically, extrapolation of the trajectory indicates that the next great step forward in the evolution of life on Earth would be the emergence of a living entity on the scale of the planet (Stewart 1995, 2000, 2014; Heylighen 2007). Initially, this would involve the management by human governance of a complex cooperative global organization which progressively integrates the planet's living processes (including human nation states and ecosystems), technology (including artificial intelligence), matter and energy (including the planet's biogeochemical cycles). Continuation of this trajectory would result in the global organization undergoing an entification process: the planetary organization would develop the capacity to establish its own goals and to pursue those goals by planning, acting and adapting as a coordinated and coherent whole. This would involve enhancing its own evolvability, including by modelling in more detail its own future possibilities.

The further extrapolation of the trajectory beyond this is straightforward: the human-managed entity would move out into space to establish new entities. As well as providing other adaptive advantages, this would enable the entity to avoid the extinction that would otherwise result from the engulfment of the Earth by the sun when the sun enters its Red Giant phase in a few billion years. Eventually, these new entities would link up with other planetary entities that originated elsewhere, forming cooperative organizations of yet larger scale and evolvability. Subject to any physical constraints that cannot be overcome, this would eventually result in the emergence of cooperative entities on the scale of galaxies and eventually the universe, infusing the universe with life and intelligence (including 'artificial' varieties). Each step in this future trajectory would again be driven by the advantages of cooperation over increasingly wider scales. Every global entity that emerges successfully and links up with others will bring unique contributions to the evolvability of the cooperative entities that it joins, due to its unique evolutionary history and unique perspectives.

3.4 *Testing the 'increasing integration' hypothesis against other objections.*

As we have seen, the major criticism levelled against previous claims that evolution is directional (including against earlier versions of the 'increasing integration' hypothesis) is that the claimed trends are not causally

driven by selection. This left the claims open to the suggestion that they relied upon impermissible teleological explanations, including 'pulls from the future' (Ruse 1996; Shanahan 2004). However, the recent work outlined above has overcome this objection by identifying the causal micro-foundations that drive the trajectory towards increasing integration and evolvability.

This extended version of the case supporting the 'increasing integration' hypothesis also answers all the other key objections that have been made against previous attempts to demonstrate directionality (Stewart 2014). I will deal with each briefly in turn:

First and foremost, the mechanisms relied upon by the 'increasing integration' hypothesis are testable, as is the overall hypothesis itself. In particular, the key 'management' mechanism leads to clear predictions about the form of organization that will manifest in the cooperative organizations that arise at each level and become entities in their own right e.g. they will be organized as nested hierarchies, and each level will be organized initially by powerful management. This mechanism also lends itself to being tested effectively by appropriate simulations.

The 'increasing integration' hypothesis also makes clear predictions about how evolution will unfold on Earth in the short-term future. Destructive competition between human nations will tend to increase the possibility of nuclear war and environmental degradation resulting from global warming. The potential of international global cooperation to mitigate these and other threats will in turn tend to drive the emergence of international management in the form of global governance. By rewarding cooperative nations and suppressing free-riding nations, this governance would tend to align the interests of individuals, corporations, and nations with the interests of the global society. As discussed above, this would ultimately lead to the emergence of a cooperative living entity on the scale of the planet. However, there is no guarantee that the forces that tend to encourage these developments will succeed in overcoming the destructive competition that produces them, and human civilization might end this century.

The hypothesis also makes strong predictions about the forms of organization that will characterize living processes that emerge and evolve on other planets. Details will differ widely, but their forms of organization will unambiguously demonstrate that they have resulted from an evolutionary process characterized by the step-wise integration of living processes into cooperatives of increasing scale and depth.

The 'increasing integration' hypothesis also answers other objections that have been levelled against the 'increasing complexity' hypothesis. As mentioned above, proponents of the 'increasing complexity' hypotheses have been unable to develop an acceptable definition of complexity that matches intuitions about the nature of the complexity that appears to have increased. In contrast, the 'increasing integration' hypothesis resolves this difficulty by showing that only a particular form of complexity increases, and this form is clearly distinguishable from others (i.e. it is complexity resulting from the emergence of cooperative organization that increases overall, and this does not include, for example, the complexity of natural ecosystems because these are not managed cooperatives that evolve and act as coherent individuals).

As outlined above, the existence of lineages of organisms such as bacteria that have not increased in complexity for very long periods has counted against the 'increasing complexity' hypothesis. It can equally be argued that this also counts against the 'increasing integration' hypothesis because many lineages have not been integrated into large-scale cooperatives (yet). However, some species of bacteria have, in fact, been integrated into complex eukaryote cells which in turn have been integrated into multi-cellular organisms such as humanity (when humans go into space, organizations of the descendants of bacteria go with them). Bacteria have also played a critical role in scaffolding the emergence and evolution of life on

Earth, including its potential to 'hatch' as a cooperative global entity.

Furthermore, the fact that some species of bacteria have failed so far to be integrated into larger-scale entities is not due to the absence of the cooperative advantages that are hypothesised to drive increasing integration. Rather it has been due to the absence of management arrangements that can cost/effectively reap the benefits of cooperation and drive further integration. For example, many bacteria live in spatially-restricted environments such as between soil particles. Such physically-restricted niches would not be able to be exploited by cooperatives of bacteria that are organized by management that can operate effectively only if the managed entities remain in physical contact with each other—the cooperatives would occupy too much space. This is why these niches have not been exploited by complex cells or multicellular organisms—they are organized by management that requires physical contact.

But the strongest reason to reject this objection in relation to the 'increasing integration' hypothesis is that these species that remained unintegrated are now increasingly being swept up into organizations managed by humans. This is expected to accelerate rapidly as a global organization emerges which incorporates an increasing proportion of the living and non-living processes of the planet, including biogeochemical cycles. In the long run, integration will tend to prevail as management emerges that is capable of exploiting the universal benefits of cooperation at all levels of organization, including at the global level (Stewart 2000, 2014; Lenton and Latour 2018).

For more detailed consideration of the evidence which supports the hypothesis that evolution proceeds in the direction of producing cooperative organization of increasing scale and evolvability, see Maynard Smith and Szathmary (1995) and Stewart (2000, 2014).

4. Implications of the Trajectory for Humanity

This model of the future trajectory of evolution can be used by humans to work out strategies for achieving their goals. The trajectory identifies the sequence of adaptations that humanity needs to make if it is to avoid becoming a casualty of selection. Humanity can locate itself along the trajectory and see how it must adapt if individuals and its societies are to survive and thrive into the future, and see what humanity must do if it is to contribute positively to the future evolution of life in the universe.

Before dealing in detail with the implications of this below, it is worth emphasizing the strength of the claim that is being made here. If humanity wants above all else to survive and thrive indefinitely into the future, it follows logically that humanity must align its development and evolution with the trajectory of evolution. This is as logically incontrovertible as the necessity for individual humans who want above all else to survive and thrive into the future to refrain from ingesting poisonous substances in quantities that will kill them quickly. If humanity wants to survive and thrive, there is no subjectivity involved. To ignore the trajectory or to pursue strategies that are not aligned with the trajectory is irrational. This strong claim will be substantiated in detail in the remainder of this section.

4.1 *Growing a cooperative and highly evolvable global entity*

Significantly, the consequences of the trajectory for humanity are not restricted to the far-off future. The next great steps in the evolution of life on Earth need to be taken in the near future if humanity and civilization is to ensure it survives this century. And the actions that individuals need to take to facilitate these steps need to have begun already.

In particular, the threats of nuclear war and pollution on the scale of the planet (e.g. global warming), necessitate the establishment of highly evolvable forms of global governance. These are needed to underpin a sustainable and cooperative global society that makes war between nations as unthinkable as war between the members of the United States of America

and as unlikely as your liver attacking your brain.

Accordingly, individuals who make the transition to intentional evolution would work immediately for the establishment of global governance and a cooperative and unified global society. In order to further advance the evolutionary process along this trajectory, individuals would need to intentionally build the adaptive capability and evolvability of the global society. To achieve this, they would have to ensure that the global society undergoes the kind of entification process that cooperatives underwent at previous levels. They would need to establish processes and structures that enable it to set its own goals, develop mental models to guide what it must do to achieve its goals, make plans, and act as a coordinated and coherent whole. The global organization would need to be organized so that 'consequence-capture' applies to all entities within it, including those involved in establishing and adapting governance (Stewart 2018).

Importantly, in order to maximize its evolvability, the global system and its governance would need to be organized so as to minimize restrictions on the freedom and creativity of its members. Global governance would need to constrain citizens to the minimum extent necessary in order to align their interests with those of the global society. Citizens would then be free to pursue their aligned interests in whatever ways they choose. Furthermore, global governance would itself need to be constrained so that it cannot lead to exploitation, domination, or suppression of individual freedoms.

Enhancing the evolvability and creativity of all citizens would not be limited to the provision by governments of universal education. It would also extend to the universal provision of psychological support to facilitate the development by individuals of their psychological and cognitive capacities (Freinacht 2017). As was the result at all other levels when larger-scale cooperatives were organized by management, the establishment of effective global governance would massively increase diversity within the global society by enabling specialization, division of labour and other forms of cooperation that could not emerge otherwise. As occurred at lower levels, it would significantly increase the opportunities for individuals to engage in mutually-beneficial cooperative interactions, including through the suppression of destructive competition.

4.2 *Psychological and cognitive development*

Two particular psychological capacities would be critically important for enhancing the evolvability of the global society. Individuals who embrace intentional evolution will work on themselves to develop these capacities and promote their development in others.

The first is the ability to be psychologically self-evolving—the capacity for individuals to free themselves from the dictates of their biological and cultural past by being able to move at right angles to their existing emotional predispositions and motivations. Metaphorically, this includes the capacities 'to resist temptation' and 'to turn the other cheek', in their widest senses. This ability is important because our current motivations have been shaped by past evolution. As a consequence, they may clash with the motivations that are optimal for our future evolution. In order to be capable of doing whatever is necessary to meet the demands of future evolution, we need to be able to self-evolve so that we can find motivation and satisfaction in whatever that requires us to do (see Stewart 2001).

The second is the cognitive capacity to construct mental models of complex phenomena and to use these models to understand and manipulate complexity. Our current capacity for analytical/rational cognition (the 'formal operations' level of Piaget 1969) has proven very effective for modelling and understanding those aspects of the world that are relatively mechanistic and analysable. This capacity has driven the growth and spectacular success of science. But it is not effective for modelling and understanding more complex phenomena including social, economic, ecological and evolutionary systems. For this, what is known as meta-systemic thinking is needed. The development

of this capacity will greatly enhance humanity's ability to deal effectively with all kinds of complex phenomena (see Stewart 2016).

4.3 *The critical importance of the transition to intentional evolution*

Significantly, the emergence and entification of a cooperative global organization cannot be expected to occur successfully unless humanity sets out intentionally to make it happen, guided by an understanding of the trajectory of evolution. This is because the processes that drove emergence and entification at lower levels of organization will not apply on Earth at the global level. At lower levels, competition between the members of a population of cooperatives drove selection that favoured those that were superior because they were more cooperative and evolvable. But at the global level there will obviously never be a population of global organizations that compete with each other. There can only be one global organization at a time. As a consequence, the emergence and entification of a global organization will not be driven by a competitive process operating between global organizations on Earth. Instead, the competitive process that drives the trajectory of evolution at the planetary level and beyond can only involve other global entities that originate elsewhere. The global entities that will survive and thrive in the universe will be those that anticipate and avoid the destructive selection arising from this inter-planetary competition and from astronomical events. Guided by an understanding of the trajectory of evolution, they will anticipate destructive selection by intentionally driving the entification process and linking up cooperatively with other entities that emerge elsewhere.

Global organizations that fail to anticipate this destructive selection will be in the same position as a member of a population of organisms that evolves blindly by trial-and-error processes. There is a very small probability that any given organism or its descendants will be the lineage that produces the particular sequence of mutations that constitute the next evolutionary step for the species. The overwhelming majority of lineages of organisms that evolve by blind trial and error will die out. The same would apply to the overwhelming majority of global organizations that adapt by blind trial-and-error. They are highly unlikely to stumble by accident on what they need to do to avoid destructive selection. The only way they can guarantee they will survive and thrive is to ensure that their ideas die in their stead. Evolving without being guided by the future trajectory of evolution is like driving a car by looking only in the rear-view mirror. A planetary civilization that evolves in this way is likely to be temporary.

Furthermore, other global entities that have successfully made this transition cannot be expected to intervene in the development of life on a planet that has not yet done so. If they were to make contact with the disparate living processes on a planet before a unified planetary organization has emerged, they would risk interfering with and undermining the successful development of a global entity. As they would know from their experience of making the transition, an effective emergence and entification process cannot be imposed externally. It must arise organically from within if it is to produce the complex internal structures and processes necessary for entification to proceed successfully. External interference would be like humans intervening in a chicken embryo and attempting to take over the manifold processes that produce the development and eventual hatching of the embryo.

External interference could also undermine the ability of an emerging entity to develop its own perspectives and capacities that would enable it to make unique contributions to larger-scale cooperatives it might link with. And it could be dangerous for the intervenors as well as life on the planet—living process that have not formed a planetary society will not have learnt the benefits of cooperation and how it can be organized successfully. For these reasons, life that has already emerged as a global entity and beyond is likely

to have a strict non-interference policy in relation to planets at lower levels of development such as Earth. Understanding this resolves the Fermi paradox (for a detailed discussion of the paradox, see Webb 2015). However, once humanity grows a highly evolvable and cooperative global entity, life that has emerged elsewhere can be expected to appear (Stewart 2010).

In summary, a fully-developed global entity will emerge on Earth only if its development and entification is driven intentionally, by humanity. If humanity fails to do this, life on Earth will fail to hatch a global entity. Humanity and life on Earth will be a failed evolutionary experiment.

It is as if humanity is embedded in a developmental process that is directed at hatching a global entity. However, it is a very unusual developmental process. It will continue to unfold successfully only if humanity: (i) awakens to the possibility it is embedded in a developing process; (ii) realizes that this developing process will continue successfully only if humanity chooses to intentionally drive the process forward; and (iii) commits to doing whatever is necessary to achieve this (Stewart 2010).

Humanity is now at a stage in its evolution where it is faced with a fundamental existential choice. Will it make the transition to intentional evolution? Will it intentionally engineer a global entity that is capable of overcoming the threats that are currently faced by human civilization and that will arise in the future? Will humanity take the steps needed to ensure that Earth's global entity can link up with others to form a larger-scale entity that has the potential to exist indefinitely into the future?

Or alternatively, will humanity turn its back on life? Will it become irrelevant to the future evolution of life in the universe, denying life the unique capacities that humanity could contribute to larger-scale living organization? Will humanity choose to squat on the planet on which it emerged, pursuing the satisfaction of stone age desires and motivations that have been shaped by its past evolution, until its inevitable demise? Will humanity choose to ignore the trajectory of evolution, and instead continue modes of social organization and psychological functioning that will eventually be selected out of existence?

4.4 *Future-orientated evolutionary ethics and the naturalistic fallacy*

It can be strongly argued that a choice in favour of making the transition to intentional evolution would be required by human values that are near-universal. If humanity were to end without contributing positively to any on-going process, it would render meaningless and purposeless all human striving, history, sacrifice, science, art, and social and political progress. All positive human achievements will have come to nothing. It will be as if humanity and life on this planet had never existed. The near-universal drive to lead a life that is meaningful and that contributes positively to a scheme of things that is larger than oneself demands that humans keep humanity going. This is turn demands adapting and evolving along evolution's trajectory.

However, whether particular individuals awaken to the nature of this choice is dependent on their level of psychological and cognitive development. This was also the case, for example, in relation to the abolition of slavery. Sufficient support for the ending of slavery could not be attracted until significant numbers of citizens attained analytical/rational cognition with the emergence of the European Enlightenment. Attainment of this level of cognitive ability gave individuals the capacity to think and feel their way into the shoes of slaves who were living lives that they had never experienced themselves. However, analytical/rational cognition is not enough to enable individuals to think and feel their way into a full evolutionary worldview and its implications for humanity. Instead, meta-systemic cognition is necessary for this, and few have achieved that capacity yet. However, the relatively recent emergence of Big History is an indication that the incidence of this capacity is increasing. Furthermore, the study of Big History can reasonably be expected to help develop the ability to build and

operate mental models of large-scale systems as they evolve and interact.

Individuals who do make the transition to intentional evolution will use the evolutionary worldview to answer fundamental existential questions that face us all. What should I do? How should I live my life? Once they make the transition, the demands of future evolution will guide them as they decide what actions to take as their life unfolds. The injunctions and ethical principles that they follow will all be derived from their over-arching goal of positively serving the needs of future evolution. This goal leads to a completely different set of evolutionary ethics than one derivable from goals that succeeded in past evolution. Injunctions that led to evolutionary success in the past may lead to evolutionary disaster in the future.

Importantly, such a future-orientated evolutionary ethics does not run afoul of the naturalistic fallacy. This is because future-orientated ethics are not derived from facts alone. The fundamental drive to adopt these ethics comes from the desire to pursue near-universal human values. Unlike past-orientated evolutionary ethics, they are anchored in pre-exiting values and injunctions. And the naturalistic fallacy precludes deriving values from facts alone, not from existing values and facts. Individuals who take account of the longer-term evolutionary consequences of their actions when deciding how to act do not commit a philosophical fallacy, any more than do individuals who takes account of shorter-term consequences when deciding how to act (Stewart 2008).

In summary, there are many immediate actions that individuals who make the transition to intentional evolution would take to advance the evolutionary process on Earth and to enable human civilization to survive this century. Briefly, these include working for the emergence of a sustainable and unified global society, promoting in oneself and in others the development of enabling psychological capacities such as self-evolution and meta-systemic cognition, spreading the evolutionary worldview, working on the further development of the worldview, and so on (see Stewart 2009 for more detail).

5. Conclusion

The trajectory of evolution sketched here can be expected to have unfolded elsewhere in the past and will unfold elsewhere in the future. This is because there is nothing in the nature of the causal micro-foundations that have driven the trajectory on this planet that are unique to Earth. The same causal processes can be expected to drive the same step-wise increase in integration and evolvability wherever life emerges in the universe. The details will be different, but the forms of organization that constitute the trajectory can be expected to be similar. Management has emerged many times during the evolution of life on Earth, but the specific way in which it manifested has been different each time.

Wherever life with a capacity for mental modelling emerges in the universe, it can be expected to develop a science of evolution and its own Big History. Eventually it will develop models of the future evolution of itself and of the ecosystems in which it is embedded. Any such instance of intelligent life can be reasonably expected to discover the trajectory of evolution. This will enable it to realize that if the evolutionary process is to continue successfully in its case, there is a critically important role for it to play. It will come to understand that if it fulfils this role effectively, its unique history would enable it to contribute uniquely to any larger-scale cooperatives that it might join in the future. But any such instance of intelligent life will also know that if it fails to fulfil this role, it will constitute a failed evolutionary experiment. It will be faced with the same fundamental existential choice that faces humanity on this planet this century.

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On the social impact of the Apollo 8 Earthrise photo, or the lack of it?[1]

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Summary
In this article, the various forms of contemporary news reports are explored of the Apollo 8 Earthrise pictures and whole Earth images photographed by the astronauts. Already during this flight to the Moon, that took place at the end of December of 1968, remarkable differences in perceptions, emotions, and interpretations emerged between the United States and Western Europe and, more likely than not, the rest of the world as well, concerning the Earth and humanity's place on it. Furthermore, it appears that within both continents a considerable portion of the population was hardly affected by these pictures, if at all. These differences in perceptions have evolved over the past fifty years, while many of them continue to exist today. All of this will be examined in some detail with emphasis on what happened during and right after the flight of Apollo 8.

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Introduction

On December 24, 2018, it was exactly fifty years ago that the astronauts of the Apollo 8 mission took the first pictures of Earth from lunar orbit. The astronauts were greatly impacted by what they saw, as witnessed by the voice recording while taking those pictures and their later testimonies (see for instance: Poole 2008, NASA 2012, Spier 2012, Vaughan-Lee 2018).

Already during their flight to the Moon, the images of Earth transmitted through 'live' black-and-white television had caused quite a stir on our home planet, especially within the United States. Yet after the Apollo 8 color pictures had been distributed by NASA, most notably the photo of the blue-and-white Earth rising above the stark gray lunar surface that soon became known as Earthrise, many people began to reconsider our position in space, now as joint inhabitants of a shared little, beautiful, but vulnerable planet with limited natural resources, moving through an inhospitable, dark, and mostly empty universe.

The Apollo 8 photos of Earth from lunar orbit were not the first such pictures. The unmanned US Lunar Orbiter 1 in August of 1966, and the Soviet Zond 6 spacecraft in November of 1968, had already delivered similar images in black and white, which had caused considerable social impact. But those effects were very limited compared to what happened as a result of the Apollo 8 pictures, presumably because those photographs had been taken by humans who had been witnessing our home planet themselves at considerable distance.

As mentioned in the *Preface* of my book *Big History and the Future of Humanity*, as an adolescent I watched all the available black-and-white Apollo 8 'live' transmissions from space in the Netherlands while snapping pictures from the screen with my Asahi Pentax 1a photo camera mounted on a tripod in front of our television set. This was before the days of home video recorders or any other devices that could record

Figure 1: The famous Earthrise photo shot by Apollo 8 astronaut William Anders on December 24, 1968. Source: NASA, Flickr.com, Project Apollo Archive. https://www.flickr.com/photos/projectapolloarchive/21713574299/in/

television pictures. I felt that I was witnessing events of great importance, while I was not certain whether these images would be preserved or be available to me (Spier 2010, 2015).

I took pictures of the launch; of the first 'live' broadcast from space, which included the first crude images of Earth; and of the two 'live' transmissions from lunar orbit showing the Moon's surface. On our family television set, Earth from space looked like a white blob, the result of overexposure by the rather basic Apollo television camera. I was very curious to know what the astronauts were really seeing, what the 'good Earth' looked like from space, as Apollo 8 commander Frank Borman called our planet during their famous 'live' Christmas Eve broadcast while orbiting the Moon. After the spacecraft had entered lunar orbit, my father installed his Elmo 8-SS double 8 film camera on the tripod and started making a home movie, now available on YouTube (H.L. Spier 1968), while I continued taking pictures with my camera, now holding it by hand in front of the screen.

I did not have to wait long. Soon my family received the January 10, 1969 issue of *Time* magazine which showed a selection of pictures taken by the astronauts. The opening picture of its 'lunar album' was the famous Earthrise photo with the caption: *The Awesome Views from Apollo 8*. This was a period in time when the word 'awesome' was used much more sparingly than today. While looking at this picture, I experienced

1. Ian Crawford, Edward van den Heuvel, Frans de Jong, Gijs Kalsbeek, Bob and Jet Shuman Spier, and Rudolf Spoor are gratefully acknowledged for their valuable commentary and contributions. Of course I remain responsible for the final text. For copyright reasons only NASA images are reproduced here. I dedicate this article to my father, without whom I would not be on this track.

a shock that I had never felt before and never have experienced since. Within a second, it changed my perspective of Earth beyond recognition. I tore the picture out carefully, stuck it on the wall of my room and looked at it for years. I still have this picture and treasure it greatly.

None of my education had prepared me for this new look at Earth. At school, I had received a classical Dutch, perhaps West European, education, which included Latin and ancient Greek; modern languages such as English, French and German; mathematics, physics, chemistry, geography and history. Yet these portions of discrete knowledge were never related to one another or presented from one single perspective. This had left me totally unprepared for the extraordinary sight of our blue-and-white planet surrounded by dark space, rising above the forbidding gray lunar landscape. These pictures showed for the first time to me how different Earth was from its cosmic surroundings. It also made other people around the globe wonder what we were doing to our home in space. This led to an unprecedented upsurge of environmental awareness, including the establishment of the first Earth Day in 1970.

Until that time, common depictions of the Earth had been mostly geographic in nature. Now, suddenly people saw Earth with their own eyes as a tiny colorful ball swinging through space. As a result of such photos, a major change in perception of Earth took place around that time, which appears similar to the one that happened after Europeans began to connect the world by trans-ocean voyages. Those earlier events led, among other things, to the first reasonably accurate world maps. Similarly, after the appearance of photos of Earth at a distance as witnessed by humans many of us started mapping our planet, our cosmic environment, and ourselves anew.

The Apollo photos of Earth at a distance, most notably perhaps Earthrise, did not only lead to a reappraisal of all of that. For some people it also raised the question of how to understand its past, in the hope that a better understanding of the history of ourselves and of our position in time and space at the grandest possible scale would lead to better decisions about how to act in the future.

In the United States, astrophysicist Carl Sagan was such a pioneer with his famous *Cosmos* television series, broadcast in the early 1980s (now available on YouTube). But other US natural scientists had already preceded him even before these famous Earth pictures had been shot, perhaps most notably US astrophysicist Harlow Shapley and US physicist Robert Jastrow, while another great pioneer, US astrophysicist Eric Chaisson, began teaching a *Cosmic Evolution* course at Harvard University in the 1970s together with astrophysicist George Field. Others soon followed.

However, none of that happened in the Netherlands. To be sure, a number of Dutch natural scientists and environmental activists were similarly impacted by those pictures. Yet none of the people I was surrounded by, including my teachers at secondary school and later at university, ever mentioned this profound change in perspective that the pictures of Earth from space had produced, but preferred to stick to their established educational programs. Given this situation, I kept most of my thoughts and feelings to myself.

Until the summer of 2018 I had simply accepted this state of affairs. Yet when I finally had some time to reflect on these matters while the 50th anniversary of the Apollo 8 moon flight was coming up in December, I posed myself the question why this had been the case. Why was it so difficult then –and now– to discuss such impressions with many Dutch academics, especially within the humanities and social sciences, while in the United States this was often not a problem at all? What had caused these differences? In other words, the central question of this article is: why has the reception of the Earthrise photo and similar pictures been very

different in the US compared to the Netherlands, and, quite possibly, also elsewhere in the world?

I am not aware of any publications that have already addressed this issue. In his excellent book *Earthrise: How Man First Saw the Earth* (2008), English historian Robert Poole provides detailed descriptions of the reception of these images within the United States. But with the exception of a few words about the United Kingdom, the British author does not say anything about their possible impact, or the lack of it, elsewhere in the world.

In a lecture for the 'European Big History Network' on October 6, 2018 in Salas, Asturias, Spain, I offered the first results of my investigation (Spier 2018a). As I see it, these differences in perceptions between the United States and the rest of the world concerning images of Earth at a distance already began to emerge during the flight of Apollo 8 as a result of the ways the news media were covering that spaceflight, in those days mostly television, newspapers and magazines. So what happened during those exciting days? To find out, let's explore the news coverage of the flight of Apollo 8 in more detail.

The flight of Apollo 8 and its media coverage

The launch of Apollo 8 took place on December 21, 1968, when the huge Saturn V rocket with the astronauts on top of it was launched into space at 7:51 a.m. Eastern Standard Time (EST), 13:51 Central European Time (CET). This monumental event was broadcast on 'live' color television in the US, and was covered by all the major TV channels: CBS, NBC, and ABC. A considerable portion of this 'live' TV coverage can now be watched on YouTube. Furthermore, virtually all US newspapers covered this flight as well. Many of those reports can now be found on www.newspapers.com.

In the Netherlands, we could watch this and other 'live' Apollo 8 TV broadcasts thanks to the fact that worldwide satellite TV connections had just become possible. For obvious reasons, the United States was interested in allocating (then) scarce and expensive satellite bandwidth for broadcasting these events around the globe, not least because the Apollo project represented a significant struggle for technological supremacy in the Cold War.

At that time there was hardly any color TV yet in most of Europe. After the TV signal for Europe had been received in Geneva, it was distributed on demand within Western Europe through the Eurovision network. In doing so, a West-European network of TV towers was used that were connected by antennas just in sight of each other. This relatively short distance was necessary because the TV signals traveled in straight lines, while the surface of the Earth is curved. This network of TV towers had just been constructed, which allowed for the first time 'live' TV transmissions within Western Europe. The system was called Eurovision, the remnants of which are still visible today in the 'Eurovision Song Contest.'

According to Rudolf Spoor (1938-), producer of all the Dutch Apollo TV programs, they could sign up for the available programs according to their preferences. Already before the Apollo project had taken off, young Rudolf Spoor had written letters to many prominent spaceflight pioneers in the United States. To his surprise and delight he received many friendly replies, which led to excellent contacts within NASA and its institutions (pers. com., summer and fall 2018).

In the meantime Spoor had been making a career within Dutch television. As a result, when the Apollo spaceflights started in 1968 he was put in charge of producing the Dutch Apollo TV programs. He used his NASA contacts to bring in the best and latest information as well as rocket and spacecraft models, and samples of space food, while in the United States

he met and interviewed prominent people involved in the Apollo project including the Apollo 8 astronauts, Mission Control in Houston, and Wernher von Braun (1912-1977), chief designer of the Saturn V moon rocket (pers. com. fall 2018, see also: Spoor & Titulaer 1973).

Rudolf Spoor was fortunate to be part of a small but talented team: presenter Henk Terlingen (1941-1994), who, because of his engaging style and expertise soon became known as 'Apollo Henkie' (cf. de Poel 2009), and the more reserved but thoughtful moon specialist Chriet Titulaer (1943-2017), who had built up his own international network of contacts and knowledge within the world of science and astronomy (cf. Titulaer 1969). For instance, Titulaer also contributed to an Apollo 8 article in the January 18, 1969 issue of the French weekly *Paris Match* (1969, p.32-37). This was part of a Dutch tradition of educating expert astronomers with an international outlook. Like Britain and some other European countries, good astronomical knowledge for celestial navigation was deemed very important by the Dutch, because its was a major precondition for making money in worldwide shipping and trade.

Rudolf Spoor and his team had signed up for all the available Apollo 'live' TV transmissions. This allowed me and others in the Netherlands to watch all those exciting events. Because the Dutch studio TV crew often knew only at the very latest moment whether the 'live' TV signal would come through or not, they had to improvise a great deal. But thanks to their expertise and the available NASA materials, Spoor and his team performed really well, as judged by the very high audience ratings, 82 to 83 (out of 100). In fact, these programs are still considered by many of those who watched them, me included, as among the best Dutch TV programs ever produced.

According to the *NTS Press Bulletin* of January 10, 1969 where these numbers were mentioned, the higher-educated viewers were over-represented. My family did not offer an exception in this respect. The percentages of all possible viewers varied from 32 percent for the 'live' launch on Saturday afternoon, 7 percent for the 'live' early Christmas morning broadcast at 3:30 a.m., to 31 percent for the December 25 program at 1 p.m. and 32 percent for the December 26 program at 23 p.m. The latter two broadcasts did not include 'live' transmissions. Both days were official holidays in the Netherlands, then as now.

Even though such viewer percentages would be considered spectacular today, in 1968 with only two TV channels available at that time this was not unusual in the Netherlands. In those years, prominent sporting events would, in fact, draw up to 65 percent of all viewers (van Meerwijk 1969, p.88). Unfortunately all the Apollo 8 tapes have been lost (Rudolf Spoor, pers. com. fall 2018). As a result, almost all the surviving images of the Dutch Apollo 8 TV programs may consist of my father's movie as well as the photos that I took off the screen.

The flight of Apollo 8 and its media coverage on their way to the Moon: the first wave of emotional responses

To stay in contact with the astronauts during their moon flights, NASA had installed three major communication stations with huge dish antennas that were strategically placed around the world: one near Madrid, Spain, another one near Canberra, Australia, and the third one near Goldstone, California. While the Moon was moving out of view from one such a station because of Earth's rotation, it came into view of the next one. This worldwide arrangement became known as the NASA Deep Space Network. For distributing this signal back to the United States, the very recent global network of communication satellites called Intelsat was used.

The first 'live' Apollo TV broadcast from space took place on December 22 at 31 hours Mission Elapsed Time (MET) –3 p.m. EST and 9 p.m. CET– while the astronauts were on their way to the Moon. During this broadcast, the Earth appeared as a white blob, the result of over exposure by their little black-and-white TV camera, which was very basic by today's standards. Again I took photos from the screen while wondering what the Earth looked like to the astronauts.

About 24 hours later, on December 23 at around 55 hours MET –again 3 p.m. EST and 9 p.m. CET–, there was a second 'live' TV broadcast while the astronauts were still on their way to the Moon. During this event the Earth was shown much more recognizably, thanks to improvements to the TV camera by using certain light filters. During this second broadcast,

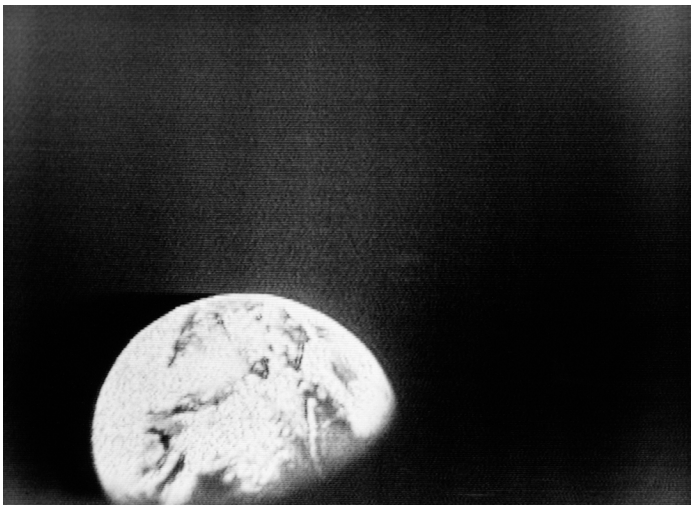

Figure 2: The Earth as shown on 'live' television during the second Apollo 8 broadcast on their way to the moon. Source: NASA, https://spaceflight.nasa.gov/gallery/images/apollo/apollo8/html/s68-55808.html

CBS anchor Walter Cronkite was audibly impressed as soon as he saw those better whole Earth images, which showed North, Central, and South America. US space philosopher Frank White (1944-), author of *The Overview Effect* (1984), was similarly impressed. In an interview on November 5, 2018, White stated that it was exactly this view of Earth that startled him, almost as much as Earthrise, because he had been totally unprepared for it while he did not expect it (Cogito in Space 2019, min 3:05). So the United States was suddenly looking at itself from a distance within a global setting using images that were produced by their own people.

In fact, both broadcasts happened at times during which the North American continent was in full view. Was this coincidence, or was this done on purpose? According to the *Apollo 8 NASA Mission Report* (Godwin 1998, p.33), the television broadcasts had been tentatively scheduled in advance at those times, but would only be officially scheduled after 12 hours MET. I have not been able to find any references to such a decision in the Apollo voice transcripts. Was this done on a back channel out of public reach?

In addition to finding suitable room within the astronauts' busy schedules during a daring space flight that had never been attempted before, a major deciding factor may have been that at those specific times the Apollo signal from space would directly go to the large Goldstone, CA, antenna. In consequence the 'live' signal would not require a satellite relay to reach the US (in those days that could easily lead to technical problems). Such a practical consideration would automatically produce an Earth image from Apollo 8 with the Americas in full view.

Whatever the reasons may have been, this choice had profound consequences. Already the next morning, December 24, these improved Earth images featured prominently on the front pages of a great many US newspapers. How did they get there so quickly? NASA was basically doing the same as I had been doing, namely shooting pictures from the TV screen. But while I was waiting patiently until my entire film roll of 36 images was fully exposed, the NASA photographers had their photos quickly developed and

printed. These images were immediately distributed through Associated Press's Wirephoto service to the news media.

Furthermore, the next day, December 25, the *New York Times* featured on its front page a *Reflection* by Archibald MacLeish, in which he declared that a new world view might have opened up. According to his final words:

> To see the earth as it truly is, small and blue and beautiful in that eternal silence where it floats, is to see ourselves as riders on the earth together, brothers on that bright loveliness in the eternal cold – brothers who know now they are truly brothers.

This fresh world view quickly became very influential in the United States, not least because of its endorsement two weeks later by Apollo 8 astronaut Frank Borman. After their successful return to Earth the intrepid space explorer read this quotation aloud during his presentation before a joint session of Congress on January 9, 1969 'because it captured the feelings that we all had in orbit' (Vaughan-Lee 2018, min. 25).

Archibald MacLeish's poetic vision was reprinted many times, including prominently underneath a full Earth image in the article by the USAF Apollo project director, Lt. General Sam Phillips (1921-1990) titled: '"A Most Fantastic Voyage:" The Story of Apollo 8's Rendezvous with the Moon' in the May 1969 issue of the *National Geographic* magazine. This article also also included a two page fold-out picture of Earthrise. These words were also reproduced in many other places, including in Macleish's own book *Riders on the Earth* (1978), while they provided a great deal of inspiration to both artists and activists.

In fact, MacLeish's *Reflection* is still remembered today. His eloquent prose can now be found on several web sites, while on December 24, 2018, almost exactly fifty years after its first publication, the *New York Times* ran an article on its front page with the headline: 'We Are All Riders on the Same Planet: Seen from space 50 years ago, Earth appeared as a gift to preserve and cherish. What happened?' (Boulton & Heithaus 2018).

Who was Archibald MacLeish, and how did he get his thoughts formulated and in print that quickly? According to Robert Poole he was both a poet and Librarian of Congress at the time of publication of his *Reflection* in the *New York Times* (2008, p.40-41). Already for decades MacLeish had contemplated views of Earth at a distance and their social consequences as he saw them, as part of a tradition among a small group of intellectual peace-loving people. He now saw his chance to get his thoughts in print. Apparently MacLeish was sufficiently well connected to the *New York Times* editorial staff to get his words out on their front page right after the astronauts showed a whole Earth image on 'live' television.

This raises the question why a tradition of contemplating such grand views would exist within the United States. In chapter three of his book *Earthrise*, Robert Poole makes a convincing argument based on a great many examples that for millennia people had been contemplating such views. After the Second World War the tireless efforts within the United States by intellectuals and others such as German rocket scientist Wernher von Braun to promote space flight including a trip to the moon –building on such a tradition in pre World War II Germany and Russia– would have stimulated US citizens to contemplate the emotional effects of the resulting fresh views of Earth.

Yet the famous rocket scientist himself does not appear to have entertained such views in public, but instead preferred to focus on technical aspects. For instance, in his article 'What the Apollo 8 Moon Flight Really Did for Us' in the March 1969 issue of *Popular Science* there is not a single word about a changed perception of Earth nor any pictures of

Earth at a distance. It is all about what was learned technically speaking from the flight of Apollo 8 to achieve a successful lunar landing, which was, of course, the official aim of the program as well as his ardent desire since the 1930s. This headline may, in fact, have expressed von Braun's possible frustration concerning the new perceptions of Earth that might distract the attention from the lunar landing still to be achieved.

Wernher von Braun's article in *Popular Science* was part of a series of technical explanations of manned spaceflight that he had been publishing in that magazine since January of 1963. Extremely lucid and well written, these articles provided his readers the best and latest insights into how it all worked, most notably the upcoming Apollo project and manned flights to Mars. Many of these articles were later jointly published in his book *Space Frontier* (1967). The translation of this book in Dutch titled: *Op de drempel van het heelal* was also published in 1967, which I then read, thanks to my father who gave it to me as a birthday present.

In fact, this book provided a wonderful overview of the new technologies being developed in the 1960s that were to change the world decisively. At the end of the book von Braun summarized in very clear terms many of the problems humanity would soon have to face while discussing the possible contributions of spaceflight to solving such problems – only five years later analyzed extensively in the famous *Limits to Growth* report of 1972 (1967, p.183-185). Apparently von Braun was already very aware of many of the environmental and social concerns stimulated by Earthrise before it had been shot and did not need such pictures to raise his awareness about these things. One wonders how many intellectuals worldwide were already thinking along such lines at that time, more or less isolated, perhaps.

Wernher von Braun's views about the future of humanity may have been influenced by watching the unmanned Lunar Orbiter 1 Earthrise picture from August of 1966. This photo featured prominently in the NASA brochure about the George Marshall Space Flight Center directed by von Braun at that time. Judging by the undated brochure's content, it was probably published in 1967. Starting from August of 1966, other intellectuals may have been similarly stimulated, possibly including Archibald MacLeish.

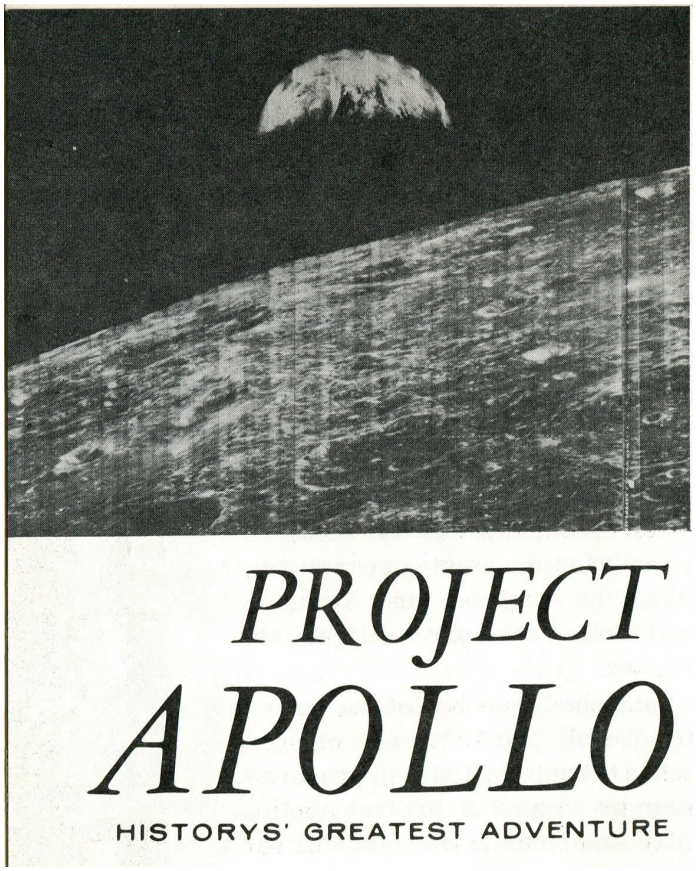

Figure 3: The Lunar Orbiter Earthrise photo on page 18 of the George Marshall Space Flight Center brochure.

Whatever the case may have been, in Europe things went differently. In the late 1940s and 1950s, this continent was still emerging from the ruins of the Second World War. As a result there were other, more

immediate concerns than contemplating the luxury of spaceflight and its possible effects. For instance, NASA rocket scientist Jesco von Puttkamer (1933-2012), who became a close collaborator with Wernher von Braun during the Apollo project, was clearly impressed with the new views of Earth produced by the flight of Apollo 8, as witnessed in his book *Apollo 8 - Aufbruch ins All* (1969) that sported Earthrise on its cover while showing more such pictures and comments inside (114-115). Yet in the same book Jesco von Puttkamer also mentioned that while going to school at the Alexander-von-Humboldt-Gymnasium in Konstanz, Southern Western Germany, right after the Second World War he was asked by his study adviser: 'wann werden Sie endlich aufhören, sich mit so einem Quatsch wie künstlichen Erdmonden abzugeben und statt dessen Ihre Hausaufgaben machen?' [When will you finally stop keeping yourself busy with such nonsense as artificial Earth moons and do your homework instead?] (1969, p.10).

The emergence of social divergences in Earth perceptions

These fresh perceptions of Earth within the United States as a result of the media coverage of the flight of Apollo 8 may have contributed to strengthen some of its internal social differences. For surely not all US citizens read the *New York Times* or similar publications, while not all may have been equally sensitive to such comments. More likely than not, many of them would, in fact, have been rather suspicious of what today are considered the 'liberal' media (and quite likely then as well). In consequence, they may have avoided them. Such attitudes can clearly be witnessed today within the United States. My personal experiences in that large country have taught me that among such people any influence of these Earth images or poetic words appears virtually absent. Within US academic circles, by contrast, such views are often still very present.

These are preliminary observations, of course. To achieve further clarity about this issue more research is needed. Yet this view is confirmed by German journalist Hermann Schreiber's commentary on January 6, 1969 in the weekly magazine *Der Spiegel*, where he stated that on the one hand in the US many were overwhelmed by the feeling that all people were brothers and that they should behave like that while seeing the Earth on their TV screens, but that on the other hand 2000 Americans had complained to the CBS TV channel, because these TV images had interrupted the transmission of the [American Football] game between the Cleveland Browns and the Minnesota Vikings right before halftime (1969, p.73, my translation).

While this confirms my view about these social divisions, according to information available on the Internet no such game between those two teams actually took place during the flight of Apollo 8. Hermann Schreiber may have intended to refer to the game on December 22 between the Minnesota Vikings and the Baltimore Colts. But during that TV transmission, the Earth was shown as an unrecognizable white blob, which did not produce many immediate emotional reactions in the news media (Pro Football Reference 2019a&b). Yet whatever this particular situation may have been, it seems as if during the flight of Apollo 8 within the United States a social division of diverging perceptions of Earth indeed emerged.

It would not be correct to describe such a nationwide division mostly in terms of 'liberal' versus 'conservative' attitudes, although this may have been part of it. Surely the astronauts themselves, for instance, all former fighter pilots, could not possibly be described as 'liberals.' Yet as mentioned above, Frank Borman told a joint session of Congress only two weeks after their successful return to Earth that MacLeish's eloquent words had expressed well what they themselves had felt in lunar orbit while observing Earth from a distance. Although political attitudes will

not have been absent as part of this emerging social division, the major split may rather have been along the lines of the higher educated versus the rest. A similar situation could later also be witnessed in the Netherlands, as we will see below. This does not mean that all higher educated would have been similarly impressed. That was surely not the case anywhere. It was a certain selection of the higher educated who would have felt like that, while others did not, or to a far lesser extent. Why such a selection would have existed, and what determined it, is unknown to me.

For lack of any quantitative available evidence it is not possible to establish percentages of these social divisions as they emerged and began to develop, both in the United States and elsewhere. Based on the media reporting in different countries, shown below in some detail, as well as on my own experiences my preliminary guesstimate is that the percentage of the total population who felt affected by these Earth images was considerably larger within the USA than elsewhere in the world. In the Netherlands, for instance, no such emotional news media responses happened while Apollo 8 was on its way to the Moon, and, quite possibly, not in the rest of Europe either. Why not in Holland?

Until very recently I thought that the first immediate cause had been that the second 'live' Apollo broadcast on December 23 which showed the improved Earth images did not reach the Netherlands. I do not have any photos of it, and neither do I have any recollections of having watched such images at that time. If I had, I surely would have taken pictures of them. Dutch Apollo TV program director Rudolf Spoor does not remember them either. But for reasons unknown to me I apparently missed this broadcast. Thanks to a collection of old Apollo newspaper clippings kindly provided by Frans de Jong, in March of 2019, it turned out that on December 24, 1968 several Dutch newspapers had published such a TV Earth photo on their front pages, all acquired through Associated Press, while one of them, *Algemeen Handelsblad*, wrote in its caption that this was exactly what they had seen on Dutch television the night before.

Yet none of the accompanying Dutch descriptions showed any emotions in terms of that we were suddenly looking at ourselves from a distance and what that might mean. Also on December 24, the rather serious establishment newspaper *Nieuwe Rotterdamse Courant* that we received at home put a rather vague version of this photo on its front page with the caption 'The Earth photographed by Apollo VIII.' The more detailed descriptions in other newspapers were all strictly geographical in nature, in the sense of that 'we were looking at North and South America even though these continents could not be distinguished very clearly on the photo.' Apparently, which portion of the world was shown as well as the national identities of those who did that, and of those who distributed them, mattered a great deal for stimulating certain reactions or the lack of them. This situation would have led to the emergence of considerable social differences between the United States and the Netherlands concerning the perception of whole Earth images, and perhaps the rest of the world as well.

In lunar orbit: the shooting of the Earthrise photos

On December 24, already during their second lunar orbit the astronauts did a 'live' TV transmission starting at 71 hours 40 minutes MET (7:10 a.m. EST and 13:10 CET). This signal reached Earth through the large Madrid antenna. During this broadcast the astronauts showed images of the lunar surface as it slowly moved beneath their spacecraft while commenting on what they saw. We watched that in the Netherlands, while I took a few pictures. Much like the earlier two broadcasts, none of that was orchestrated other than by the astronauts themselves. This produced a very improvised and spontaneous atmosphere. It made me –and presumably many others as well– feel that

we were watching some of our fellow human beings in action during their space exploration. This was, in fact, the first time in human history that such 'real time' long-distance contacts were possible between courageous humans who were boldly going where no one had gone before and the great many others who stayed home.

During their fourth lunar orbit, after having circularized their initial elliptical orbit, the astronauts turned their spacecraft so that they could look forward. Until that time, their windows had been facing the lunar surface. While approaching the portion of the Moon's surface that is always visible from Earth, they suddenly saw our home planet rising above the stark lunar surface. This led to great excitement among the astronauts as well as a scramble to grab cameras and films to take pictures.

It was William Anders who took the famous Earthrise picture at around 75 hours 49 minutes MET (11:40 a.m. EST and 17:40 p.m. CET). In fact, he took two very similar pictures, known as AS08-14-2383 and AS08-14-2384 in NASA terminology, the first one of which became very famous. In doing so Anders used a Hasselblad 500 EL electronic camera equipped with a 250 mm Sonnar telephoto lens. He used a Kodak SO-368 color 70 mm negative film, ASA 64 sensitivity (outdoor), that was loaded in film magazine B, until then unexposed (later renumbered as magazine 14/B). The film exposure was 1/250th second with aperture f:11, according to the audio transcript. At that time none of the astronauts knew what the pictures looked like, because they first needed to be developed and printed, which could only be done back on Earth.

This event is well documented, most notably by a voice recording and its transcription using a tape recorder that was running while the spacecraft was behind the Moon and thus out of radio contact with Earth. Yet for decades this led to a rivalry among the astronauts about who had actually taken that picture, while errors in interpretations of the astronauts' voices during those moments continue to exist today, even in official NASA productions. This is partially caused by the fact that the voices of Borman and Anders sounded very similar (cf. Zimmerman 1999, Poole 2008, Spier 2012, NASA 2013, 2018).

Even though this excitement did not reach the news media at that time, because it had not been part of any conversations between the astronauts and Mission Control in Houston, there was at least one US newspaper that had anticipated such a view. On December 25, 1968 *The New Haven-Courier Journal* published on its front page a drawing of an astronaut looking out of the spacecraft window over the barren lunar surface with the Earth coming up. This image was attributed to Associated Press Wirephoto while it sported the caption: 'The astronauts' Christmas view of the earth – an artist's conception.'

The attribution to Associated Press shows that this image was, in principle, available to all the news media. It is unknown to me who the artist was, when it was made, or who the persons were that helped Associated Press make it available at that time. But surely, some of those people had considerable foresight and imagination. The depictions of the astronaut's hat and the spacecraft's interior do not faithfully reflect Apollo technology. This makes me wonder whether the drawing had been made before all of this had been designed. But it may also simply represent artistic license. Whatever the case, this may well have been part of the earlier mentioned tradition of imagining to look at Earth from lunar distance.

Interestingly, the *NASA Apollo 8 press kit* dated December 6, 1968 (meant for release on December 15) had already featured on its front page a black-and-white image of the spacecraft in lunar orbit with the astronauts looking at its surface while in the background the Earth was rising. The same picture, in color with much more detail, also appeared in the

December 27 issue of *Time* magazine, where it was attributed to North American Rockwell, builders of the Apollo spacecraft. Also that picture ended up in my Apollo scrapbook. Clearly such Earthrise-like images were not unknown at that time. Yet compared to Earthrise they caused very little emotional impact.

Furthermore, before the flight of Apollo 8 some NASA officials, most notably perhaps Richard Underwood, who was in charge of the Apollo photography in Houston, had urged the astronauts to take such pictures while providing the correct camera settings. Yet apparently witnessing the real thing still came as a big surprise to the crew (Poole 2008, p.23-24).

Right after the astronauts had taken these exciting pictures of Earth rising above the lunar surface, radio contact with Mission Control was reestablished. The crew immediately engaged in rather technical, but very important, exchanges about the specific parameters of their new circular lunar orbit. During further exchanges with Houston, including later TV transmissions, no mention was made of witnessing Earthrise and of trying to shoot pictures of it, even though it had affected all of them greatly. The great discipline required did not offer much room for digressing emotionally in such ways other than making a few observations. As a result, their Earthrise experiences could not have any direct effects back on Earth during the flight of Apollo 8.

Interestingly, during three subsequent orbits, five, seven, and nine, the astronauts shot another twenty-two Earthrise pictures using the standard Planar 80 mm lens that produced more-or-less the angle of view that humans have. The famous Earthrise pictures, by contrast, had been taken using the Sonnar 250 mm telephoto lens. This showed a much larger Earth, which enhanced its effect. Twenty of the other Earthrise pictures were in color, while two of them were in black and white. Although none of them achieved the same fame as Earthrise, one of these Earthrises, AS08-14-2392 in NASA terminology, shot during the seventh revolution presumably by Frank Borman, was, in fact, prominently reproduced in several publications, as we will see below.

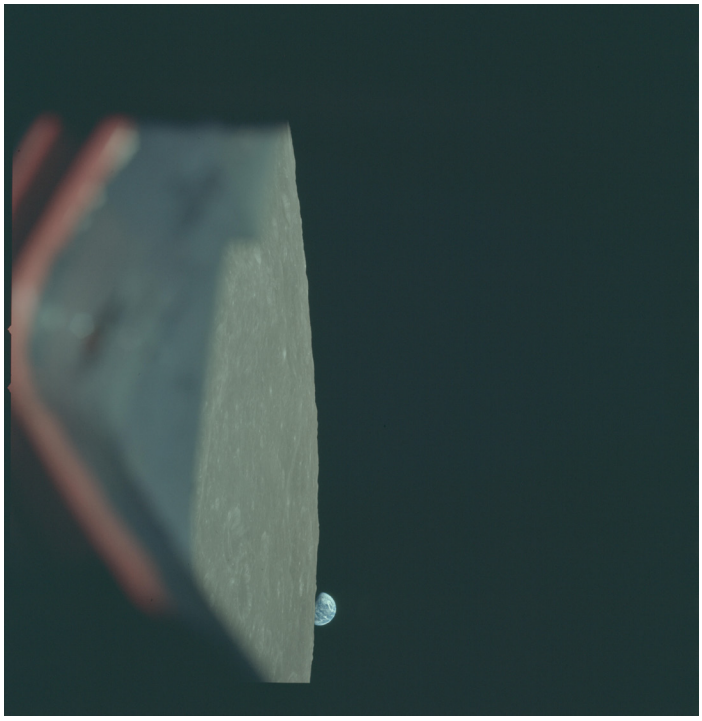

Figure 4: The Earthrise photo AS08-14-2392 presumably taken by Frank Borman. Source: NASA, Flickr.com, Project Apollo Gallery.
https://www.flickr.com/photos/projectapolloarchive/21900445315/in/album-72157658985288718/

Surprisingly, the shooting of these subsequent Earthrise pictures appears to have escaped the attention not only of all authors about Earthrise whose work I have read over decades, including the official NASA photo analysis of that flight (NASA 1969), but it was not mentioned either in any of the astronauts' later conversations that I have heard. As part of that, no one appears to have inventoried yet all those Earthrise pictures, including most notably: at what times they were shot and by whom, even though this can be established relatively easily using information

available on the Internet. In Appendix 1, my results are shown. Apparently the lure of the famous Earthrise photo has been so strong that this subject may have been neglected until today.

The reading of Genesis in lunar orbit: a second wave of emotional reactions

During their ninth lunar orbit, on December 24, starting at 85 hours 43 minutes MET (9:34 p.m. EST, Christmas Eve in the US, and 3:34 a.m. CET early Christmas morning), the astronauts realized a second 'live' TV transmission, which they started by showing a fuzzy image of the Earth, quickly followed by images of the lunar surface while commenting on what they saw. Finally, while approaching lunar sunrise, clearly visible on the TV screen, Bill Anders informed the viewers that the crew of Apollo 8 had a message that they would like to share with us. He then read the first four lines of the bible book Genesis. Jim Lovell followed by reading the next four lines, while Frank Borman read another two lines. The commander then finished the TV transmission by saying: 'And from the crew of Apollo 8, we close with good night, good luck, a Merry Christmas and God bless all of you - all of you on the good Earth.'

This produced an extraordinary emotional impact back on Earth. My father and I watched that while taking pictures. We looked at each other – what is happening now? I will never forget those moments, including the setting of our living room I found myself in. This happened to a great many other people as well, especially in the United States but also elsewhere. In other words, this produced strong emotional waves worldwide with clear religious overtones (cf. for instance Poole 2008, NASA 2012).

NASA had not scheduled this bible reading in advance. Even though they had told the astronauts that they could expect the largest ever 'live' audience with their broadcast on Christmas Eve, the only instruction that NASA gave them, according to Frank Borman, was 'to do something appropriate.' Because Borman had been too busy preparing for this flight, he had asked some of his friends to come up with ideas, one of whom made this suggestion. Also because the astronauts were all active Christians, while, in their view, the first lines of Genesis offered the foundation of three major world religions, they decided to do that. But the astronauts had informed in advance only very few people within NASA. As a result, even for most members of Mission Control in Houston this came as a total surprise. In fact, as can be seen in the voice transcript, right before the 'live' TV began there was a discussion among the astronauts about what they would exactly do (Poole 2008, p.133-140, Woods & O'Brien 2017, page: orbit nine).

Clearly, reading Genesis at that moment can be interpreted as a reflection by the astronauts on humanity's place in the Cosmos, including its presumed history. And only five orbits earlier, the Earthrise photos had been taken by astronauts, producing an extraordinary emotional effect among them, while they had been trying to snap a few more of such pictures during the orbits five and seven. In fact, right before this second 'live' TV broadcast from lunar orbit began, they appear to have taken another set of such shots (see: Appendix 1). One wonders to what extent all of this may have contributed to the intensity of their reading of Genesis and its effects back on Earth.

Within the United States, as Robert Poole pointed out, all of this very soon stimulated many people to combine religious views with pictures of Earth at a distance, most notably Earthrise, as soon as they became available. Perhaps the clearest example is offered by the post stamp produced by the US Postal Service in the spring of 1969 showing Earthrise together with the words "In the beginning God..." . By contrast, very little of that happened in the Netherlands,

if at all, and perhaps not elsewhere in the world either, probably because the earlier whole Earth TV pictures had not elicited a great deal of emotions either. As a result, a further deepening took place between the often intense emotional responses to these events within the United States and the far smaller effects in the Netherlands and, quite possibly, also in most of the rest of the world.

On their way back to Earth, the astronauts did two more 'live' transmissions. During the first one, starting at 104 hours MET (December 25, 4 p.m. EST and 10 p.m. CET), no images of Earth or the Moon were shown, because, as Borman said right before the transmission began: 'We're just going to have to just do it inside today because there are no good shots of the Moon or the Earth; the Sun's too darn bright.'

At 128 hours MET (December 26, 4 p.m. EST, 10 p.m. CET) there was another 'live' transmission, about 97,000 nautical miles (about 180,000 km) from Earth, in which relatively good images of Earth were shown, thanks to camera improvements and the fact that Earth was getting closer, thus resulting in a bigger image, while the astronauts rather freely commented on what they saw and how they felt. Again, the Americas were in full view. However, for the United States such images were no longer new, so they did not produce a new wave of emotional reactions in the news media.

The publication of Earthrise in black and white: a third wave of US emotional reactions

A third wave of emotional responses took place in the US after the Earthrise photo was made available. The astronauts had returned to Earth by splashing down in the Pacific Ocean on December 27 right before dawn, at only a few miles' distance from the aircraft carrier Yorktown that had been sent there to pick them up. Within two hours they stood on its flight deck, while a few hours later also the spacecraft was recovered. A movie that they had taken was quickly developed onboard and shown to the astronauts before they left the ship the next day. But the photos were not developed on the Yorktown.

The astronauts could not immediately leave the ship, because the aircraft carrier was still too far from Hawaii for any of its small passenger airplanes to reach those islands. So the aging Yorktown went full steam toward the archipelago, blowing its main water pipes in the process, which very much limited water consumption on board. The next morning the astronauts flew to Hawaii. Within two hours after arrival they boarded a plane that took them back to Houston together with their photographic materials. The next day these were developed and printed. The pictures deemed newsworthy were immediately distributed through Associated Press together with hastily made descriptions. This included the Earthrise photo, numbered AS08-14-2383 in film magazine 14/B in NASA terminology (NASA 2015).

Many of these photos received a great deal of attention, but none of them approached Earthrise in that respect, presumably because of the stark contrast between the barren gray lunar surface and the colorful image of Earth, both surrounded by pitch black space.

Interestingly, NASA did not make much of an effort to publicize Earthrise. As Robert Poole formulated it, the description of the 'Apollo 8 Earth View' as supplied by the photographic service was informative rather than poetic, emphasizing the specific position of the spacecraft over the lunar surface as well as what was in view. A later version by the Public Affairs Office added the sentence: 'This view of the rising Earth greeted the Apollo 8 astronauts as they came from behind the Moon after the lunar orbit insertion burn.' (Poole 2008, p.28-29). However, this was not entirely correct, because the photo had been shot during their fourth orbit, so not right after insertion into lunar orbit. This NASA statement may have signaled the beginning of a considerable number of misrepresentations of this famous picture over the past 50 years, including by NASA itself.

According to what can be found on www.newspapers.com, the next day, December 30, at least sixty US newspapers put Earthrise on their front page, including the *New York Times*, even though all these picture were in black and white. Some newspapers may have featured color photos, but I have not seen any of them. This can be interpreted as a third wave of emotional responses to whole Earth images. To be sure, all these emotional responses by the printed news media including the earlier ones must have had a financial incentive as well, namely to sell as many issues as possible. Yet the perception of such anticipated effects provides a clear indication of the recognition by the printed news media of the potential impact of such emotions.

It is difficult to assess the effects of this new wave of emotions within the United States caused by the publication of Earthrise in black and white by the newspapers. Yet it seems likely that the new black-and-white Earthrise photo was interpreted in the United States within the same wide range of emotional and cognitive contexts that had emerged the week before while contemplating the black-and-white TV photos of Earth at a distance.

This relative mild wave of emotions may also have happened because the first version of Earthrise was distributed through Associated Press had to be in black and white. This was necessary for a quick worldwide distribution, given the limitations of such technology at the time and the connected fact that virtually all newspapers then printed only photos in black and white. Color versions of Earthrise were made available few days later. Unfortunately I do not know how exactly Associated Press distributed those pictures to the press.

In the Netherlands, the black-and-white Earthrise photo did not lead to a a great deal of emotions. On December 30, newspaper *De Tijd* showed Earthrise on its front page together with another photo of the barren lunar surface with the headline: 'Rare Moon Photos' without any further reflections. On the same day, the commercially-oriented *Algemeen Handelsblad* published a small Earthrise on page 5, section 'Foreign Affairs,' in the orientation preferred by Bill Anders, namely with a vertical horizon on the right, while summarizing the rather technical NASA description. And on December 31, the leftist-leaning newspaper *Het Vrije Volk* published it on its front page with the headline: 'Look, the Earth is coming up,' again without any further reference to the fact that we were looking at ourselves from a distance.

Furthermore, on December 31, 1969, also the *Nieuwe Rotterdamse Courant* that my parents were subscribing to published a rather small Earthrise photo. This photo was part of their sixteen-page long annual overview titled: 'The Year 1968.' Earthrise featured as a relatively small image at the bottom of page 9 in the 'Foreign Affairs' section, surrounded by mostly larger photos of social action. It was described as: 'The year was ended by a successful trip around the Moon by three Americans in the Apollo capsule.' To the best of my knowledge, none of that led to any perceptible emotional wave in the Netherlands.

What, one wonders, was different in this little part of the world? A lack of data always leaves a great deal of room for speculation unconstrained by observational evidence. My current thinking is as follows. First of all, the Dutch were not doing it themselves. Also, on the Earthrise photo Holland was not visible, situated too much to the north and just in the dark portion of Earth, because when the picture was taken at 17:40 p.m. CET night had already fallen in the Netherlands. All of that made it a little harder to identify with those pictures, not least because notwithstanding it international outlook, Dutch elite culture was – and still is – very much centered on itself, including mostly reading materials in Dutch, including translations into Dutch.

The idea of the importance of 'doing it themselves' in eliciting such emotional reactions is strengthened by what happened during, and after, the much later space flight by Dutch ESA astronaut André Kuipers,

who went to stay at the International Space Station between December 21, 2011 and July 1, 2012. During his flight and even more so after his return to Earth, Kuipers' eloquent descriptions as well as his evocative photos and movies, some which can now be seen on his website https://andrekuipers.com, did lead to emotional responses in the Netherlands that were a little similar to those that had happened in the United States during and after the flight of Apollo 8.

In addition, in the 1960s many people in Europe felt that they were 'lagging fifty years behind the United States,' an expression that I remember well, while they looked with admiration and a certain degree of jealousy to that large, wealthy, and powerful country. All of this contributed to a considerable interest in the technical achievements of the Apollo 8 flight, which featured prominently in the European news media, including the Dutch. Yet Europeans also felt themselves to be 'culturally' different from the United States, often to some extent superior, then as now. All of this went hand-in-hand with a considerable degree of cultural self confidence, none of which would have heightened their sensitivity when exposed to the American wave of Earthrise emotions.

Furthermore, a certain arrogance and self-confidence characteristic of many Western Dutch known in the Anglo-Saxon world as the 'Dutch uncle' mentality may have played a part as well. When I recently questioned a few Dutch citizens of my age about this lack of cognitive and emotional reception, almost invariably the answer was: 'because we knew that already.' By this they meant that they knew already about the Earth and its geography as well as its position in the universe thanks to their general education at school. That is how these new images were mostly interpreted. More of such examples will be shown below. Yet quite often, in my experience, such people may not always take sufficient time to wonder what they actually know as well as what they might have missed. As a result, there was a remarkable lack of surprise, wonder, fresh emotions, and openness for new views of the Earth and our place on it.

To be sure, the Western Dutch tradition of engaging in worldwide trade and gathering all the available knowledge about it, including the astronomical expertise necessary for long-distance navigation, had contributed to a Dutch global and cosmic awareness already for centuries. A similar argument can be made for Spain and Portugal (Spier 2017), and perhaps also to some extent for the United Kingdom, France, and (former) Western Germany. But in contrast to these other European countries, the Western Dutch middle classes ruled themselves while engaging in all of that, which would also have bolstered their particular form of self-confidence.

Dutch universities, and also their academy of science, where such activities were undertaken, were dominated by the middle classes and not by other elites, a landed nobility, for instance, who may have felt themselves to 'be above such mundane knowledge.' Wherever nobilities and their cultural expressions have dominated the academic world, they have tended to develop and display their own particular types of self-confidence, by others often perceived as their own particular types of arrogance. None of such attitudes would be helpful in reappraising our position in space and time as a result of images of Earth at a distance, photographed by fellow human beings that were not considered to be part of their 'own' societies.

All of this, including the teaching of astronomical cosmography at some Dutch secondary schools – which was being abolished around the time when the flight of Apollo 8 took place, probably because navigation by artificial satellite signals was becoming a reality– may well have contributed to the Dutch feelings of that 'we knew this already,' even though as a result many of them may have missed a reevaluation of our position in space of sharing life on a planet with limited resources within an inhospitable universe. For

their own particular reasons, similar situations may also have existed in other West European countries. All of that would need to be further investigated. Yet whatever the causes may have been, clearly such new views could be witnessed in the Netherlands, and quite possibly also in the rest of Western Europe, to a far lesser extent than in the United States.

The publication of Earthrise in color: a fourth wave of US emotional reactions

Color versions of Earthrise together with other Apollo 8 photos both in color and black-and-white were also immediately made available by NASA. Their distribution and reproduction in the printing press took about a week. As a result the glossy magazines lagged behind the newspapers, which could immediately feature Earthrise in black and white. It is unknown to me how Associated Press distributed those pictures to the press, quite possibly by mail which worked quickly and efficiently in those days.

In many of those lunar photos, colors appeared that did not correspond with what the astronauts had seen. As they stated themselves in the 1969 NASA Analysis of Apollo 8 photography and visual observations: 'Our photographs on black-and-white film illustrate observed general lunar color more closely than do the initial printings of the color films. Neither were specific colors observed associated with any particular lunar features' (1969, p.10). Yet such false lunar colors began to appear in Apollo 8 pictures all over the place, thus adding some emotional impact.

To my great surprise, at the beginning of 2019 it turned out to be possible to purchase through eBay the issues of a considerable number of magazines, ranging from the United States, Britain, France, Germany, Spain, Italy and Yugoslavia, that had featured Apollo 8 photos and articles at the beginning of 1969. These are described below. Unless referenced by another source, all these weeklies are currently in my possession.

The first to produce Apollo 8 special issues in color in the United States were the major newspapers. In doing so they could beat the weeklies, who were tied to their specific production and publication schemes. Even though the *New York Times* had already published Earthrise on its front page on December 30, in early January they also produced a full 72 pages Apollo 8 special issue in cooperation with the glossy biweekly *Look* magazine, a direct competitor of *Life* magazine, with the headline: 'Apollo 8: Voyage to the Moon.' This *LOOK special* was not part of the regular publication scheme of *Look* magazine, but it was brought out separately as a large-size booklet. No specific date of publication was mentioned, only the year 1969. Its main text was provided by a team of authors from the *New York Times* led by science news coordinator Henry Lieberman (1969). According to the information supplied, they had acquired their Apollo photos through Wide World Photos owned by Associated Press.

This *LOOK special* opened with Archibald MacLeish's *Reflection* printed over two full pages. Its cover did not feature Earthrise (which was already prominently shown on the *New York Times* front page a week earlier) but another Apollo earthrise photo shot with a regular lens and framed by the spacecraft's window. This was photo AS08-14-2392 mentioned earlier, probably shot by Frank Borman during their seventh lunar orbit. This astronaut's perspective lent it a personal touch. Yet inside, the Earthrise was prominently shown in color over two pages in mirror image. On other pages, more large Apollo 8 photos in color and black-and-white were shown. This issue offered a detailed and intelligent contemporary report of the Apollo 8 flight. It explained, for instance, Apollo space navigation technology by placing it into the historical perspective of how to determine one's position on the globe spanning two millennia. This special issue also contained a considerable amount of

personal information gleaned from public sources as well as some emotional editorial descriptions.

The *New York Times* was not the only newspaper producing an Apollo 8 special issue in color. On January 5, 1969 the *Chicago Sun Times* published a similar 'Special Edition, Apollo 8's Epic Flight' with color photos and the headline: 'Voyage To The MOON.' It prominently featured Earthrise on its cover, depicted however with a light blue sky and a light brown lunar surface. It is unknown to me whether this might have been caused by a deterioration of the colors over time, or whether this was done on purpose. Inside, the other earthrise photo framed by the spacecraft's window was shown with the caption: 'Earthrise! Astronauts' view of the Earth as it rises above the lunar horizon.' This may have been the first time that the word 'Earthrise' appeared in print, only one week after these pictures had been published. Yet in this case it was not used for the iconic picture now known as Earthrise. Emotions were not lacking either, most notably the astronauts' reading from Genesis.

On January 7, 1969 also the *Detroit News* published a special issue in color with a similarly impressive Earthrise on its front page headlined: 'The Moon and Beyond. A specially prepared Detroit News photo and word history of the flight of Apollo 8 and what it means.' In its mid double page fold out (p.8-9), impressive images of Earth were shown with the caption: 'The Good Earth - A Beautiful Orb.' Also this magazine paid ample attention to the astronauts' Genesis reading, yet they also offered a 'Dissenter's Opinion: ''I think that the astronauts were not only ill-advised but that it was a tragic situation . . . it seems to me when man is expanding human knowledge and attempting to explore so that we can find answers that it is extremely unfortunate . . . that they should read portions of the Genesis Bible which is accepted by a very minor number of persons in the total world.' – Mrs. Madalyn Murray O'Hair, the woman who got prayer removed from public schools' (p.6).

There may well have been more such glossy magazines cooperating with, or produced by, US newspapers that paid color attention to Earthrise. For the mostly black-and-white newspapers this was a way of competing with the popular weeklies such as *Time*, *Life*, and *Newsweek*, who all routinely published color pictures.

Those three major US weeklies lagged a few days behind the newspapers. Because the reproduction of color pictures in the printing press took about a week, and because most of them published their issues on a weekly basis, these magazines were only able to get their Apollo 8 color issues out starting January 10, 1969. As a result, they found themselves at the tail of this emotional wave. Much like what the glossy specials had just done, this situation may also partially explain the remarkable emotional content in these weeklies which, in doing so, also sought to capitalize on these earlier waves to sell their copies, many of which were sold at newsstands.

Life magazine did it as follows. The cover of its January 10, 1969, issue featured a huge Apollo 8 color photo of Earth at a distance, with the text 'The earth as seen from Apollo 8 in space, showing the outlines of North and South America,' together with the headline: '*Incredible Year '68*.' Furthermore, within an article of 12 pages it sported a full two-page Earthrise photo with the headline 'Discovery,' while on the next pages more photos of this mission were shown. It also prominently featured a poem by James Dickey (1923-1997) over three pages titled: 'So long,' which described in strong poetic terms the starkness of the Moon and the great adventurers who had dared to go there.

Life magazine had a special position among the US weeklies, because it held an exclusive contract with the NASA astronauts providing the magazine privileged access to their personal lives in exchange for a financial remuneration that made it possible for

these intrepid space explorers to buy life insurances - surprisingly, to me, their NASA salaries and benefits did not include this. In their January 10 issue *Life* magazine could not yet include much of such private information, but it did so in their subsequent January 17 issue (Borman, Lovell, Anders 1969). This privileged access of *Life* magazine to the astronauts' private lives may explain why *Look* magazine in cooperation with the *New York Times* went all out in producing their 72 page issue just mentioned, in doing so seeking to compete as effectively as possible for the attention and money of the American public. At that time, an issue of *Life* magazine cost $ 0.40, while the *Look* special was sold for $ 1.25.

Newsweek's issue of January 13, 1969 ($ 0.50) also featured a series of Apollo 8 color photos. It opened on page 17 with a partial color photo of Earth with a large blazing Saturn V rocket racing out of the atmosphere into the black sky. In reality, it never happened that way, because the Saturn V rocket did not go any higher than 40 miles before shedding its first stage – by then its fuel had been depleted. The next two pages featured a whole Earth photo with the text: 'Against the backdrop of a deep black sky, the earth shows itself to Apollo 8.' Over the next two pages, the Earthrise photo in color was featured with the text: 'The astronauts looked up from the dead sandy-gray Moon passing 70 miles below them and see the earth 240,000 miles away–a brilliant agate floating in the blackest ink. The oceans of earth are vibrantly blue; continents are brown, brushed with pink beneath swirling white clouds.' And on their last page of the series of color photos, it featured another Earthrise picture, this time photo AS08-14-2392 presumably made by Frank Borman during their seventh lunar orbit.

The January 13 issue of *Newsweek* did not show anything like that on its cover. But it had already done so one week earlier on its January 6 issue, prominently featuring the Moon (with a spacecraft added orbiting it), Earth (as seen on color television), and the astronauts with the caption 'Apollo Triumph.' That January 6 issue had just missed Earthrise and the other Apollo color photos. But it did contain more TV Earth pictures, while emotions and reflections were not lacking either.

In keeping with this trend, the January 10, 1969 issue of the rather serious *Time* magazine ($ 0.50) –not known for its strong emotional or poetic expressions–, started its 'lunar album' in color (six pages for the US edition, and only four in the Atlantic edition that I saw) with the Earthrise photo sporting the caption: 'The Awesome Views from Apollo 8.' The text below the photo described it as: 'the first "earthrise" that any man has ever seen.' This may have been the first time that the word 'earthrise' was used in print for characterizing that particular photo.

Yet this issue did not contain any further emotions or reflections, while it did not put anything related to Apollo 8 on its front cover either. But that was probably related to the fact that only one week earlier, *Time* magazine had shown the three astronauts very prominently on its January 3 cover, nominated by them as 'Men of the Year' (1968). That January 3 issue did contain more emotions and reflections, for instance by stating in its *Time Essay*: 'Nothing comparable has happened in man's history, except possibly the great ocean voyages that led to the discovery of the New World –and to the transformation of Western Man' (1969, p.17). But none of that was accompanied by photos of the Earth at a distance, which made it very difficult for me to assess such a statement in the Netherlands because I had not yet seen such images. This situation offers another warning that one should always try to understand cultural expressions first of all from within their 'own' social context, while outside of such a context they can lead to very different understandings.

Time magazine's rather concise caption: 'The Awesome Views from Apollo 8' on top of the Earthrise

photo was the emotion that hit me when we received that copy in the Netherlands, thanks to the fact that my parents were subscribing to *Time* magazine. I had also read the preceding issue, as witnessed by the clippings from that issue in my Apollo scrap book. But it had not impacted me that much, probably because of the lack of whole Earth photos. In retrospect, fifty years later, it may have then have hit me especially hard because I had virtually entirely missed the earlier emotional waves that had taken place in the United States, while I had only seen the initial very blurry TV images of Earth. But I did not know any of that back in 1969, and began to realize this only in the summer of 2018. But even though I realize all of this now, I still experience *Time*'s Earthrise picture as a most powerful image.

Within the United States, the publication of Earthrise in color in all these glossy magazines –while more likely than not it was also shown extensively on color television– led to another considerable, and very varied, wave of emotions and comments. It was suddenly seen by many as Apollo 8's major accomplishment, even though this mission had been planned as the first exploration into lunar orbit for a later landing on the Moon –which was and remained the main goal of the Apollo project, but had not yet been achieved.

As an example of that new trend may serve the fact that on January 9, 1969, the three astronauts presented a large framed photo of Earthrise to the outgoing president Lyndon B. Johnson during an official reception at the White House as a symbol of summarizing their flight. Many more examples of the sudden prominence of Earthrise exist, many of which were mentioned by Robert Poole. Furthermore, as the British historian argued, Archibald MacLeish's poetic words in the *New York Times* were soon conflated with the Earthrise picture, not least because Frank Borman did so himself during his presentation before a joint session of Congress on January 9, as mentioned earlier. Many others started interpreting Earthrise in terms of the astronauts' reading of Genesis in lunar orbit.

As part of all these developments, within the United States many of its citizens began ascribing an increasing variety of meanings to the Earthrise picture, ranging from science, environmentalism, world citizenship, to religion and spiritualism. This trend has continued up until today. In doing so, it has produced a remarkably rich harvest of cultural expressions, many of which are mentioned by Robert Poole in his book *Earthrise*. If the reader wants any further quick confirmation of this trend, a search for 'Earthrise' on www.ebay.com and www.amazon.com is recommended. My recent research on www.ebay.com yielded, for instance, no fewer than five different Earthrise LP music albums produced in the 1970s. One of them, by US singer Chris Ruhe, known as compadre Chris in Peru and Chile because of the radio shows that he had produced there, featured the song 'Anthem of the world citizen,' now available on YouTube (Ruhe 1969).

In sum, all these whole Earth images, including the subsequent ones from later Apollo flights, had a huge impact among many people in the United States, probably first of all among the higher educated who read newspapers such as the *New York Times* and weeklies such as *Time*, *Life*, and *Newsweek*. Yet by contrast, it seems as if the sizable portion of the US population that did not read such publications was far less affected by these fresh world views. In consequence, this cultural divide within the United States would further have deepened, a situation which has continued to exist until today, or so I suspect.

What happened in the Netherlands?

Much like the reactions to Earthrise and similar pictures in the United States were interpreted within the framework of their national and regional cultures, the same can be said for European reactions to these photos.

Let us begin with the Netherlands. As far as I have been able to ascertain, in Dutch publications from that period, mostly newspapers, there was a great deal of prominent reporting on the flight of Apollo 8. Yet none of the US emotional reactions could be witnessed. By contrast, the Dutch glossy magazines paid little attention to this flight, if at all. The major Dutch weekly *Elseviers Weekblad*, modeled on *Time* magazine, did not show any Apollo 8 Earth photos at all in its January 1969 issues.

However, in their January 4 issue they did feature a commentary on page 44, written by their 'scientific collaborator,' saying that 'now we have seen the Earth in its true form, like a tiny, glittering, fragile Christmas ornament against a pitch black background – this has forced the reality upon us human beings of our limited existence in a Cosmos, in many little corners of which, perhaps at this moment, thousands of spacecraft with thousands of living beings who think differently are visiting thousands of sister planets.' (1969, p.44, my translation). Such a comment may have been inspired by the Dutch tradition of long-distance ocean voyages. Yet *Elseviers Weekblad* did feature Earthrise on the cover of their February 8, 1969 issue together with a lunar module spacecraft prominently pasted in front of it, headlined: 'The First Landing.' Again there were no cognitive or emotional reflections about that we might be looking at ourselves and what that might mean. All the further comments were either technical or referred to the courageous behavior of the astronauts.

In fact, I have not been able to trace any Dutch magazines that featured color pictures of Earthrise or other similar Apollo Earth and Moon photos in January of 1969. Perhaps I have missed them, but certainly I did not see them at that time, or I would have put such pictures in my Apollo scrap book. My research in the Royal Library in The Hague in March of 2019 has shown that no Apollo 8 photos featured in the January issues of the Dutch weeklies *De Groene Amsterdammer*, *Haagsche Post*, *Panorama*, and *Nieuwe Revu*. The latter two weeklies were rather middle of the road socialite magazines that most Dutch intellectuals would avoid.

However, in the January 25, 1969 issue of *Panorama* there was an article titled 'How good is our Earth?' – apparently a reference to Frank Borman's closing-off words 'all of you on the good Earth' at the end of their second 'live' TV transmission in lunar orbit. This article provided an overview of all states on Earth, alphabetically arranged, specified according to the following criteria: population size, political system, free press, annual income per capita, percentage of analphabetism, war or peace, and life expectancy. On both page 18 and page 20 these data were accompanied by an Earthrise photo on the left without further commentary, but with the article's title placed above it, while the question mark was inserted into its black sky. So clearly, the editorial staff of *Panorama* staff knew about this photo and came up with their own interpretation of it in combination with Frank Borman's eloquent words.

A little later in 1969, however, both *Panorama* and the *Nieuwe Revu* did pay attention in color to Earthrise or similar photos. The February 1, 1969 issue of *Panorama* surprisingly featured an Apollo 8 article with the headline 'Eye in Eye with the Moon' (p.33-37). It showed some of the familiar NASA Apollo 8 photos including an Earthrise in color over two pages, with the description: 'The vision of Jules Verne is now an historical reality. From their spacecraft the astronauts are looking down onto the terrifying landscape of the moon, while in the immeasurable distance the half-obscured Earth is speeding along in its orbit. The fairytale of the Man in the Moon has now forever been cast aside.' Surely emotions of some sort, but no reflections al all about a possibly changed perception of our position in space and its possible consequences. Why this article was published comparatively late is unknown to me. The 'vision of Jules Verne' referred to the novel written by this world famous French

author titled *De la Terre à la Lune* (1872), in which he had described a manned circumlunar flight that was remarkably similar to the flight of Apollo 8 about one century later. I knew that at the time, because my father had read that book to me in 1965 in a Dutch translation.

Furthermore, in their July 17, 1969 issue the *Nieuwe Revu* published a twenty-page special section in color 'Nieuwe Revu Exclusive: Day of the Moon' about the flight of Apollo 10, which took place between May 18 and 26, 1969, seen in the light of the upcoming Apollo 11 moon landing. The Apollo 10 flight to the Moon, the first after Apollo 8, was the final rehearsal for the Apollo 11 lunar landing. Like Apollo 8, the Apollo 10 astronauts went into lunar orbit, but then partially descended to the surface, however without actually landing on it. This special section of the *Nieuwe Revu* was published only one day after the Apollo 11 flight had been launched, so only three days before Neil Armstrong and Edwin 'Buzz' Aldrin were scheduled to land on the Moon. It contained a full-page whole Earth photo as well as an even larger earthrise in color shot by the Apollo 10 crew, without, however, commenting in any way that we were looking at ourselves.

In fact, after the flight of Apollo 8 all the Apollo crews that went to the Moon tried to take such earthrise and whole Earth pictures. The Apollo 10 astronauts, for instance, shot no fewer than 40 earthrises and 120 Earth photos out of a total of 413 pictures, about 26 percent of all photos, which provides an indication of the importance the astronauts attached to taking pictures of such unscheduled 'targets of opportunity.' By contrast, Apollo 8's images of this type represented only 17 percent of all photos taken. Most notably the full Earth picture taken by Apollo 17 has become very influential as well. To the best of my knowledge, a comprehensive study of all these Apollo photos is still lacking.

Figure 5: The Apollo 17 Full Earth known as the 'Blue Marble.' Source: NASA, Flickr.com, Project Apollo Archive.
https://www.flickr.com/photos/projectapolloarchive/sets/72157659085112111/with/21517731239/

Let's return to what happened in the Netherlands in 1969. A color photo of the Apollo 8 Earthrise and an Earth photo did feature prominently in Titulaer's book *Operatie Maan* published later in 1969, but again without saying anything about that we were looking at ourselves (1969, in-between p.150-151). Like virtually all other Dutch reporting concerning the Apollo 8 flight, it was first of all technical in nature. Yet a number of Dutch natural scientists and some activists would have felt such an impact. Earthrise was featured, for instance, very prominently on the 1969 cover of the *Winkler Prins Gezinsatlas* (Family Atlas). And in the 1970s, the Dutch government used images of the Earth as a symbol for the coming exhaustion of resources, as a planet in need of protection. But none of those campaigns ever worked well.

Again, finding an explanation for this absence of such considerations is difficult. But my suspicions go along the same lines as those mentioned earlier.

Whatever the causes may have been, these fresh Earth perceptions did not become part of wider Dutch popular culture at that time, which explains why I felt so lonely then, and why it is still difficult in the Netherlands today to explain all of this to the lay public including virtually all scholars from the humanities and social sciences, while within the United States this is often not a problem at all. To the contrary, such conversations with elderly US colleagues often offer an almost instantaneous and pleasant recognition of shared experiences.

As a result, in the Netherlands the Earthrise photo became mostly associated with science and environmental activism but rarely with religion or spiritualism, if at all. Also in other West European countries such American emotional fresh perceptions of our home planet were mostly lacking, as we will see below. All of this led to remarkable differences of perceptions about these things between the Dutch and probably also other West Europeans on the one hand, and their American counterparts on the other hand.

What happened elsewhere in Europe?

In Britain, the reactions to Earthrise that I have been able to trace can be summarized as a fresh, 'humbling' perspective on Earth and its position within the universe. Compared to all the other European reporting known to me, the British comments were perhaps the closest to the more emotional US perspectives mentioned earlier in terms of that we were suddenly looking at a fresh perspective of Earth and its inhabitants. This can perhaps be seen as part of their 'special relationship with the USA, including sharing the same language. Yet the British views should also be seen within the context of the United Kingdom losing its status as a world colonial power at that time while trying to preserve as much of it as possible by creating the British Commonwealth.

I have not yet encountered any British statements or emotions such as that we were looking at ourselves from a distance, and that we were now all brothers. Furthermore, while discussing the contributions of people to Apollo 8's success, much like most of the American reporting the British media attention was mostly focused on individuals and their achievements and contributions, even though astronauts such as Frank Borman kept emphasizing the importance of the joint, collaborative efforts of all the people involved in the Apollo project.

On December 31, 1968, the prominent newspaper *The Times* commented on the color picture of Earthrise that had been shown the night before by BBC television as 'a humbling reminder of the world's insignificance,' while on January 6, 1969, the newspaper produced 'four pages of color photographs from Apollo, led by a full page Earthrise' (Poole 2008, p.31-32).

The *Evening Post* newspaper published a January 6, 1969 Apollo 8 special issue with the headline: 'Moonshot: a 16 - page souvenir Evening Post reading.' It featured on its front page a large color picture of the launch, while on its backside a large color photo of Earth was shown shot by the astronauts soon after leaving Earth orbit. This picture was described as: 'EARTH –in all it's glory–from Apollo 8.' For additional clarity, a traditional globe was depicted showing the portion of Earth that was visible on the photo. Inside, it featured a similarly large photo of our planet, this time in black and white, with the headline: 'In focus–a space man's profile of Mother Earth, one of the dramatic pictures taken by the astronauts.' No Earthrise, however, and none of the other American emotions and perceptions either, but instead a great deal of personal info presented in a sensationalist style. Their historical depiction of the Sputnik 1 flight was wildly off the mark, however, while their historical overview of important explorers placed the astronauts right after Columbus, (Sir Francis) Drake, and (James) Cook.

The January 10, 1969, weekly issue in color of the *Daily Telegraph* newspaper featured on its cover an enlarged picture of the Langrenus lunar crater with terraced walls (in false color), named after Michael van Langren (1598 –1675), Dutch lunar cartographer and royal cosmographer in Spanish service. This spectacular photo was often reproduced at that time. The caption below stated: 'In July the first man should set foot on a place close to this crater on the face of the Moon [which was not correct]. In this first full report in colour we commemorate the epic six-day flight of America's Apollo 8.' Furthermore, as part of the article 'Aiming for the Moon' a full two-page color photo of a very much enlarged Earthrise (again in false color) was shown with the description: 'First sight of earth from another planet, huge and marbled in the jet cold infinity of space. In the foreground the burnt-out desert of the Moon's surface is 80 miles wide and the horizon is 485 miles from Apollo 8's camera lens. Earth is 240,000 miles and two days away. The photograph was taken by astronaut Anders with hand-held Hasselblad..'

There may have been more of such issues in color in the United Kingdom. But whatever else may have been reported in Britain at that time, these examples clearly show that at least some media were impressed by the change in perspective, yet without stating any of the emotional or social effects as interpreted by Americans on the other side of the big pond.

In Western Germany, the media reporting in the weeklies that I have found can be described as technical and/or sensational, depending on the news outlet, with an emphasis on technical cooperation while confronting the difficulties of spaceflight, but again without any of the emotions or changing perceptions of Earth and of humanity's place within it as shown in the US media.

In their January 6, 1969 issue, the prominent and rather serious weekly *Der Spiegel* –modeled on *Time* magazine– provided extensive and rather detached reporting while seeking to portray various points of views within the United States. In their main article 'Ein Salto Mortale vor den Augen der Welt' [A salto mortale in front of the eyes of the world], there was relatively little attention to Earthrise, however, which was shown on less than a quarter page. An Apollo 8 photo of Earth at a distance was allotted another quarter page, while half a page was devoted to a photo of the partial Earth as photographed soon after translunar injection. None of these photos were accompanied by comments or emotions in the sense of that we were looking at ourselves.

Yet *Der Spiegel* did devote two pages to an interview with medical doctor Charles Berry from Mission Control about space sickness. Instead, the magazine first of all focused its attention on the technical aspects of spaceflight including its difficulties. On its cover Apollo 8 was not mentioned. Instead it featured rather graphic images of how Moscow would be viewing the Western German leaders with the caption: 'Nazis, Räuber, Revanchisten: Moskaus Bild der Deutschen' [Nazis, Robbers, and Revanchists: Moscow's Image of the Germans]. Apparently, such concerns were deemed more important than a possibly changed view of Earth and its inhabitants.

The socialite and more sensationalist weekly *Bunte Illustrierte* featured on its January 15, 1969 cover a large photo of the then Dutch crown princess Beatrix (married to German nobleman Claus von Amsberg) showing her recently baptized son Johan Friso. Yet a large text box on the left announced: 'Der erregende Farbbericht – Die Sensation des Jahrhunderts: Der Flug zum Mond' [The exciting story in color: The sensation of the century: The flight to the Moon]. Inside, the article opened with a large photo of Wernher von Braun, chief designer of the Saturn V rocket, joined by Apollo program director San Phillips and by another German, Kurt Debus, then head of the Kennedy Space Center. Below, another photo showed

the Apollo astronauts seriously preparing themselves for navigating through space as part of a larger team. In short, an emphasis on human technical cooperation with special attention to German contributions.

On the opposite page a full Earth photograph was shown, described as: 'the good mother Earth as seen from 35,000 km distance.' This was, however, not an Apollo 8 picture but the first whole Earth color photo ever made, in 1967, by the unmanned US ATS-III geostationary satellite. While most of the photos and the article were about the astronauts and their experiences, on p.35 some sort of an Earthrise photo was shown in black and white accompanied by the statement: 'Das hat noch nie ein Mensch gesehen!' [No man has ever seen that!]. However, this was not the famous Earthrise but a combination photo in black and white of a graphic lunar surface picture shot by Apollo 8 and the Earth as seen on Earthrise.

In France, the leading French glossy magazine *Paris Match*, was (and still is) a socialite magazine similar to *Life* and *Look* magazine, yet aiming at a French 'refined' cultural level. On the cover of its Jan. 11, 1969 issue it featured the earthrise photo framed by the spacecraft window with the caption: 'Lever de Terre sur la Lune. En couleurs, les photos les plus bouleversantes jamais faites' [Earth rising above the Moon. In color: the most staggering photos ever made]. This issue further contained the article 'En couleur de la Terre a la Lune: Les photos rapportées par les cosmonautes.' This article was clearly added at the latest possible moment, because it appears right in the middle of the issue, in fact stapled in the middle of an article about the introduction of plastics as a construction material for small boats. Several Apollo 8 moon shots as well as whole Earth photos were shown, while Earthrise was featured over two full pages, describing it as 'Pour les astronautes en orbite lunaire, la Terre se leve avec une majesté bouleversante [For the astronauts in lunar orbit, Earth rises with a staggering majesty].

Their January 18 issue provided further detailed coverage of the mission, the astronauts, and their personal relationships, including a photo of a broadly smiling Frank Borman during his formal presentation at the joint session of Congress on January 9, with the caption (p.23): 'C'est le jour de gloire de Borman, Lovell et Anders.' Furthermore, on four densely printed pages a summary of the communication between the astronauts and Mission Control was provided, while this issue also featured a photo of astronaut Lovell presenting the Earthrise picture to the outgoing President Johnson, while quipping: 'Une photo de votre ranch' (p.24). In none of the US news media that I have seen was such a joke mentioned. In sum, considerable reporting, with considerable emotions, yet no mention of any of the reflections that had abounded in the US news media. Interestingly, other than implicitly in its headline, the *Paris Match* did not mention Jules Verne's novel.

In Spain, the glossy weekly *Blanco y Negro* had been established as an illustrated magazine already in 1891. In 1969 it was an independent publication similar to *Life* magazine or the *Paris Match*. On its January 11, 1969 cover it featured a full (green) moon shot by Apollo 8 with the caption: "La luna y la tierra en color.'. Inside, its main article 'De la tierra a la luna: El <<Apolo 8>> en la senda que soñara Jules Verne ' [From the Earth to the Moon: Apollo 8 on the track dreamt by Jules Verne] described this flight within the context of the great Frenchman's imaginary circumlunar flight a century earlier. Several photos of the moon and of Earth are shown, all in false colors, while pointing out the visible geographic features of the Hispanic world, most notably Andean South America and the Spanish Sahara.

Furthermore, both earthrise photos mentioned earlier were shown, with Earthrise in color over a whole page with the headline: La tierra aguarda a los bravos astronautas' [The Earth awaits the brave astronauts] (1969, p.26). Earthrise was further described as: 'el

horizonte de nuestro satéllite da a la imagen un marco de espectacularidad jamás soñado' [the horizon of our satellite provides a spectacular frame to the image never dreamt of]. This was a clear emotional recognition of a change in perspective. Yet there were no further emotions or reflections expressed about that we were looking at ourselves other than from a geographical perspective and what consequences that might entail. In two subsequent articles the personal adventures of the astronauts were recounted in 'La gran hazaña ha sido cumplido' [The great feat has been accomplished] as well as the history of spaceflight in 'La conquista del espacio' [The conquest of space].

In Italy, *La Domenica del Corriere* (the weekly magazine edition in color produced by the Milanese *Corriere della Sera* newspaper) published an Apollo 8 article in its January 14, 1969 issue with the headline 'E dopo la luna?' [And next the Moon?] (Goy 1969, 17-23). The article opened with Earthrise in color over a full page, yet with the lunar horizon vertically, and prominently, on the left and Earth on the lower right (the only time I have seen Earthrise portrayed like that – artistic license Italian style?). It also showed another Apollo 8 full Earth photo, both accompanied with rather factual descriptions. On its cover titled: 'Interroghiamo Il 1969,' however, spaceflight and the Apollo 8 astronauts featured only marginally. Also in this case there were no emotions or reflections American-style whatsoever.

In Central Europe things may have gone differently. Hungary, then under severe repression by the USSR, produced an Apollo 8 post stamp in 1969, which was perhaps a way of protesting Soviet occupation. In Yugoslavia, by contrast, which then tried to maintain a political balance between East and West as a 'non-aligned' country, the glossy magazine in Serbian *Politika* produced a January 12, 1969 special issue about the Apollo 8 flight that featured on its front page a color photo of the full Earth, no further information supplied. However, much like what happened in the *Bunte Illustrierte*, this was the whole Earth color photo taken in 1967 by the unmanned US ATS-III geostationary satellite. This image was accompanied by the famous quote from the great Russian space pioneer Konstantin Tsiolkovsky (1857-1935): 'Earth is the cradle of humanity, but one cannot remain in the cradle forever.'

Inside, a similar balance between East and West was maintained. On the one hand, the magazine featured a full two-page Earthrise photo accompanied by other Apollo pictures and text while describing the spaceflight and the astronauts' heroism without any further Earth-view related emotions or reflections. On the other hand, it also paid extensive attention to the achievements of Soviet spaceflight, while it placed both programs within a larger historical context. In doing so, the magazine kept its Yugoslavian readership remarkably well informed about what was happening in the world of spaceflight. The issue also featured a cartoon of the three astronauts standing in line in their space suits, all of them with crowns on top of their helmets. The first in line, Borman, is holding the moon in his hands as if he is offering it as a gift, without further explanation. Were the astronauts portrayed here as the Magi, the Kings from the East (in the astronauts' case: the 'Kings from the West'), bringing a gift to the newly born Jesus, an end to the Cold War, perhaps, starting a period of peace and prosperity? We may never know.

Whatever else may have occurred in the rest of the whole wide world, which also then represented by far the largest portion of humanity (in 1969 about 3.5 billion people, in 2019 more than 7 billion), is virtually unknown to me. My preliminary investigation has yielded that a few African countries produced commemorative post stamps, while a glossy magazine from Lebanon in Arabic published by the end of 1968 paid attention to the flight of Apollo 8 including an image of Earth from space as seen on television. But this is all extremely flimsy and fragmentary evidence. There must have been much more reporting. As a result, there is a great deal of room for further research,

and no room al all yet for any preliminary conclusions about what happened in this respect in the world at large.

All of these observations are, of course, no more than first impressions. It is unknown to me what further happened in Europe, most notably how all of this was received. Much more research is needed to provide a more substantiated view. Yet we should also keep in mind that all historical research is built on fragmentary sources, mine not excepted. But at least we now know that there was such reporting, and that none of that contained any of the emotional changes in perception that were expressed in American news media.

Yet also in Europe there was clearly such an emotional and cognitive impact among scientists and business leaders, which led to the establishment of the 'Club of Rome' in 1970. In fact, an earlier meeting on discussing global interconnected problems had already taken place in 1968, today described on their website as 'a monumental flop' (Club of Rome 2018). Yet in 1969 their meetings suddenly became much more focused. That was probably not a coincidence. However, in none of their writings have I found any mention of a change of Earth-related views. But that may not have been the right European thing to say then as now. One wonders how many of them may have been influenced by the US media reporting of the flight of Apollo 8.

Whatever the case may have been, already during the first official meeting in 1970 the Club of Rome commissioned the Massachusetts Institute of Technology to perform a computer study financed by the Volkswagen Foundation into what was called the 'present and future predicament of man,' none other than the planetary worries that had been stimulated by watching Earthrise. This US-European cooperation resulted in the famous 'Limits to Growth' report, which generated an extraordinarily amount of attention and discussion worldwide. Interestingly, the US version showed an Earth image on its cover surrounded by black space, while on the cover of the Dutch version Earth was totally lacking (Meadows 1972).

More recently Dutch public culture appears to be catching up with these developments, perhaps also stimulated by Dutch ESA astronaut André Kuipers' spaceflight of 2012 mentioned earlier. A few of such examples were mentioned in my public presentations in English about this subject in Salas and at Astron, Dwingeloo, the Netherlands, the latter now available on Vimeo (Spier 2018a&b). Yet in the United States today, such cultural expressions would appear 'old hat,' or so it seems to me. In 2018 several African countries, including Congo, Djibouti, Guinea, Guinea-Bissau, Mali, Mozambique, Niger, Togo, Sao Tomé and Príncipe, Sierra Leone as well as the islands St. Thomas and the Maldives all issued Apollo 8 commemoration stamps, and perhaps other countries as well. Are they also trying to catch up, one wonders? To my knowledge, none of such stamps have ever been issued in Western Europe, not in 1969, and not in 2018 either. And the US Postal Service has not yet issued such a stamp recently either.

Yet today, many adolescents from anywhere in the world that I have been in contact with through teaching and exchanges of various kinds appear to be sensitive to these now fifty-year old images. But that is only a very small and relatively well-educated fraction of the world population.

Conclusions

Although there is ample room for further research, it seems as if already during, and right after, the flight of Apollo 8 a considerable cultural divide developed between the United States and Europe, and within these continents as well, in terms of perceptions and emotions concerning photos of Earth at a distance. Among the better educated in the United States, a wide range of such perceptions emerged, varying

from religiously and spiritually inspired to changing academic views of Earth and environmental concerns. Yet a considerable portion of US citizens may completely have missed or ignored such views. Today, some impressions of this range of cultural responses within the United States can easily be found by typing in 'Earthrise' on a search engine or, for instance, on Amazon.com or Ebay.com.

Within Europe, by contrast, the cultural reactions were far more limited and less emotional, mostly limited to science and environmentalism. Furthermore, the percentage of people in Europe that were not influenced by these views, or only to a limited extent, may have been considerably larger than in the United States.

The first US academic responses, most notably cosmic evolution and similar approaches including serious academic big history, in principle combine well with the European academic traditions. Yet there has been a clear lack of such European academic responses so far to cosmic evolution and especially big history in Britain, France, and former Western Germany, where Earthrise and similar photos were displayed in the news media right after the flight of Apollo 8. By contrast, there have positive responses to academic big history in the Netherlands, where that was apparently far less the case. Today, in fact, the Netherlands has by far the highest big history density per capita of any country in the world. This suggests that the situation concerning the acceptation of big history is more complicated. As I argued elsewhere, the earlier academic cosmographic traditions of both Spain and the Netherlands may have provided such fertile ground for big history in both countries (Spier 2017).

In Europe, Earthrise and academic big history combine well, while in the United States a great many cosmic perspectives, of which academic big history is only one, have been combined with Earthrise and similar photos. Within the United States, religiously and spiritually inspired people, academics, and environmental and social activists have all claimed to derive their inspiration from Earthrise and similar pictures, while in Europe this has happened to a far lesser extent. This situation may have been contributing to recent transatlantic academic differences, including the remarkable variety of US citizens that have tried to promote their equally varied views of big history within the International Big History Association.

Yet even though the impact of these images has been very different depending on the social situations, there can be no doubt that Earthrise, often described as one of the most influential photos of the twentieth century, has had a huge, lasting, and very varied impact. As Richard Underwood, in charge of the Apollo photography, formulated it in 1997: 'It all ended up that nineteen cents worth of film became the most important part of a multi-billion dollar project. I think that is rather neat.'

Literature

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Appendix 1:
Inventory of Earthrise and whole Earth photos taken by the Apollo 8 crew

All the NASA Apollo 8 photo scans can be found at the *Project Apollo Archive* on *Flickr*, where NASA put them: https://www.flickr.com/photos/projectapollo-loarchive/albums.The Apollo 8 voice transcripts can be found at the *Apollo 8 Flight Journal*: https://history.nasa.gov/afj/ap08fj/index.html. The NASA *Analysis of Apollo 8 photography and visual observations* is available at: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19700005062.pdf.

The (in total) 862 photos taken by the Apollo 8 astronauts include 22 earthrises and 125 whole Earth photos. They jointly represent 17 percent of all the photos. None of those pictures were part of the official photo plan, even though most notably Richard Underwood had urged the astronauts to take such photos.

The Apollo Hasselblad photo magazines were specially constructed for the Apollo project to contain a 70 mm film that provided room for as many as 200 images.

1. Magazine 14/B

Photo Magazine 14/B contains a total of 152 color photos. The first two photos are the two famous Earthrise pictures AS08-14-2383 and AS08-14-2384, both taken with the Sonnar 250 mm telephoto lens during the fourth lunar orbit. The first Earthrise is the one most often reproduced. Right after these photos there are more four earthrises, all taken with the regular Planar 80 mm lens. These are numbered AS08-14-2385 to AS08-14-2388. These photos must have been taken during a later orbit, because on all of them the Earth is closer to the lunar surface than on Earthrise. These earthrises are followed by a set of eight similar pictures numbered AS08-14-2389 to AS08-14-2396, which must have been shot during a

subsequent orbit, for the same reason. Much farther down in the same magazine there is another series of eight earthrises numbered AS08-14-2510 to AS08-14-2517.

At what times were these other earthrises shot, and by whom? Below are my answers, based on scrutinizing those pictures as well as the astronauts' conversations.

Earthrises AS08-14-2384 to AS08-14-2387

During the fifth revolution, two hours later, according to the onboard voice recorder transcription at 77 hours, 36 minutes, 56 seconds MET, so almost exactly one lunar orbit after Earthrise had been shot, Bill Anders said: 'Okay, f – f:11. 250th' (This meant: lens aperture 11, shutter speed 1/250 second). This happened almost exactly at the time when the Earth came into view again, as shown on the four photos AS08-14-2384 to AS08-14-2387. Compared to Earthrise, the rotation of Earth and its cloud pattern as seen on these earthrises corresponds to a time difference of about two hours. It therefore seems likely that Bill Anders took those photographs during the fifth lunar orbit at the time mentioned.

Earthrises AS08-14-2388 to AS08-14-2396

During their seventh lunar orbit at 81 hours 21 minutes 45 seconds MET Bill Anders suggested:

> 'You've got color film. Why don't you get a picture of the earth as it comes up the next time?' About twenty-one minutes later, at 81:43:06 MET –exactly at the time when the Earth started rising above the lunar surface– Borman said: 'Oh, brother! Look at that!' Lovell: 'What was it?' Borman: 'Guess.' Lovell: 'Tsiolkovsky?' [a prominent crater]. Borman: 'No. It's the earth coming up.' Lovell: 'Oh.' Anders: 'Augh! Quit rocking the boat!'

These shots would have been the photos AS08-14-2388 to AS08-14-2396, this time presumably taken by Frank Borman. The Earth's further rotation seen on those pictures corresponds with about four hours' difference compared to the earlier four earthrises.

Earthrises AS08-14-2510 to AS08-14-2517

During their ninth orbit, starting at 85 hours 40 minutes 11 seconds MET, when again the Earth started appearing, the following conversation was recorded:

> Borman: 'Here it comes!' Anders: 'Okay.' Borman: 'Oh boy!' Lovell: 'Get a good shot of her?' Borman, 'Yes, see it?' Lovell: 'Well, keep the camera there, keep the camera.' Anders: 'Here it comes. Here it comes. But you're not on yet.' Anders: 'You got it – you got to do something.' Anders: 'Pitch up or yaw –.' Borman: 'Yaw right?' Anders: 'Yaw right.' Lovell: 'Oh Jesus.' Borman, 'Oh, I get it off this camera – window over here.' Anders: 'Okay.'

At that time, the astronauts were getting the TV camera ready for their second 'live' transmission from lunar orbit. But while doing so, they apparently also shot eight more Earthrises, AS08-14-2510 to AS08-14-2517. These images correspond well with Earth's further rotation of about 4 hours compared to the previous series. Again it may have been Frank Borman who took those photos.

Whole Earth photos

Fairly soon after the broadcast from lunar orbit nine had ended, or so it seems, the astronauts shot no fewer than seventeen pictures of Earth, AS08-14-2518 to AS08-14-2534. All of these pictures show a further rotation of Earth corresponding with a time period of less than two hours after the previous series of earthrises, now with mostly South America in view (where it stayed light longer than in North America because it was in the middle of the summer there).

However, no traces of taking such pictures can be found in the voice recordings.

2. Magazine 12/D

This magazine contains 171 black-and-white photos. Only one of them is an earthrise, AS08-12-2188. It must have been made during the fifth lunar orbit, around the same time as the four earthrises in color mentioned above, because its cloud pattern looks very similar to those photos. It is unclear who took it.

3. Magazine 13/E

This magazine contains 168 photos in black-and-white, including one earthrise photo: AS08-13-2329. On this photo the Earth is just coming up from the lunar horizon. Because its cloud pattern is virtually the same as on the famous two Earthrise photos, it must have been shot right before those pictures, presumably by Frank Borman, according to Robert Zimmerman (1998, p.173). At the end of this photo magazine there are fourteen whole Earth pictures, all shot with the 250 mm telephoto lens: AS08-13-2369 to AS08-13-2382. It is unknown to me who took them.

4. Magazine 15/F

This magazine contains 46 photos in color, all whole Earth photos taken from considerable distance, some of them shot with the 250 mm telephoto lens, but most with the 80 mm regular lens. Again it is unknown to me who took them.

5. Magazine 16/A

This magazine contains a total of 75 photos in color, 62 of them whole Earth photos, some from close by right after trans lunar injection. Also in this case it is unknown to me who took them.

Further comments

There is a discrepancy between the Magazine 14/B photos available on Flickr and the photos of that same Magazine shown in the NASA Analysis of Apollo 8 photography and visual observations (NASA 1969, p.205). The photos AS08-14-2481 and AS08-14-2482 in the online Magazine are shots of the moon, while in the NASA document they are photos of the Earth taken with the telephoto lens. Yet in the inventory of that the same document on p.142, these photos are described much like those that appear in the online Magazine. All the other photos and numbers in both versions of Magazine 14/B correspond well with each other.

The Analysis of Apollo 8 photography and visual observations prominently displayed Earthrise on its cover. Yet it contains no comments whatsoever about it, or about other earthrises and whole Earth photos, even though all three astronauts as well as Richard Underwood contributed to this document. All the attention was focused on the quality of the pictures as well as on what could be learned from that regarding future moon flights. Although this is understandable, given their mission, this totally ignores the huge social impact that those photos were having.

In the inventory of that document, both Earthrise photos at the beginning of Magazine 14/B are mentioned as: 'Earth above hor, good 250-mm' (NASA 1969, p.138). The other earthrises in Magazine 14/B are not mentioned at all, while only the whole Earth photos at the end of the Magazine are mentioned as 'Earth'. Their reproductions in the document are of poor quality, which makes it hard to recognize them. Their quality may have been better in the original document.

The Evolution of Earth Federation from a Cosmic Perspective

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Abstract

From a cosmic perspective, we are all citizens of the one small and lonely planet Earth, and we all face some major global challenges. Some of them may even threaten the future of our civilization, such as climate change and nuclear weapons, to name but two. These critical global problems need global solutions, and we need to work together to find solutions to them. Ideally, we need some form of Earth Federation, empowered to make binding laws and regulations to deal with these global issues. I will trace the history of the world federation concept, and discuss how it might be put into practice. Post-war efforts have always concentrated on reform of the United Nations, only to be stymied by the rigidity of the UN Charter. Meanwhile, Europe has shown the way, with the stage-by-stage evolution of the European Union, and has developed the basic principles upon which the Earth Federation should be based. I will discuss a possible alternative route to the goal, which follows the European example. A detailed discussion of a possible first step is discussed. It is suggested that the North Atlantic Treaty Organization be reformed to accept membership from democratic countries outside the North Atlantic area, to become a World Security Community of democratic nations. It could act as a strong right arm to the Security Council on the world stage. Such a community would form a natural starting point for the evolution over time of a genuine global parliament.

Key words: Earth Federation, world federation, global parliament, world security community, NATO.

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Introduction

All human beings, regardless of their nationality, have many fundamental interests in common, and face some enormous common problems, such as:

- Global warming and other forms of damage to the environment have become an alarming new threat to our children's heritage. This could be humanity's greatest challenge.
- Seventy years after World War II, mankind still faces a looming threat from nuclear weapons. There are still many thousands of nuclear warheads in existence, and if they all went off they could literally destroy human civilisation as we know it.
- Conflicts and wars have displaced around 69 million people, a number greater than the entire population of France, forced to abandon their homes or become refugees.
- Billions of the world's poor still face the ever-

present dangers of famine, disease and war. Each day, to our shame, many thousands of children still die needlessly.

- The basic human rights of many thousands of people are trampled on every day, without means of redress.

These global problems require global solutions. They can only be resolved if the peoples of the world work together to construct a system of binding international law and democratic global governance, which ideally should be based upon a democratically elected global parliament, or *Earth Federation*. The present United Nations is not adequate to the task. A recent article by Luis Cabrera (2017) has emphasized this conclusion anew, focusing particularly on the human rights aspect.

From a cosmic perspective, these conclusions seem obvious (Sagan 1994, White 2014), as emphasized in an inspiring recent article by Ian Crawford (2017). Several of the astronauts have commented, looking back at the Earth, that the artificial boundaries between nation-states are invisible from space. Rusty Schweickart, for example, said:

> "You look down there and you can't imagine how many borders and boundaries you cross, again and again and again, and you don't even see them. There you are – hundreds of people in the Mid-East killing each other over some imaginary lines that you're not even aware of … And from where you see it the thing is a whole, and it's so beautiful. You wish you could take one in each hand, one from each side in the various conflicts, and say 'Look, look at it from this perspective…'" (Schweickart 1977)

According to the popular TV and film series *Star Trek*, United Earth, also known as the World Government, was a planetary state created through the unification of Earth in the 22nd century, following First Contact with Vulcans in 2063. United Earth continued to exist as a member world of the United Federation of Planets when Earth helped found that interstellar state in 2161. From a cosmic perspective, it would be inconceivable that we should not speak with one voice in our first contacts with extraterrestrial beings, or try to export our petty and parochial national disputes and conflicts into space. Adlai Stevenson once commented:

> "We can never again be a squabbling band of nations before the awful majesty of outer space." (Stevenson 1965)

An earlier proponent was H.G. Wells, the godfather of 'Big History' in his attempt at a history of the whole planet, "The Outline of History" (1922). He was also a prophet of world government, with two books, "The World Set Free" (1914), and "The Shape of Things to Come" (1933). In a forceful summary of his beliefs, he wrote:

> "There can be little question that the attainment of a federation of all humanity, together with a sufficient measure of social justice, to ensure health, education, and a rough measure of equality of opportunity to most of the children born into the world, would mean such a release and increase of human energy as to open a new phase in human history." (Wells 1922)

Albert Einstein was also a world federalist, and spent much of the last ten years of his life arguing tirelessly for world government, co-authoring the Russell-Einstein manifesto, for instance. One of his famous quotes is:

> "In my opinion the only salvation for civilization and the human race lies in the creation of a world government, with security of nations founded upon law. As long as sovereign states continue to have separate armaments and armament secrets, new world wars will be inevitable." (quoted in Nathan and Nordern 1968)

The objectives of an Earth Federation would include:

- "To save succeeding generations from the scourge of war", i.e. to end all wars, and finally get rid of nuclear weapons;
- To preserve the global environment, and halt climate change;
- To guarantee fundamental human rights;
- To establish a system of binding international law;
- "To promote social progress and better standards of life in larger freedom."

In other words, the same aims as the United Nations, which has not been strong enough to achieve them!

The more difficult question is, *how do we get there from here?* World federalists have been grappling with this problem ever since World War II. The history of the world federalist movement is recounted, for instance, in books by Joseph Baratta (2004), and a recent detailed and in-depth discussion by Leinen and Bummel (2018). Uniting seven billion people in nearly two hundred countries – each jealous of its sovereignty – is an enormous task. Like climbing Mount Everest, it will not be achieved in a single giant bound. We will only get there gradually, through a series of base camps. In the Schuman Declaration (1950), the founding document of the European Union, it is stated for example that *"Europe will not be built in a day, or according to a single plan."* The same applies to the global system of governance.

Principles of an Earth Federation

It is probably more useful to set out the principles upon which a global parliament should be based (Hamer 1998), rather than try to specify the detailed form or structure it might eventually take. For these principles we rely heavily on the lessons learnt in the construction of the European Union. The preamble to the Maastricht Treaty (1992) mentions some important principles, although it gives no detailed exposition of them. It includes obvious principles like the rule of law, and respect for human rights. The Treaty also includes important new principles needed for the integration of the diverse European nations, such as:

Solidarity. Equity demands that all citizens be accorded equal rights and equal opportunities under the law, regardless of race, religion, gender or ethnicity. Hence springs the European policy of structural development funds, to bring the more economically backward member states up to speed with the others.

Subsidiarity. Decisions must be made as closely as possible to the individual citizens, to allow them to participate fully in the political process. This implies a multi-layered system of government in which local councils look after local affairs, and national governments retain sovereignty over their own internal affairs very much as they do at present. Only those matters which cannot be dealt with by a single nation acting alone become the province of the European parliament. This implies a federal system of government. Both of these principles would apply equally well to a future global parliament. Finally, there are two more important principles, which unfortunately are not mutually compatible at the global level at present. They are:

Democracy. To guard against autocracy and abuse of power, and to preserve the liberty and equality of all its citizens, the government must be chosen by means of free and fair elections, with guaranteed freedom of organized groups to stand in opposition to the government in power. Democracy is the only form of government with a 'safety valve', whereby the people can replace the government if it is doing a bad job.

Universality. Finally, if the global parliament is to deal successfully with global problems, it must in-

clude all of the world's nations, as the United Nations in essence already does. Universality was announced as the first principle of world federation at the great Montreux Congress of 1947 (Montreux 1947).

There is a major difficulty here, however, in that the principles of democracy and universality are not mutually compatible at present. Not all nations are democratic. The Freedom House group in the United States carries out a yearly rating of countries around the globe, based on a combination of political factors and civil liberties. They estimated in 2015 that 89 states were "free", 55 states were "partly free", and 51 states were "not free" (Freedom House 2015). In other words, less than half of all nations are fully democratic at present.

Could a global parliament include non-democratic states, putting the principle of universality first, or do we have to wait until all states become democratic, putting democracy first? We address this question in the next section. Suffice it to say that a fully-functioning global parliament including non-democratic states would involve intolerable anomalies, such as the violation of human rights under autocratic governments.

Pathways to an Earth Federation

There are some enormous obstacles to be overcome in the construction of a global parliament. The realist Hans Morgenthau, for instance, wrote in 1948 that:

> "The argument of the advocates of the world state is unanswerable. There can be no permanent international peace without a state coextensive with the confines of the political world." He argues, however, that such a world state is simply not feasible: "No society exists coextensive with the presumed range of a world state. The nation is the recipient of man's highest secular loyalties. Beyond it there are other nations, but no community for which man would be willing to act regardless of what he understands the interests of his own nation to be. In other words, the people of the world are not ready to accept world government, and their overriding loyalty to their own nation erects an insurmountable obstacle to its establishment." (Morgenthau 1973)

Times have changed since Morgenthau wrote these lines at the beginning of the Cold War, but nevertheless he correctly identifies the major roadblock to a world government.

So what then is the most likely route towards the ultimate goal of a global parliament? At least four possible routes have been identified (DWF).

a) Create a World Constitution.

According to this idea, we should immediately hold an international Convention to hammer out a Constitution for the proposed world federation, and then put it into practice, as at the founding of the United States. This is the strategy espoused by the World Constitution and Parliamentary Association, among many others.

The problem here is that the strategy presupposes general agreement that a world federation is necessary and desirable. That is unfortunately not the case, and a referendum would most likely show that only a few percent of the general public would say that we are ready for a world federation at present. A Constitutional Convention should be the last step in the integration process, not the first, and is hardly feasible at present in my view.

b) Integrate the Regions

According to this strategy, we should first concentrate on integrating the regions, following the European example, and then integrate the regions to form a world federation. The European federalists decided to concentrate on their own regional integration after the great Montreux Congress in 1947, and since then the evolution of the European Union has been emulated

by organisations such as the African Union and the South American union UNASUR, although the latter still remains largely on the drawing-board.

This strategy may succeed eventually, but it would be a long and difficult route, very hard to predict in detail. There are many fledgling regional organisations around the globe, but they are not developing very rapidly. The European Union itself is in some danger of unravelling at present, following Brexit. It would probably be better to work on parallel strategies which might reach the goal more quickly.

c) Transform the United Nations

The strategy here is to reform the United Nations, the peak global organisation we have at present, to become a genuine world federation. The present United Nations is far too weak to deal effectively with the global problems that beset us. We shall not enter here into the manifold shortcomings of the organisation. In essence, it follows a pattern dating back to the Congress of Vienna after Waterloo: an alliance of the great powers (the P5 in the Security Council) to keep the peace.

This is the most obvious strategy to follow, and it is the one which the world federalist movement (WFM-IGP) has concentrated on for seventy years, ever since World War II (Baratta 2004, Leinen and Bummel 2018). But always the campaign has run up against the great obstacle of the UN Charter. It is very difficult to amend, similar to a national constitution. It requires two-thirds of the member states and all five permanent members of the Security Council to approve any amendment. This is so hard to achieve, in fact, that no meaningful change has ever been made to the Charter. No Charter Review Conference has even been convened.

In these circumstances, the WFM-IGP has lowered its sights in recent years, and concentrated on reforms which do not require any change in the Charter. There they have had some very important successes. They have convened Coalitions of non-government organisations to campaign firstly, for an International Criminal Court, and secondly, for the doctrine of Responsibility to Protect. Both those campaigns have succeeded, and bolstered the structure of international law very significantly. But they do not address the structural problems of the UN organisation itself.

The most lively new initiative along this route is the Campaign for a United Nations Parliamentary Assembly (UNPA), which aims to inject at least an element of democratically elected parliamentary representation into the UN system. This campaign is led by its Global Coordinator, Andreas Bummel (see Leinen and Bummel 2018).

Nevertheless, the UN Charter presents a very daunting obstacle along this route. Broadly speaking, everybody agrees that the UN needs reform, but no two nations can agree on what those reforms should be. We should keep pushing along this route, but the prospects appear rather dim at present.

d) Unite the Democracies

This brings us to the final strategy, which is to begin by integrating the democratic nations first, and then bring in other nations later, as they adopt more democratic forms of government. This strategy emphasizes the principle of democracy before that of universality. An early proponent was Clarence Streit. In the final postwar edition of his book 'Union Now!' (Streit 1939), he advocated a union of democracies as a first step towards an eventual world federation. The Streit Council continues to advocate a union of democratic nations today.

This is the strategy most likely to succeed, in our opinion. There is no rigid Charter in the way, so change can proceed in an evolutionary fashion following the European example. We could start with an association with strictly limited aims linking some of the more

progressive nations – i.e. the democracies – and then build from there, progressively expanding functions, developing institutions, and including more members, until a democratic Earth Federation is eventually achieved.

The European example

Historically, there have been calls for European integration over some 600 years (Hamer 1998, Baratta 2004), For example, William Penn called for a European Parliament in 1692, George Washington predicted the creation of a United States of Europe after the foundation of the United States of America (Millard 1969), and Victor Hugo gave a slashing speech calling for the same objective at the first Paris Peace Conference in 1849.

Then came World War II, which was the fifth major war between France and Germany in 200 years, and resulted in around 55 million dead, or about 3% of the entire world's population at the time! Leaders in Europe determined that it must never happen again, and recognized that integration between the nations of Europe was the way to prevent it.

Jean Monnet and his colleagues, such as Robert Schuman, Konrad Adenauer, Paul-Henri Spaak, Alcide De Gasperi and Altieri Spinelli, devised an effective strategy. They started with a smaller group of 'progressive' states (the 'Six'), and established a community with a limited aim to unite the coal and steel industries of Europe, in the form of the European Coal and Steel Community. They then evolved step-by-step through a series of Treaties to build first the European Economic Community, and finally the present European Union and European Parliament, which now embraces twenty-eight nation-states and nearly 500 million inhabitants.

Their ultimate aim of a European Federation has still not been achieved in full, and the EU is going through some severe trials and tribulations at the present time (e.g. Brexit), but the great original objective is now secure. There will never again be a war between France and Germany.

The question then arises, can we do something similar at the global level? The first step would seem to be the formation of a *community* on the European model, rather than the more ambitious target of a union or federation. Hence we are led to propose a world community of democratic nations.

Now we come to what is likely to be a much more contentious question, namely, what should be the basis or purpose of such a community? Ideally, it should be economic, and have a strong impact on the daily life of the community in order to attract new members, following the European model. But there seems little call at present for a community based on free trade, like the EEC. The world has been pursuing free trade agreements ever since World War II, and the last Doha Round ended in failure. At present, the nations are mostly pursuing bilateral rather than multilateral agreements.

At the present time, there is a much more obvious need for a community based on common security, a world security community of democracies. The US tried for a time recently to act as 'global policeman' on its own, and has had its fingers severely burnt in most cases. It led interventions in Afghanistan, Iraq, Libya and Syria which cost huge amounts of money and left chaos behind them, as witness the present maelstrom in the Middle East. It is now widely recognized that the US needs to work much more closely with its democratic friends and allies. Hence the formation of a security community made up of the democracies would be a natural next step. Such a community would provide a virtually unchallengeable guarantee of security for its members, and could also provide a strong right arm for the United Nations in security and peacekeeping missions in the wider world.

In the following we will discuss a more detailed proposal of this type. It is proposed that NATO and the OECD should be reconstituted as two arms of a new *World Security Community of democratic nations*.

Proposal and Objectives

The proposal then consists of the following basic elements:

- Refocus NATO to give it a global mission, first to guarantee the security and freedom of all its members, and then to act as their security and peacekeeping arm in the wider world, under the aegis of the UN.
- Open membership to stable democracies outside North America and Europe, e.g. Japan, South Korea, Australia, and New Zealand. Eventually membership of the Community should be opened to any stable, democratic nation, subject to suitable criteria laid down by the existing member states. In the long run, it is envisaged that the organization will become universal, as democracy spreads to the rest of the globe;
- An explicit declaration should be made that the new community will only intervene forcibly in external states if authorized to do so by the UN Security Council, in accordance with international law;
- Alter the dysfunctional decision-making system within NATO, preferably at all levels, to a 'qualified-majority voting with opt-out' system, as advocated previously by a group of senior military men, all former chiefs of staff in their respective countries (Jones 2007, Naumann et al. 2007). To avoid indecision and deadlock, decisions on functional matters within the agreed competence of the organization should be made by some form of qualified-majority voting – unlike the consensus which is customarily required in NATO today. Such a scheme has been used by the European Union. This would transform the alliance into a '*security community'*, which might be named the *World Security Community of democratic nations.*
- Channel funds to foster development in the more backward member states under the principle of "solidarity" established by the European Union. This would promote a feeling of community among the member states, and provide a strong incentive for new states to join in. This function could perhaps be undertaken by adding in the OECD, which has a very similar membership, as a second arm of the community.
- Restructure the organization with appropriate organs of democratic governance, following the pattern established by the European Union:
  - A North Atlantic Council already exists, representing the member states. Instead of consensus decision-making, it should adopt a 'qualified majority' voting system, as above.
  - A NATO Parliamentary Assembly already exists, as the basis for a democratic chamber, but its official recognition is low;
  - A Court needs to be established, to settle differences over the interpretation of the founding treaty, and settle disputes between the member states on the basis of international law. This would form the embryo of an eventual legal system;
  - A bureaucracy in Brussels already exists, headed by the Secretary-General, and the regular budget of NATO is about $6 billion per annum, which is already larger than the UN core budget.

Such an association would be much more flexible than the UN, able to change and grow through successive treaties, and could indeed form the nucleus for an eventual system of democratic global governance.

Benefits

The Community could evolve over time, following the European example, into a full-blown Earth Federation or global parliament. Meanwhile, the Community would bring some major benefits in terms of global peace and security.

Firstly, it would provide a virtually ironclad guarantee against external attack for its expanded and growing list of members. It would enable them to share the burden and the responsibility, and pool their resources, in carrying out peacebuilding and security operations on the world stage. It would also provide a new legal framework for settling international disputes between members in a peaceful fashion.

It would cure the dysfunctional decision-making procedure presently operative within NATO, as has been recommended in the past by senior military men (Jones 2007, Naumann et al. 2007). It would also give NATO (and possibly the OECD) an extended and hugely important mission for the future.

Acting in tandem with the UN, the new Community could bring important benefits to the wider world community. Acting strictly at the behest of the Security Council, the Community would provide a powerful means of enforcement for the resolutions of the Council. It could play a role very like that originally envisaged for a standing security force under Article 47 of the UN Charter. It would only intervene in an external state if authorized to do so by the Council; but conversely, like its member states, it would be obliged to lend support to any security enforcement actions which were in fact mandated by the Security Council, under article 43 of the Charter. It would thus provide a strong right arm to back up any security actions of the UN.

Furthermore, the new Community could quite easily set up rapid reaction units to carry out the role advocated for UNEPS, the proposed UN Emergency Peace Service. It could and should also set up mechanisms to prevent future conflicts, and to reconstruct failed states after conflict, in conjunction with the new Peacebuilding Commission at the UN. This would follow the outstanding example of the Marshall Plan after World War II. It would give the new Community a very positive role to play in healing the wounds created by armed conflict, something conspicuously absent after the recent overthrow of regimes in Iraq and Libya.

Thus the UN and the Community together would make up a greatly strengthened and more effective system of common security and international governance.

Political considerations

What is the likelihood of acceptance of such a scheme? Let us consider this question from various viewpoints.

a) **The United States**

One of the Republican contenders for the U.S. Presidency in 2008, John McCain, caused quite a stir when he proposed the formation of a '*League of Democracies'* in order to build an enduring peace based on freedom (McCain 2007). *"We Americans must be willing to listen to the collective will of our democratic allies,"* he said. On the Democratic side, Ivo Daalder, formerly the U.S. Permanent Representative on the Council of NATO, together with James Lindsay, proposed a '*Concert of Democracies'* in order to form *an "international institution capable of prompt and effective action both to prevent, and where necessary respond to threats to international security"* (Daalder 2007). The idea of a Concert of Democracies was also promoted in an authoritative, bipartisan report from the Princeton Project (2006), *"Forging a World of Liberty under Law"*. So it seems

there could be support for such ideas from both sides of politics in the U.S.

The main advantage for the US would be the opportunity to share with its partners the burden and responsibility of acting as 'global policeman', which no single nation has the right to assume in any case. In these times of financial stringency, the cost is a major consideration. In recent years, the astronomical cost of the wars in Iraq and Afghanistan, plus an expenditure on armaments roughly equivalent to the rest of the world put together, has taken a heavy toll on the US budget, so that the national debt now stands around 100% of GDP. Action to cut costs needs to be taken urgently, and sharing more of the security burden would help enormously. A move towards shared responsibility and collective security is clearly the right thing to do in any case.

The fact that spokesmen on both sides of US politics have advocated somewhat similar ideas indicates that a scheme of this sort should have a good chance of acceptance in the US, and if the US leads the way, the other members of NATO and the OECD are very likely to follow. The advent of the Trump administration has thrown all such calculations into doubt, of course, but President Trump has shown himself very keen to get the other members of NATO to shoulder more of the burden, and this scheme should help him to do that.

b) Europe

Europeans have already had long experience with transnational cooperation through the European Union. The Chancellor of Germany, Angela Merkel, is very much in favour of multilateral cooperation, as is the President of France, Emmanuel Macron. An ex-prime-minister of France, Edouard Balladur, has gone so far as to suggest a full union between the USA and Europe to deal with the full range of global foreign policy issues (Balladur 2007).

Despite this, the Europeans have apparently been very wary of the idea of a 'global NATO', being fearful of being dragged into neo-imperialist adventures under the dominance of the United States. These fears would be answered by an explicit declaration that the new Community would never use force to intervene in an external state unless authorized to do so by the Security Council, or else if it was itself under external attack. Furthermore, under a qualified majority voting scheme the US would have the largest voice, but by no means a dominant voice, in the councils of the Community. The introduction of qualified majority voting would give the Europeans a full voice in the decisions of the Community.

Very recently, debate has been revived in Europe as to whether a European army should be set up. Jean-Claude Juncker, the President of the European Commission, called for the EU to create a "common military force", including a command headquarters in Brussels. *"We have to take responsibility for protecting ourselves and the European way of life",* he said (Juncker 2016). Britain has always been firmly opposed to this idea, but now that the Brexit vote has taken place, this impediment has been removed. The Eastern Europeans are also opposed, being more concerned that the Atlantic alliance, i.e. NATO, should reinforce its presence in the East as bulwark against the perceived Russian threat. NATO has indeed agreed to station four battalions in the Baltic states and Eastern Poland (Stoltenberg 2016).

Establishment of the Community would probably settle the long-running debate as to whether Europe should build up its own armed forces for external defence. Europe would be able to rely on the Community for its external defence, and thereby save a considerable amount of money.

c) Sweden

Sweden is an example of a neutral state within

Europe, and is not currently a member of NATO. There has been considerable internal debate, however, as to whether Sweden should in fact join NATO, and this has been fuelled recently by the revanchist behaviour of Russia. If NATO were to become a global security community, in conjunction with the UN, that might very well tip the balance and persuade neutral states such as Sweden to join the new organisation.

d) **Russia and China**

During the Cold War, the USSR looked on NATO with fear and suspicion, regarding it as a tool of the Western democracies and a threat to their very existence. Russia evidently continues to hold that viewpoint today. But if the new Community could only intervene externally when authorized by the Security Council to do so, then Russia would effectively have a veto over Community operations in the outside world. This should allay any Russian fears, especially when combined with the promise that they could eventually earn entry into the Community themselves. Similar remarks would apply to China, albeit to a lesser extent.

Possible Problems

a) Polarization of the international community

Non-member states of the new Community may feel excluded, and suspicious of the motives behind it. If the Community interfered in their affairs, they would feel resentful, and would tend to regard the Community as an "enemy", creating a split between "us" and "them". Such a polarization of the international community should be avoided at all costs.

Thus it would be important to make overtures to non-members, as the far-seeing Harmel Report recommended for NATO many years ago (Harmel 1967). It should be emphasized that membership of the Community is open to all countries, provided only that they satisfy suitable criteria for democratic governance and peaceful relations with their neighbours.

Furthermore, we have emphasized that the Community should guarantee never to undertake a military intervention in a non-member country, unless authorized to do so by the Security Council of the UN.

This might be a somewhat contentious issue in some quarters in the US, for instance, because it would place restrictions on the role the Community could play in serving US interests. It would even give Russia and China a veto over the external interventions of the Community. But in fact such a policy is obligatory under international law, as laid down in the UN Charter (Articles 2 & 42). It would also allay fears in Russia and China that the new Community was aimed against them.

b) Conflict with the role of the UN

A related problem is that the Community might be seen as competing with the role of the UN, in that both would be global security organizations. It will be vitally important to demonstrate that the Community would function in a manner complementary to the UN, rather than competing with it. Again, the Community should only intervene in a non-member state at the behest of the Security Council. The forces at the Community's disposal would then provide powerful reinforcement to the decisions of the Security Council. In fact, they would effectively supply the place of the standing armed forces originally envisaged for the UN under Article 47 of the Charter.

In summary, far from conflicting with the role of the UN, the new Community would fit in very neatly as the Security Council's strong right arm.

c) **Forcing 'Western' values on other cultures**

It might be charged that requiring democracy of new members is tantamount to forcing Western ideas

of government onto what is meant to be a global community. But that is not a sustainable argument. Government *"of the people, by the people, for the people"* is a universal concept, not a purely Western one, and the thriving democracies in Japan and India are convincing examples of this. As more non-Western members join the Community, these fears should quickly be allayed.

Conclusions

In summary, the new Community would bring many benefits. It would cure some of the major problems within the present NATO system. It would produce a powerful new global security community, which acting in tandem with the Security Council would be a strong force for peace and freedom in the world.

Spokesmen on both sides of politics in the US have put forward similar schemes in the past, so there is a good chance that a plan of this sort would be acceptable to the USA. The Europeans would most likely be happy to follow, and so the proposal could have a realistic chance of being implemented.

If the Community is open to new members, subject to suitable criteria of democracy and peaceful relations with their neighbours, then one can envisage many new members joining up, attracted by the prospect of new structural development funds coming their way. The membership could soon include the majority of the world's nations, as more countries become democratic. Eventually, one may hope that membership in the Community would become universal.

With the addition of a Court, and the adoption of qualified majority voting, the association would become a community on the European model. It would provide a convenient forum for discussion and the making of common policy on matters beyond the security sphere, including trade, finance and the environment.

In time to come, one can envisage the Community evolving into a full-blown system of democratic global governance. That is "the light on the hill" for those of us who regard themselves as world citizens. From the cosmic perspective, as we reach for the stars we need to be able to speak with a single voice, and act together through a better and more effective system of global governance, one which will uphold the basic principles of democracy and human rights on the worldwide stage.

What could we do as global citizens to help implement this strategy? The world federalist movement WFM-IGP has found a successful strategy, forming large Coalitions of NGOs in support, first of all, of an International Criminal Court, and secondly, of the UN doctrine of Responsibility to Protect. Both of these campaigns achieved success in a relatively short time. Correspondingly, a new Coalition for a World Security Community of democratic nations (CWSC) is being set up as we speak.

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Widening Perspectives: The Intellectual and Social Benefits of Astrobiology, Big History, and the Exploration of Space

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Abstract

Astrobiology is the field of science devoted to searching for life elsewhere in the Universe. It is inherently interdisciplinary, integrating results from multiple fields of science, and in this respect has strong synergies with 'big history'. I argue that big history and astrobiology are both acting to widen human perspectives in intellectually and socially beneficial directions, especially by enhancing public awareness of cosmic and evolutionary worldviews. I will further argue that these perspectives have important implications for the social and political organisation of humanity, including the eventual political unification of our planet. Astrobiology and big history are also concerned with the future of humanity, and I will argue that this future will be culturally and intellectually enriched if it includes the exploration of the universe around us.

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> It is only when the different scientific disciplines and the different specialities choose to interact, and only when all cultures and states recognize that they have common interests, that humanity can evolve towards one single co-operative society. (Aerts et al., 1994; p. 20)

Introduction

Astrobiology and 'big history' are two relatively new intellectual disciplines, the former focussed on searching for life elsewhere in the universe and the latter on integrating human history with the wider history of the cosmos. Despite some differences in emphasis these two disciplines share much in common, not least their interdisciplinarity and the cosmic and evolutionary perspectives that they both engender. In this essay I will explore the relationships between astrobiology and big history and argue that both are acting to widen human perspectives in intellectually and socially beneficial directions. These include stimulating the (partial) re-integration of scientific disciplines after a period of extreme specialisation, and the (again partial) breaking down of barriers that exist between the sciences and the humanities. In addition, both disciplines act to enhance public awareness of cosmic and evolutionary perspectives which, I will argue, constitute a strong, if implicit, argument for the eventual political unification of humanity. Astrobiology and big history are also concerned with the *future* of humanity, and I will make the case that the future will be culturally and intellectually richer if it includes an ambitious programme of space exploration. Not only will the exploration of space further reinforce socially beneficial cosmic perspectives, but ultimately it may be the only way for human (and post-human) societies to avoid the intellectual stagnation once predicted for the 'End of History'.

Astrobiology and Big History

The International Big History Association adopts the following working definition for the discipline:

> Big History seeks to understand the integrated history of the cosmos, Earth, life and humanity, using the best available evidence and scholarly methods.[1]

This is strikingly similar to a common working definition of the comparably recent discipline of astrobiology:

> The scientific study of the possible origin, distribution, evolution, and future of life in the universe, including that on Earth, using a combination of methods from biology, chemistry, and astronomy.[2]

Although the term "astrobiology" dates from 1953 (see, e.g., Cockell, 2001), it is only in the last 25 years or so that it has become firmly established as a scientific discipline, with the appearance of dedicated textbooks, journals, and university courses. The field is inherently interdisciplinary because any serious attempt to understand the prevalence and distribution of life in the universe requires familiarity with, at least, the established scientific disciplines of astronomy, biology, chemistry and geology (as well as established interdisciplinary combinations among these sciences, e.g., astrophysics, biochemistry, evolutionary biology, geochemistry, palaeontology, and planetary science). In order to illustrate the interdisciplinary nature of astrobiology more clearly, Table 1 summarises the syllabus of the undergraduate module "Introduction to Astrobiology" that the author has taught at Birkbeck College, University of London, since 2004.[3]

Table 1

Week	Topic	Most relevant scientific field(s)
1	Origin and distribution of the chemical elements	Astronomy/Astrophysics
2	Conditions in the early Solar System	Astronomy, Planetary science
3	Earliest evidence for life on Earth	Geology, Palaeontology
4	Biological basics	Biology, Biochemistry
5	Pre-biological chemical evolution/Origin of life	Geochemistry, Biology, Biochemistry
6	History of life on Earth	Palaeontology/Evolutionary biology
7	Requirements for life	Biology/Biochemistry/Geochemistry
8	Prospects for life on Mars	Planetary science/Geochemistry/Biology
9	Life elsewhere in the Solar System	Planetary science/Geochemistry/Biology
10	Detection and habitability of exoplanets	Astronomy/Planetary science
11	Search for extraterrestrial intelligence	Astronomy

Table 1: Syllabus of the Birkbeck College "Introduction to Astrobiology" module (each week comprises three hours of face-to-face teaching).

1 https://bighistory.org/ (accessed 18 November, 2018); see also Rodrigue (2017).

2 https://www.thefreedictionary.com/astrobiology (accessed 18 November, 2018).

3 http://www.bbk.ac.uk/study/modules/easc/EASC064H5 (accessed 18 November, 2018).

A glance at Table 1 indicates that approximately half of this undergraduate astrobiology module could equally be described as big history[4]. With the exception of the material covered in Week 4, which is included to ensure that non-biology students are familiar with at least the basics of biological knowledge, the material covered in Weeks 1-6 is all essentially 'historical' in nature (albeit invoking a range of scientific disciplines) and is invariably covered in the first few chapters of standard big history texts (e.g. Christian, 2004, 2018; Brown, 2007; Christian et al., 2014; Spier, 2015). After this point astrobiology necessarily diverges from big history, with the former branching out to look for life elsewhere in the Universe while the latter continues the historical narrative to include the evolution of *Homo sapiens*, human societies and human culture.

The links between astrobiology and big history may be further illustrated by means of a personal anecdote: the first half of the astrobiology syllabus outlined in Table 1 is based on an earlier course entitled "Cosmic Perspectives for World History" that I devised for the City University's extramural programme in 1994 (see Figure 1). At the time I was unaware of big history as such, although Christian (1991) had already coined the term. I was, however, partly inspired by G.S. Kutter's (1986) book *The Universe and Life*, which is often identified as a big history precursor (Rodrigue, 2017). In retrospect, it is clear that this early 'Cosmic Perspectives' course, which in time led to the Birkbeck College undergraduate module in astrobiology, was big history in all but name. This anecdote reinforces observations already made by others that the early years of big history were characterised by individuals and small groups working independently. It seems that by the late 20th century big history was an idea whose 'time had come', although of course the subject has much deeper roots (see, e.g., Spier, 2015; Rodrigue, 2017; Katerberg, 2018).[5]

4 See also Dick (2018), pp. 169, 235, 311.

5 If I may be permitted an additional personal anecdote: having had the proposal for a course on 'Cosmic Perspectives' accepted by the City University in 1993, I started writing it while working at the Anglo-Australian Observatory, then based in Epping, a northern suburb of Sydney. This was (almost literally!) a stone's throw from Macquarie University, where David Christian was already developing his big history perspective, although neither of us knew of each other's existence.

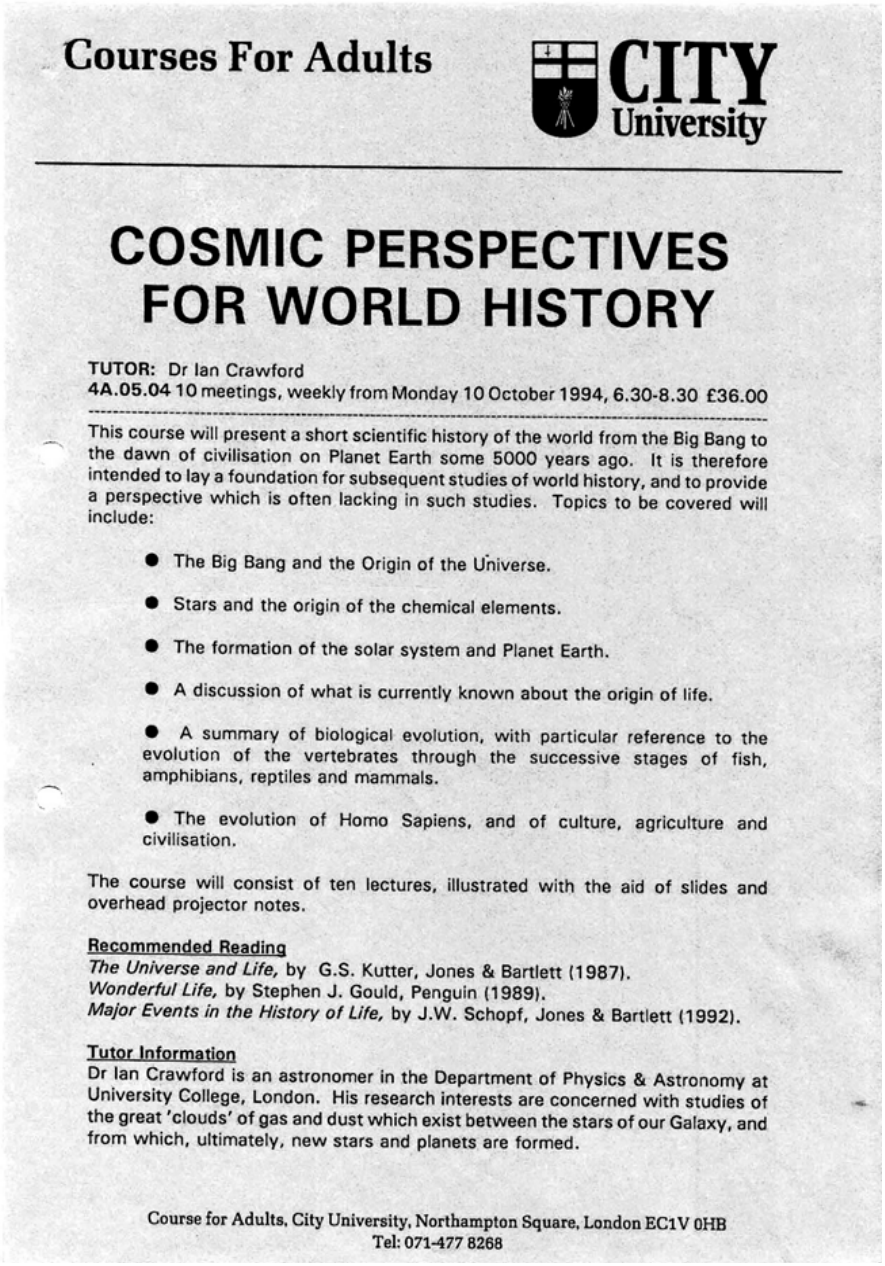
William Katerberg (2018) has recently argued that the academic fields closest to big history are deep history (where 'deep' here refers to human pre-history), evolutionary history, and ecological economics. Based on the discussion above, however, I suggest that astrobiology is an even closer match, both in terms of content and perspective (where there is considerable overlap), but also in the way both disciplines have struggled, eventually successfully, for academic recognition over the last quarter of a century.

Much more important than the origins of interdisciplinary subjects like astrobiology and big history, however, is the extent to which they can have lasting intellectual and societal benefits. Because the academic and intellectual benefits of these subjects, and what I perceive as their wider societal benefits, are rather different (albeit interconnected) they will be addressed separately below.

Intellectual Benefits of Big History and Astrobiology[6]

The main academic and intellectual benefits of both astrobiology and big history (and related disciplines) arise from their inherent interdisciplinarity. In the case of astrobiology these benefits have already been noted by several authors (e.g., Connell et al., 2000; Race et al., 2012), and mostly result from interactions between scientific disciplines. For example, astrobiology forces astronomers to work with biologists and geologists in the pursuit of finding life elsewhere in the universe. By producing broadly knowledgeable scientists, familiar with multiple aspects of the natural world, astrobiology

6 The astrobiology side of the discussion in the following two sections draws on an earlier publication (Crawford, 2018a).



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TUTOR: Dr Ian Crawford
4A.05.04 10 meetings, weekly from Monday 10 October 1994, 6.30-8.30 £36.00

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Recommended Reading
The Universe and Life, by G.S. Kutter, Jones & Bartlett (1987).
Wonderful Life, by Stephen J. Gould, Penguin (1989).
Major Events in the History of Life, by J.W. Schopf, Jones & Bartlett (1992).

Tutor Information
Dr Ian Crawford is an astronomer in the Department of Physics & Astronomy at University College, London. His research interests are concerned with studies of the great 'clouds' of gas and dust which exist between the stars of our Galaxy, and from which, ultimately, new stars and planets are formed.

Course for Adults, City University, Northampton Square, London EC1V 0HB
Tel: 071-477 8268

Figure 1. The syllabus of a course on "Cosmic Perspectives for World History" taught by the author at the City University, London, in the academic years 1994-95 and 1995-96. Image by the author.

is therefore helping to re-unify the sciences after a long period of intense specialization. Moreover, by considering questions related to the philosophical and cultural implications of the discovery (or non-discovery) of extraterrestrial life, astrobiology is also stimulating intellectual activity outside the normal scope of the physical sciences, including theoretical work in anthropology, ethics, linguistics, philosophy, and theology (e.g., Bertka, 2009; Dick & Lupisella, 2009; Race et al., 2012; Dunér et al., 2013; Impey et al., 2013; Vakoch, 2013, 2014; Dick, 2018). To this extent, astrobiology is well-placed, if only partially, to help heal the rift between science and the humanities identified sixty years ago by C.P. Snow in his famous 1959 Rede Lecture at the University of Cambridge (Snow, 1963; pp. 1-51).

Similar arguments have been advanced for big history, although there are some differences in emphasis (e.g. Christian, this volume). Big history clearly has the potential to stimulate research activity in the natural sciences, on which it relies for much of its historical narrative, but in origin, and perhaps especially in outlook, big history is closer to the humanities than interdisciplinary natural sciences such as astrobiology. To my mind, this strengthens the synergies between them, not least because it means that big history is even better placed to bridge Snow's "two cultures" divide.

The synergies between big history and astrobiology are perhaps most apparent when it comes to interdisciplinary education, and this may indeed prove to be one of the most important legacies of both disciplines. Snow himself explicitly recognized the importance of interdisciplinary education when he returned to the problem of the "two cultures" with *Two Cultures: A Second Look* (Snow, 1963; p. 61):

> In the conditions of our age, or any age which we can foresee, Renaissance man is not possible. But we can do something. The chief means open to us is education. … There is no excuse for letting another generation be as vastly ignorant, or as devoid of understanding and sympathy, as we are ourselves.

Interestingly, in the same year as Snow's *Second Look* appeared, the astronomer Harlow Shapley also made a powerful plea for interdisciplinary education. Shapley went as far as to characterise the 'vertical' separation of academic disciplines as "education-defeating" (Shapley, 1963; p. 134) and proposed that an ideal undergraduate historical curriculum

> would present the history of the universe and mankind as deduced from geology, cosmogony, paleontology, anthropology, comparative neurology, political history, and so on. … wide integration is the essential key (Shapley, 1963; pp. 135-6).

In 2009, the art historian Martin Kemp contributed an article in the scientific journal *Nature* to mark the 50th anniversary of Snow's original lecture. He concluded that the main problem was not so much a division between "two monolithic 'cultures' of science and humanities", but the "narrow specialisation of all disciplines." As he put it (Kemp, 2009):

> It is the perceived need for intense specialization of any kind – in history or physics, in languages or biology – that needs to be tackled. …. What is needed is an education that inculcates a broad mutual understanding of the nature of the various fields of research.

This line of thinking has been taken up by others. For example, in an article stressing the desirability of producing scientifically minded citizens, Erika Offerdahl (2013) observed:

> The structure of undergraduate curricula and courses tends to compartmentalize science into discrete disciplines that focus on particular questions rather than an integrated, interdisciplinary way of understanding the world, let alone any discussion of the societal implications of the science.

If nothing else, big history (and related interdisciplinary subjects such as astrobiology) can provide *exactly* this kind of interdisciplinary education, and do so in a manner that students of all ages find very engaging (e.g., Chaisson, 2014; Katerberg, 2018; Voros, 2018; Bohan, this volume). As Snow (1963; p. 61) himself noted, this will necessitate revising school and university curricula around the world, but the benefits of doing so are likely to be considerable (e.g., Katerberg, 2018; Bohan, this volume; Christian, this volume).

Expanding Worldviews

Transcending the academic, intellectual, and even practical benefits of a broadly-educated citizenry, the *perspectives* provided by astrobiology and big history may result in positive influences over a wide range of societal and political concerns. In an earlier article (Crawford, 2018a), I argued that wider public engagement with, and knowledge of, the topics covered by astrobiology (Table 1) would lead to beneficial social and political consequences. Based on the discussion above, it seems clear that these arguments are even stronger in the case of big history, which covers much of the same ground while explicitly articulating an evolutionary perspective rooted in deep time.

The key point relates to the broadening and deepening of worldviews resulting from increased public awareness of cosmic and evolutionary perspectives. Here, I adopt the definition of a worldview given by Diederik Aerts and colleagues in their excellent and important monograph on *World*

Views: From Fragmentation to Integration (Aerts et al., 1994; p. 9):

> A world view is a system of co-ordinates or a frame of reference in which everything presented to us by our diverse experiences can be placed. It is a symbolic system of representation that allows us to integrate everything we know about the world and ourselves into a global picture, one that illuminates reality as it is presented to us within a certain culture.

Aerts et al. (p. 8) also note that:

> World views …. have a strongly motivating and inspiring function. A socially shared view of the whole gives a culture a sense of direction, confidence and self-esteem.

Unfortunately, at present, and in some quarters increasingly, the worldviews of many people are dominated by narrow nationalistic and religious ideologies. Although historically some of these restrictive, and often mutually exclusive, worldviews may have had (local) societal benefits, and a propensity to hold them may have evolved naturally through group selection in humanity's distant past (e.g. Wallace, 1871, p.313; Darwin, 1874, p. 64; Wilson, 2012), they are potentially disastrous at a time of growing global interdependence. Our world faces many global problems (including, but not limited to, proliferation of weapons of mass destruction, climate change, pollution, loss of biodiversity, over exploitation of the 'global commons', and insufficient provision of food, water and sanitation for millions of people) that can only be satisfactorily addressed through concerted global action. However, meaningful global action will be, and is being, impeded by nationalistic and other essentially tribal worldviews, in which a sense of global identity and responsibility is lacking (or even denied). As Aerts et al. (p. 5) put it:

> It is our conviction that the time has come to make a conscious effort towards the construction of global world views, in order to overcome this situation of fragmentation. … It is precisely because we lack such global views of the world that our ability even to start looking for lasting solutions to these problems is limited.

There is therefore a pressing need to find unifying cosmopolitan perspectives that can counter the divisive and exclusionary worldviews of the past. In identifying such unifying worldviews, it will be essential that they are based on factual foundations that everyone can accept, and this is where big history and related disciplines are well-placed to help.

Spier (2016) has argued that big history should not be taken as an all-embracing worldview from which ethical implications can legitimately be drawn. He is undoubtedly correct that normative considerations cannot logically be derived from a factual history of the Universe such as big history seeks to provide. However, this does not mean that big history cannot provide a worldview (or, at least, part of a worldview) in the sense developed by Aerts et al. (1994), and that this worldview, once grasped, will not influence human behaviour. Indeed, the recognition that fact-based universal histories have ethical, and even political, implications has long been a significant motivation for constructing them. For example, in 1844 Robert Chambers published (anonymously) his *Vestiges of the Natural History of Creation*, which is perhaps the first serious attempt to create a (pre-Darwinian) evolutionary history of the Universe and humanity's place within it. Chambers himself certainly saw it as such, writing (p. 388):

> As far as I am aware [my book] is the first attempt to connect the natural sciences to a history of creation…. My sincere desire … was to give the true view of the history of nature.

Vestiges caused a huge sensation at the time (Secord, 2000), and the following year Chambers felt the need to offer some 'Explanations' (Chambers, 1845). In the

course of this (p. 184) he explicitly drew the ethical implication that the "new view of nature" articulated in *Vestiges* could contribute to:

> Establishing the universal brotherhood and social communion of man. And not only this, but it extends the principle of humanity to the other meaner creatures also. Life is everywhere ONE.[7]

This quotation is especially significant because it shows that Chambers was concerned not just with laying a foundation for "the universal brotherhood and social communion of man", but also his expectation that a proper understanding of cosmic and evolutionary perspectives would have ethical implications for relations with other living things (and to this extent anticipates Peter Singer's (1981) concept of an 'expanding circle' of ethical progress).

The year following the publication of *Vestiges*, Alexander von Humboldt (1845) published his first volume of *Cosmos*, which also combined many different aspects of knowledge into an integrated view of humanity's place in the universe (albeit without the evolutionary emphasis of *Vestiges*). Humboldt's perspective was also seen to have unifying societal implications by at least some contemporaries, with the American physician and author James Whelpley (1846) noting that "the individual is made to feel that he is connected, by the very nature and substance of his body, with every part of the universe", and drawing the implication (p. 603) that:

> If the world is ever to be harmonized it must be through a community of knowledge, for there is no other universal or non-exclusive principle in the nature of man.

It appears that Whelpley had a sense that humanity might be able to "harmonize" itself socially and politically if it could only agree on a common integrated worldview of the kind Humboldt had developed. Several 20th Century advocates for what we might today call a 'big historical' worldview have likewise drawn attention to the societal benefits of the resulting cosmopolitan perspectives. H.G. Wells' *The Outline of History*, written in the appalling aftermath of the First World War, is arguably the foremost example, and Wells (1920, p. v) left no doubt about his reasons for writing it:

> The need for a common knowledge of the general facts of human history throughout the world has become very evident during the tragic happenings of the last few years …. There can be no common peace and prosperity without common historical ideas. Without such ideas to hold them together in harmonious co-operation, with nothing but narrow, selfish, and conflicting nationalist traditions, races and peoples are bound to drift towards conflict and destruction.

These considerations famously led Wells to conclude (p. 608) that "human history becomes more and more a race between education and catastrophe." He was convinced that every thinking person should do what they can to help win this race, and that finding a common historical perspective was the key (p. 603):

> The essential task of men of goodwill in all states and countries remains the same, it is an educational task, and its very essence is to bring to the minds of all men everywhere, as a necessary basis for world cooperation, *a new telling and interpretation, a common interpretation of history*.[8]

Other examples of arguments for the societal benefits of big historical/astrobiological perspectives include works by the astronomers Harlow Shapley and Hubert Reeves. Shapley, in particular, dedicated much of his career to popularising the cultural benefits of a cosmic perspective (see Palmeri, 2009) and began the preface of his book *The View from a Distant Star* (Shapley, 1963; p. 5) by noting:

7 Capitals in the original.

8 Emphasis in the original.

> Mankind is made of star stuff, ruled by universal laws. The thread of cosmic evolution runs through his history. [9]

Shapley argued that this vast perspective could, indeed *should*, "incite orientating thoughts" (see pp. 38, 93, 161) that would, among other benefits, help "take us through the present and future predicaments" (p. 97) facing humanity. In his book *The Hour of Our Delight: Cosmic Evolution, Order and Complexity*, Reeves (1991) was similarly motivated by potential societal benefits arising from a knowledge of cosmic evolution and by the hope that the resulting "sense of wonder" would help turn humanity away from violence, conflict, and, especially, nuclear war. Reflecting on the contrast between the wonder of cosmic evolution revealed by modern science, and the often absurd pointlessness of human conflict, he wrote "The awakening of a sense of wonder and delight is the best antidote to absurdity at all levels" (Reeves, 1991; p. 8), and went on to propose that an understanding of cosmic evolution evokes an argument for human solidarity and dignity (p. 185):

> A new vision of humanity emerges from contemporary scientific knowledge. Though mankind can no longer pretend to be the center of the world, our new position gives us our real dignity. … we occupy the top level of the pyramid of nature's organised entities. We reached this level after a gestation period of fifteen billion years, in which all of the cosmic phenomena participated. *All human beings, regardless of their origin, have an equal claim to this dignity*. The respect for human rights implies also an awareness of the importance of every individual in the history of the universe.[10]

Perhaps the clearest recent enunciation of why the perspectives provided by big history and related disciplines have the potential to help unite humanity was made by the biologist Ursula Goodenough in her 1998 book *The Sacred Depths of Nature* (p. xvi):

> Any global tradition needs to begin with a shared worldview: a culture-independent, globally accepted consensus as to how things are. … our scientific account of nature, an account that can be called The Epic of Evolution. … this is the story, the one story, that has the potential to unite us, because it happens to be true.[11]

Given the potential importance of developing such a unified worldview, it would be desirable to assess empirically the extent to which the teaching of 'the epic of evolution' (which is essentially big history by another name) can achieve this in practice. This might be done by comparing the worldviews of cohorts of individuals (e.g. school children, university students, general public), ideally from a range of cultural backgrounds, before and after exposure to cosmic and evolutionary perspectives. I am not aware of any such studies, and I don't have the expertise to advise on appropriate methodologies for them, but I do think they would be worth performing.[12]

Geopolitical Implications

The importance of developing a planetary perspective as a prerequisite for effectively tackling planetary-scale problems has long been recognized in the professional international relations community

9 The phrase "Mankind is made of star stuff" is often attributed to Carl Sagan, but as far as I am aware Shapley was the first to use it.

10 Emphasis in the original.

11 Although the title of Goodenough's book suggests a theistic outlook, her actual perspective is one of 'religious naturalism' which combines a naturalistic worldview with emotional and ethical perspectives normally associated with religion. As she argues (p. xiv), "the role of religion is to integrate the cosmology and the morality" of a culture. It seems important to recognize that if the 'Epic of Evolution' (aka big history) is perceived to be consistent with at least some religious worldviews that may aid its wider acceptance, although big history itself is better seen (in David Christian's phrase) as a secular 'origin story' anchored in scientific fact.

12 I am grateful to an anonymous reviewer for this suggestion.

(e.g. Morgenthau, 1948; Herz, 1962; Ward, 1966). The potential role of big history in developing this perspective, with geopolitical implications, has recently been noted by Jo Leinen and Andreas Bummel (2018) in their book *A World Parliament: Governance and Democracy in the 21st Century* (p.361):

> Big history provides an account of the origin of all existence and of life on Earth on a strictly scientific basis. The cosmological worldview thus helps us on the path to an integral consciousness and creates an important frame of reference for planetary identity.

The need for such a perspective is also developed in the *Planet Politics Manifesto* advanced by Anthony Burke and colleagues (2016). They argue that the existing, state-centric, political organisation of the world is "failing the reality of the planet", and seek to reorientate the study of international relations to answer the question "Can we match the planet with our politics?" They conclude that:

> Our fundamental image of the world must be revolutionised. Our existence is neither international nor global, but planetary. Our anthropocentric, state-centric, and capital-centric image of international relations and world politics is fundamentally wrong; it perpetuates the wrong reality, the wrong commitments and purposes, the wrong 'world-picture'.

Importantly, they stress that in order to make progress "we don't need more reports or policy debates. We need new practices, new ideas, stories and myths." By providing a common, scientifically robust, "origin story" (or, viewed another way, a "myth" describing humanity's place in the universe that is as true as modern science can make it), big history and related disciplines can help satisfy the last two of Burke et. al.'s prerequisites for progress, while in parallel stimulating interdisciplinary advances in the first two.

It is interesting to consider the potential longer-term political implications of a "planetary identity" engendered (in part) by big history. Fred Spier has drawn attention to the fact that academic history in its modern form emerged in the 19th century, largely to support the formation and consolidation of nation-states, and that this nationalistic imperative has led to the downplaying of integrated human, or universal, histories. This then leads him (Spier, 2015; p. 12) to make the following observation:

> the study of human history as a whole has only rarely been practiced up to the present. This remarkable situation may be linked to the fact that to do so would produce global identities, which are not directly associated with any presently viable state society.

This begs the question, already alluded to in the title of Leinen and Bummel's book quoted above, of whether the creation of "global identities" through the promulgation of big history and related perspectives could help in the development of global political institutions above the level of the nation-state. Both Wells and Shapley were convinced of this, and both devoted chapters of their books to making the case for world government[13]. Moreover, although authors like Wells and Shapley might easily be dismissed as overly idealistic and lacking in professional expertise in the field of international relations, essentially the same conclusion was reached by such leading 'realist' international relations scholars as Hans Morgenthau (1948) and John Herz (1962). Daniel Deudney (2018) has recently summarised Morgenthau's position as follows: "humanity thus faces a tragic impasse: it needs a world state for security, but lacks a sufficiently thick sense of common identity both to make it possible and to prevent it from being threatening." Morgenthau himself (1948, p. 419) appears to have viewed this as a challenge to be overcome:

13 Wells (1920) Chapter XLI: "The possible unification of the world into one community of knowledge and will"; Shapley (1963) Chapter 13: "The coming world state."

> If the world state is unattainable in our world, yet indispensable for the survival of that world, it is necessary to create the conditions under which it will not be impossible from the outset to establish a world state.

Morgenthau saw the way forward through international diplomacy, but was clearly aware that developing a sense of common identity would be a prerequisite for success, just as "the community of the American people antedated the American state … a world community must antedate a world state (Morgenthau, 1948; p. 406).

This is not the place to reiterate all the arguments for or against the creation of a world government, or the various forms such a government might take. There is a large literature on this topic to which the interested reader can refer (e.g., Kant, 1795; Russell 1916; Laski, 1925; Reves, 1946; Toynbee, 1972; Kerr, 1990; Hamer, 1998; Wendt, 2003; Baratta, 2004; Yunker, 2007; Cabrera, 2011; Wendt, 2015; Leinen & Bummel, 2018; Hamer, this volume); a comprehensive and scholarly historical overview has been given by Heater (1996), and interested readers may wish to follow the contemporary on-line discussions at the *World Government Research Network*.[14] My own view (e.g. Crawford, 2015; esp. pp. 206-209) is that a federal world government, implementing the principle of subsidiarity[15] on a global scale, would be the most appropriate institutional response to tackling the many planetary-scale problems that human civilisation will face in the 21st century. That said, I find myself in agreement with Morgenthau and others that such geopolitical developments, while desirable, may be impractical until humanity develops a greater sense of its common identity, what Herz (1962, p. 317) termed a "planetary mind", Anderson (1991, p. 6) a sense of "imagined community", and Ward (1966, p. 148) "a patriotism for the world itself".[16]

It seems to me that the temporal and evolutionary perspectives provided by big history, combined with the spatial ('cosmic') perspectives provided by the exploration of space (discussed below), will play a valuable, and perhaps essential, role in laying the foundations for a common human identity on which a future world government might be built (see also Crawford, 2018b).

Space Exploration: Augmenting the Cosmic Perspective

Big history and astrobiology are both concerned with the *future* of humanity as well as the past, and, barring some unforeseen calamity, it seems likely that the exploration of space will be a part of this future. Certainly, if some of the more ambitious aspirations to make humanity a multi-planet species are realised, space exploration and development could become a very large part of the human (and post-human) future. Even if these aspirations are never realised, it seems likely that we will continue to explore our Solar System with robotic space probes, and probably also with astronauts. In this section I will therefore briefly examine the synergies, as I see them, between astrobiology, big history, and the exploration of space. Of course, space exploration is already an important component of astrobiology, because space probes are required to search for life on other planets, and discoveries made by space probes and space telescopes also inform big history. However, beyond these essentially practical synergies, I contend that important socio-political benefits will also result from an ambitious programme of space exploration, and that these will reinforce the societal benefits of big

14 http://wgresearch.org/ (accessed 17 December 2018).

15 I.e., that "a central authority should have a subsidiary function, performing only those tasks which cannot be performed effectively at a more immediate or local level" (OED, 2013).

16 Barbara Ward (aka Baroness Jackson)'s slim book *Spaceship Earth* (1966), based on her George P. Pegram lectures at Columbia University, contains much of interest to the present discussion. Of particular importance is her insistence on the need to build global institutions for planetary management.

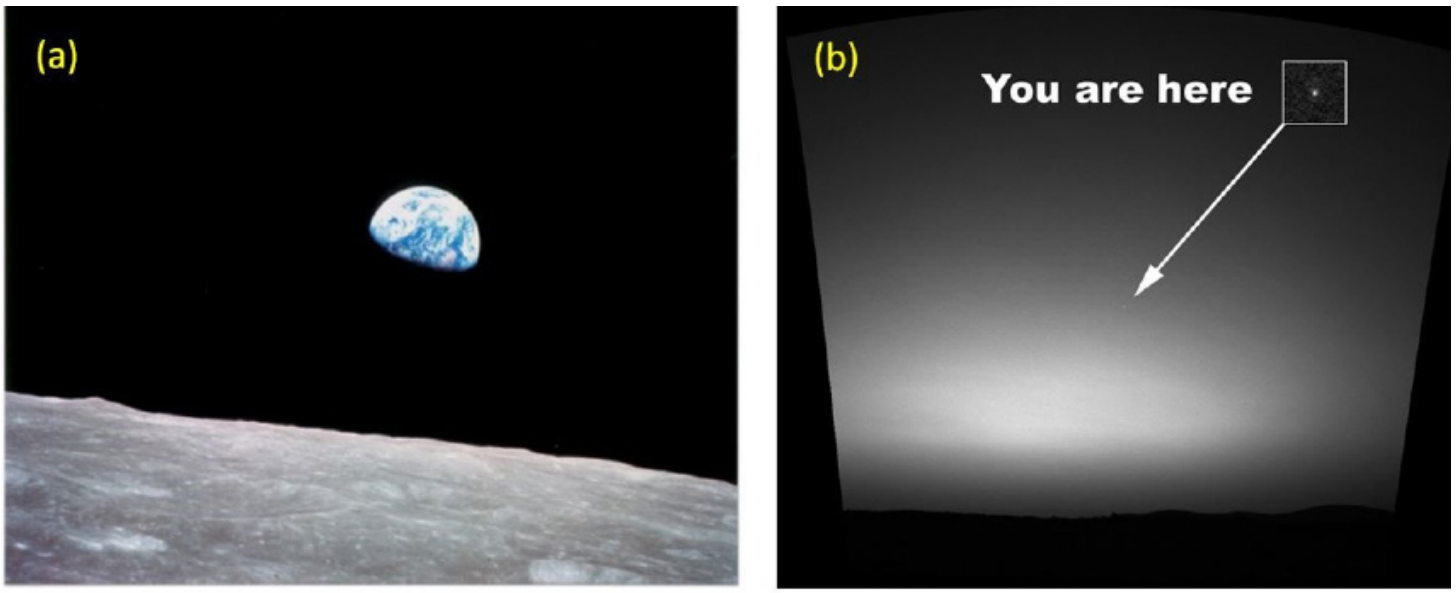

Figure 2. The cosmic perspective: (a) Earthrise over the lunar surface, photographed by the crew of Apollo 8 in December 1968. (b) The Earth photographed from the surface of Mars by the Mars Exploration Rover Spirit in March 2004. Such images powerfully reinforce a 'cosmic perspective' that can have a unifying influence on human affairs. Images courtesy of NASA.

history and astrobiology discussed above.

Most importantly, space exploration provides a *spatial* perspective on human affairs which complements the temporal and evolutionary perspectives of big history. Any society that is rigorously exploring the Solar System, can hardly fail to be aware that Earth is a very small planet when viewed in its cosmic setting (Figure 2). The social, cultural and psychological importance of this perspective has been noted by multiple authors (e.g. Clarke, 1946, 1951; Hoyle, 1950; Ward, 1966; Sagan, 1994; Poole, 2008; White, 2014). For example, even before any images of Earth from space had been obtained, the astronomer Fred Hoyle (1950, p. 9) wrote that:

> Once a photograph of the Earth, taken from the outside, is available, we shall, in an emotional sense, acquire an additional dimension … once let the sheer isolation of the Earth becomes plain to every man, whatever his nationality or creed, and a new idea as powerful as any in history will be let loose.

There is persuasive evidence that images of the Earth from space have raised environmental awareness, and thus contributed to popular movements for the reduction of pollution and the preservation of biodiversity (e.g., Zimmerman, 1998; Poole, 2008; Spier, this volume)[17]. Although it is sadly true that the cosmic perspective of "Spaceship Earth" (Ward, 1966; Fuller, 1969) hasn't yet triggered a sufficiently strong global response to solve these environmental problems, raising awareness of their planetary scale is nevertheless an important contribution of space exploration and a prerequisite for political action.

17 Zimmerman (1998, p. 275) reproduces an interesting diagram from Balzhiser (1990) which shows a dramatic growth in US environmental legislation in the late 1960s; proving a causal link to images of the Earth taken from space may not be possible, but the timing is suggestive. Fred Spier (this volume) draws attention to the differences in cultural impact of the original Apollo 8 'Earthrise' image (Fig. 2(a) above) in the United States and Europe; he argues that the immediate impact, especially outside of the US, may not have been as great as is often assumed, although its legacy has proved to be lasting and influential.

Similar observations can be made regarding the geopolitical implications of the cosmic perspective. Even before the space age, the science fiction author and space visionary Arthur C. Clarke (1946, p. 72) had noted that:

> It is not easy to see how the more extreme forms of nationalism can long survive when men begin to see the Earth in its true perspective as a single small globe among the stars.

Hoyle (1950, p. 9) echoed this sentiment a few years later, when he noted that this new perspective "must increasingly have the effect of exposing the futility of nationalistic strife." By the 1960s, when images of the Earth from space had been obtained, the implications were not lost on at least some professional diplomats. For example, Adlai Stevenson, then US Ambassador to the United Nations, expressed his view (Stevenson, 1965), that "we can never again be a squabbling band of nations before the awful majesty of outer space." This perspective is, understandably, much more visceral for people who have actually seen our planet from outside (White, 2014), and it is worth quoting one such observation here:

> You look down there and you can't imagine how many borders and boundaries you cross, again and again and again, and you don't even see them. There you are – hundreds of people in the Mid-East killing each other over some imaginary line that you're not even aware of …. And from where you see it the thing is a whole, and it's so beautiful. You wish you could take one in each hand, one from each side in the various conflicts, and say, 'Look. Look at it from this perspective….' (Schweickart, 1977).

As space exploration proceeds more people will be exposed to this perspective, both in person and vicariously, and the more it will diffuse through society. Such an enlargement of perspective can hardly fail to strengthen the sense of planetary identity inherent in big historical and astrobiological worldviews. Indeed, images of Earth from space, and especially personal experiences of this perspective, are likely to be even more effective in this regard because they prompt an instinctive, emotional, appreciation of 'one worldness' that the more intellectual perspectives provided by big history, astrobiology, and related academic disciplines cannot. We may hope that this perspective will gradually gnaw at the minds of political leaders (as it clearly did for Adlai Stevenson), and the minds of the wider public, until it leads to the emotional realisation that human activities affecting the planet as a whole need, and *ought*, to be organised collectively (see, e.g., Crawford, 2017). Only space exploration can provide this perspective, which has led Frank White (2014, p. 102) to argue that:

> It is time for the influence of space exploration on human consciousness to be seen as a legitimate justification for investing in it.

Cultural Benefits of Space Exploration

In addition to providing a valuable, and uniquely compelling, spatial perspective on human existence, an ambitious future programme of space exploration will also result in a range of additional social and cultural benefits. Leaving aside the strictly scientific benefits, to which the whole history of space exploration can attest, I think we can also identify potential cultural benefits of space exploration under the broad headings of 'art', 'philosophy', and, albeit in the more distant future, 'diversity'. I have addressed these aspects in previous publications (e.g., Crawford, 1993, 2014), which I summarise here.

William McLaughlin (1993) considered the potential impact of space exploration on the fine arts and concluded that the influence is likely to be considerable. At one level it seems obvious that new space scenes, and novel space events and experiences, must inspire new works of space art. It is difficult to see how this could be otherwise. However, the potential long-term artistic impact of space exploration is likely

to be more profound. The increasing dominance of the cosmic perspective on human thought is likely to change the whole paradigm of artistic expression. Not only will it be necessary to find ways of portraying and communicating human (and human-derived) values in the face of a universe whose strangeness will likely become ever more apparent as exploration proceeds, but the human (and post-human) mind is itself likely to become increasingly 'cosmicized' (Finney, 1988) in a way that can hardly fail to be reflected in artistic and cultural evolution. Indeed, in the immediate aftermath of the Apollo missions to the Moon, the American literary scholar Joseph Campbell (1972, p. 233) clearly grasped this insight when he wrote:

> For although our voyage is to be outward, it is also to be inward, to the sources of all great acts, which are not out there, but in here, in us all, where the muses dwell.

And, further (p. 236) that:

> All the old bindings are broken. Cosmological centers now are any- and everywhere…all poetry now is archaic that fails to match the wonder of this view.

If anything, the stimulus that space exploration will provide for the philosophical disciplines may be even more profound. In Table 2, I summarise some philosophical issues that are likely to be stimulated as humanity (and post-humanity) moves out into the Solar System, and perhaps beyond. I have made a distinction between natural, moral and political philosophy, but we must also expect that the vast and mysterious universe in which we live very likely contains the seeds of entirely new fields of philosophical investigation waiting to be discovered.

In the longer term, one of the most important socio-cultural contributions of space exploration may be the opportunities it will provide for increasing human (and post-human) cultural diversity. In the nineteenth century, John Stuart Mill drew attention to the benefits of what he termed "different experiments of living" (Mill, 1859; p. 120), but such experiments are becoming increasingly difficult in a homogenizing world. Indeed, I have argued above that some of this homogenization, at least on a political level, is positively desirable if it helps breakdown tribal animosities on Earth, and that a common 'big historical' perspective could help facilitate this. Moreover, although federal political systems, such as a future federal world government, are well-suited to maintaining cultural diversity in the face of common high level political structures, it seems likely that cultural diversity on this planet is likely to continue to decrease.

Although clearly a long way in the future, it is possible that space exploration, and especially the colonisation of other planets by humans (and post-humans), will provide a solution to this dilemma. Interestingly, this possibility was recognized by the philosopher Olaf Stapledon (1948) a decade before the space age had even begun, when he expressed the view that:

> The goal for the solar system would seem to be that it should become an interplanetary community of very diverse worlds each inhabited by its appropriate race of intelligent beings, its characteristic "humanity"… Through the pooling of this wealth of experience, through this 'commonwealth of worlds' new levels of mental and spiritual development should become possible, levels at present quite inconceivable to man.[18]

That said, the colonisation of the Solar System will also create additional risks: we don't want to unite the Earth only to live in a politically anarchic Solar System where colossal energies would be

18 Much of Stapledon's thought is relevant to big historical and astrobiological perspectives, and I recommend especially his science fiction novel *Star Maker* (Stapledon, 1937). For a more detailed discussion of Stapledon's ideas in the context of space exploration, see Crawford (2012).

Natural Philosophy	Moral and Ethical Philosophy	Political Philosophy
How secure is our basic physical understanding of the universe?	Extension of environmental ethics to other planets.	Consideration of the ownership of extraterrestrial resources
Can we define 'life' in a cosmic context? Is this even important?	What are the moral and ethical relationships between humanity and extraterrestrial life (should any be encountered)?	Consideration of appropriate forms of planetary and interplanetary governance.
If life can be defined, how common is it in the universe? What are the ultimate constraints on the origin of life and its distribution?	What are the ethical implications of spreading Earth-life through the Solar System and the Galaxy?	Consideration of political relationships with advanced extraterrestrial societies (if any); what limits would *biological* differences place on developing political institutions?

Table 2: Some philosophical issues that are likely to arise as space exploration proceeds.

available for anyone (or anything) minded to use them destructively (e.g., Baxter and Crawford, 2015; Deudney, 2016, 2019) For this reason, care will have to be given to developing appropriate interplanetary political institutions (Crawford, 2015).

Thirty years ago, the American political philosopher Francis Fukuyama (1989, 1992) argued that our world is becoming politically and culturally homogenized, and that this may lead to political and cultural stagnation. Following Hegel (1832), Fukuyama famously (or, depending on your point of view, infamously) termed this perceived endpoint in human cultural evolution the 'End of History'. Although subsequent events have shown that this process is proceeding more slowly than Fukuyama perhaps envisaged, some of the trends he identified seem likely to continue. Although, as I have argued above, increasing *political* unification of humanity seems positively desirable, Fukuyama's concerns regarding cultural stagnation in a politically unifying world do need to be taken seriously. As he put it (Fukuyama, 1989, p. 18):

> The end of history will be a very sad time. The struggle for recognition, the willingness to risk one's life for a purely abstract goal, the worldwide ideological struggle that called forth daring, courage, imagination, and idealism, will be replaced by economic calculation, the endless solving of technical problems, environmental concerns, and the satisfaction of sophisticated consumer demands. In the post-historical period, there will be neither art nor philosophy, just the perpetual caretaking of the museum of human history.

A decade before the dawn of the space age, the possibility that an ambitious programme of space exploration could help prevent just this kind of cultural and intellectual stagnation was recognized by Clarke (1946, p. 72) when he wrote:

> Interplanetary travel is the only form of 'conquest and empire' now compatible with civilisation. Without it, the human mind, compelled to circle forever in its planetary goldfish bowl, must eventually stagnate.

Human expansion into the Solar System, and eventually beyond, will certainly present a vast new field of human activity, with literally infinite potential for discovery and intellectual stimulation on multiple levels.

As Dunér (2013, p. 13) has recently argued:

> Encounters with the unknown outer space will … change our thinking, conceptions, categories, belief systems, culture and meanings of things. What we have come to believe so far through science and human cognition will face anomalies. The old categories, systems, and beliefs will fall short when we try to understand these new unfamiliar things. Our thinking, science, and belief systems will then have to be revised.

However one views it, it seems certain that a future in which space exploration plays a significant role will provide a far richer range of cultural and intellectual stimuli than we could ever hope to experience if we never leave our home planet (e.g., Clarke, 1946, 1951; Sagan, 1994; Crawford, 2014). Sagan (1994, p. 285) perhaps expressed it as well as anyone:

> We're the kind of species that needs a frontier – for fundamental biological reasons. Every time humanity stretches itself and turns a new corner, it receives a jolt of productive vitality that can carry it for centuries.

In the long run, the exploration of space may help us avoid Fukuyama's 'End of History' by keeping history *open* while simultaneously helping to unite human cultures on Earth.

Conclusions

The twin, and closely related, academic disciplines of big history and astrobiology have the potential to yield a wide range of social and intellectual benefits. Indeed, intellectual enrichment is already resulting from the interdisciplinary research agendas of both astrobiology and big history, which involve scholars from a wide range of sciences and the humanities working closely together. More importantly, both disciplines rely on, and naturally engender, cosmic and evolutionary perspectives which, I argue, ought to form part of the worldview of every educated person (see also Elise Bohan's paper in this volume). If suitable methodologies could be conceived and implemented, it would be desirable to quantify the effects of exposure to these perspectives on individuals from a wide range of ages and cultural and educational backgrounds. Such data could then inform evidence-based proposals for reforming educational curricula to include big history and related mind-broadening perspectives.

By powerfully reinforcing the fact that all human beings, and all human societies, exist on the same small planet, and are related by a common evolutionary history, I have argued that cosmic and evolutionary perspectives strengthen intellectual and emotional arguments for the eventual political unification of humanity. My own view is that a federal world government would be an appropriate institutional framework for a united humanity, and that a world government of some kind may be necessary if serious global problems are to be properly managed. However, such a political outcome is only likely to become realistic if humanity develops a greater sense of its common identity, what Barbara Ward (1966, p. 148) called "a patriotism for the world itself." The perspectives provided by big history, astrobiology and space exploration can all help achieve this objective. That said, I also agree with Fukuyama (1989) that a politically homogenised world may lack sufficient sources of intellectual stimuli to maintain a vibrant culture, and I have argued that an ambitious programme of space exploration would help in this respect. Needless-to-say, the exploration of space will also yield new knowledge about the universe, informing both the science of astrobiology and the ever-evolving big historical worldview.

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Genotemporality: The DNA Revolution and The Prehistory of Human Migration

A Review of David Reich, *Who We Are and How We Got Here: Ancient DNA and the New Science of the Human Past.* New York: Pantheon Books, 2018, 335 pp.

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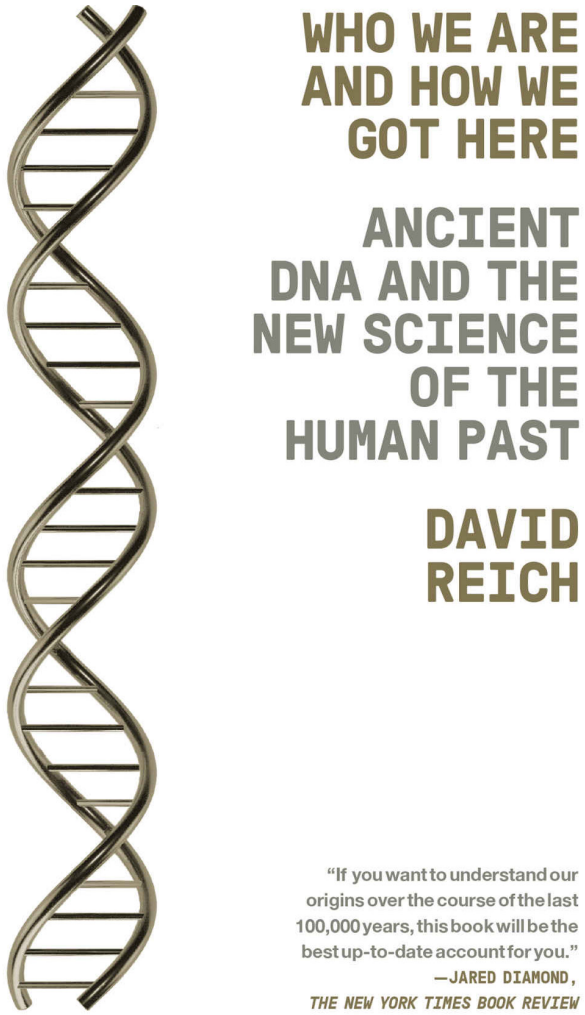
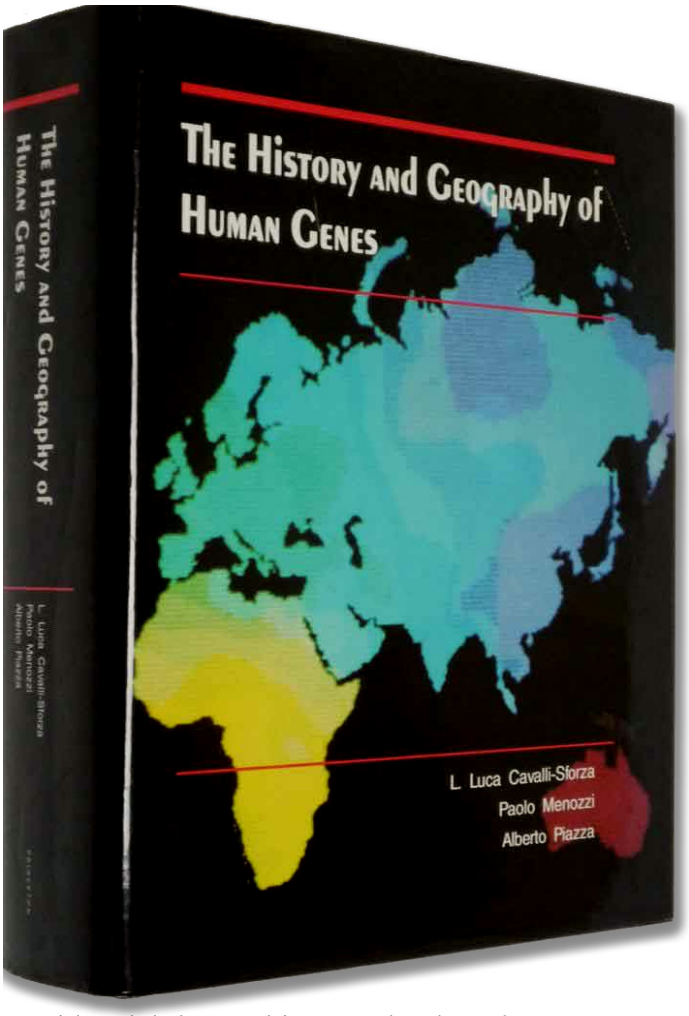
I am attracted to big books that promise a gold mine of research data. Several years ago I ran across a second-hand, mint-condition volume at extraordinarily reasonable cost: Luca Cavalli-Sforza's magnum opus, *The History and Geography of Human Genes* (1994), an enormous book: 9 ½ by 11 ¼ inches, 2 ½ inches thick, 1088 pages. It was rich in charts and statistics, with maps that traced out the spread of agriculture from its origins a few thousand years ago across whole continents. Cavalli-Sforza (1922-2018) spent the second half of the 20th century attempting to work out prehistoric human migrations from differences in the genes of today's human population, enriched "by bringing in as many relevant disciplines as possible, from historical demography to archaeology, paleoanthropology and linguistics, and perhaps ethnography, together with population and molecular genetics" (Cavalli-Sforza, 272). It was an ambitious and impressive goal—and ultimately beyond the capabilility of genetic science of the day; his work was done before the revolution in genetics that we might date from the complete sequencing of the human genome in 2001.

Though Cavalli-Sforza's work has been eclipsed by a tsunami of studies based on genetic sequencing, David Reich respectfully begins his book, *Who We Are and How We Got Here* (2018) honoring him: "This book is inspired by a visionary, Luca Cavalli-Sforza," noting that *The History and Geography of Human Genes* was the "high water mark" of his career. He was a pioneer in his early recognition of





David Reich began his 2018 book, *Who We Are and How We Got Here,* by honoring Luca Cavalli-Sforza, author of the 1994 book, *The History and Geography of Human Genes.*

"the full potential of genetics for revealing the human past, but his vision predated the technology need to fulfill it" (Reich, xi, xv). Reich, a professor of genetics at Harvard Medical School, now has a lab that is turning out genetic analyses at breakneck speed, with his major contribution being analysis of ancient DNA.

Prior to what Reich calls "the ancient DNA revolution," the primary insight was the tracking of mitochondrial DNA in the female genome that suggested all humans had descended from a single female sometime around 160,000 years ago (Lewin 1987). The detective story of "Mitochondrial Eve" as she was dubbed was presented in Michael Brown's *The Search for Eve* (1990), an unfortunate spillage of biblical imagery into serious science. Its twin was the tracking of Y chromosomes which were traced to an African male, "Adam" perhaps, who lived around 320,000 years ago. This huge variance in dates must have upset liberal interpreters of the biblical story who would like to have learned the primal couple lived together at a more scientifically respectable time. Reich's updated contribution is the discovery that "the genome contains the stories of diverse ancestors—tens of thousands of independent genealogical lineages, not just the two whose stories can be traced with the Y chromosome and mitochondrial DNA" (Reich 10).

The most important benefit of DNA analysis is the ability to tease out dates for very ancient events that have left traces in the human genome. In some cases, the traces are found in separate, often distant, populations that show evidence of an earlier "ghost population" that can no longer be found and has most likely gone extinct, a kind of genetic triangulation where two vortices allow for locating the third. Developing a schedule for genetic changes that signal encounters between variant populations works toward a distinctive time scheme that we have termed *genotemporality* (Wood 2016), an evolutionary chronology based on DNA combinings, divergences, markers, and mutations. Genotemporality can be inferred from pieces of DNA that trace to mammalian, reptilian, amphibian, and marine ancestors (Shubin 2009), and even further back to genetic fragments incorporated into human cells from invertebrates and the earliest bacteria (Ryan 2009).

Reich's approach is what he calls the "whole-genome perspective" (9-10); his territory is *Homo sapiens* with forays into hominid predecessors such as Neanderthals and Denisovans. Based on non-African DNA, modern humans appear to derive from a common ancestor between 60,000 and 50,000 years ago, a time during which a small population of migrants was leaving Africa along the southern coast of Arabia and

across South Asia according to emerging research on the so-called Southern Route (Armitage *et al*, 2011). This route is confirmed by hominid remains from the East Africa to the United Arab Emirates, prehistoric floral and faunal resources on the prehistoric Arabian peninsula, undersea freshwater springs once above sea level on the South Arabian coast, and a sequence of genetic markers from Africa across South Asia.

Since the sequencing of the human genome, a revolution in DNA analysis has occurred. The reader should be forewarned: Reich is a clear and informative writer, but some of the analytical methods developed by geneticists are challenging, with masses of data that are growing exponentially. In colloquial idiom, we may have to replace "It's not rocket science" with "It's not genetic science." At the level of the laboratory work, the power of sequencing is astonishing: in the period of 2006 from 2010 notes Reich, "the brute power of new machines" has "reduced the cost of sequencing by at least about ten thousandfold" (31). The results are equally astonishing. The most ancient DNA obtained comes from an individual found among a cluster of twenty-eight *Homo heidelbergensis* remains recovered from the Sima de los Huesos Caves in Spain. Dating to 400,000 years ago, these humans appear to be ancestors of Neanderthals following their split with modern human ancestors but before encounters that led to recombination of Neanderthal and modern human genes (Reich 71). Archaeological evidence from caves in Iraq, Croatia and France dating from 130,000 to 180,000 years ago indicate Neanderthal social and cultural sophistication (Reich 26-27); naturally, their genetic makeup was of great interest. The sequencing of DNA from Neanderthal bones from Croatia dating to 40,000 years ago led to the discovery that Neanderthals carried four to six percent of modern human DNA while modern humans contain two to three percent of Neanderthal ancestry—opening up fascinating questions of influences of each on the other.

The possibility of Neanderthal/*Homo sapiens* interaction was hinted at nearly forty years ago—before genetic sequencing verified its occurrence—when Jean Auel mapped out her six-volume story of Earth's Children@, beginning with *The Clan of the Cave Bear* (1980) in which Ayla, a *Homo sapiens* toddler, is found and reared by Neanderthals. The hint has become a reality in the new millennium. Analysis has revealed several prolonged contacts between *Homo sapiens* and Neanderthals; whenever they met, they mated. Precisely where these encounters occurred is conjecture, but the evidence suggests that the *Homo sapiens* population where the most influential encounter occurred is a "ghost population," now long extinct, that cannot be definitively located other than deep in the Near East, possibly on or close to the Southern Coastal Route. This is one of several ghost population that recent DNA analysis has identified.

The most striking new Eurasian discovery is a hitherto unknown species of hominid from a finger bone and molar from Denisova Cave in Southern Russia. Gene sequencing of these miniscule finds (Krause *et al* 2010) has revealed a whole new prehistoric hominid now known as Denisovans, cousins of Neaderthals, the two occupying overlapping territory in Central Asia. The Denisovan genes show interactions with Neanderthals in East Asia and ancestral connections with *Homo sapiens* in the isolated regions of New Guinea, Philippines, and Australia. Reich terms them "Australo-Denisovans"; the presence of Denisovan DNA in Island Southeast Asia and its absence in *Homo sapiens* elsewhere suggests mating encounters probably occurred beyond what was originally called "Wallace's Line," later "Huxley's Line," which separates Philippines, New Guinea, and Eastern Indonesia from the rest of Southeast Asia (Reich, 60-63).

Both Neanderthals and Denisovans occupied vast territories and were evidently descended from *Homo erectus* who found their way out of Africa twenty times earlier, 1.8 to 2.1 million years ago. The earliest finds of what Reich calls "Superarchaic humans," now thought to descend from *Homo erectus*, were the 900,000 to one million-year old Java Man

(*Pithecanthropus*) remains found (1891-1892) in Indonesia; the 680-780,000 year-old Peking Man (*Sinanthropus*) skulls found (1923-1927) in China; the recent (2004) discoveries of one-meter tall inhabitants ("Hobbits") of Flores in Indonesia of uncertain date but tentatively trace to *Homo erectus* ancestors in the region 700,000 to one million years ago; and the 1.8-million-year old skeletons uncovered (1991-2005) at Dmanisi in Georgia (Reich, 63-67). Remarkably, all of these *Homo erectus* descendants across Eurasia were displaced and eventually suffered extinction following the arrival of *Homo sapiens.* Whether these earlier humans were driven to extinction by the arrival of modern humans or were too few in numbers to survive is unknown. Possibly they lacked the innovative skills typical of the newly arrived *Homo sapiens*. We simply do not know. What we do know is that *Homo sapiens* were socially unified and they appear to have had superior technical and cognitive skills. Their numbers increased as they criss-crossed the Eurasian landmass; in fact, their movements were so complex that ancient DNA has barely cracked open the story of their migrations.

Maps of human movement out of Africa are overly simplified; they show radiating routes like spokes of a wheel across the planet—an image suggesting a branching tree that implies continuing divergence with no subsequent interaction between the branches. However, Reich points out that the metaphor of the tree is no longer effective for tracing population relationships which involve later encounters and genetic exchange between previously separate migrating groups (Reich, 77-78). These are revealed by analysis of ancient DNA. The power of genetic analysis acquired in the past few years has revealed a genotemporality relevant to several populations that have since vanished, one of which we have already mentioned. From northern Eurasia, DNA from Europeans and Native Americans reveals an ancestral population somewhere between, presumably in northern Russia or southern Siberia north of the Black and Caspian Seas. But this group which appears to have suffered extinction is another "ghost population," a second of several identified in the past decade.

Such ancestral sources of genetic encounters provide a challenge to long-standing metaphors. The branching tree is thus more aptly replaced with a complex web with multiple intersections. Digging for information about earlier populations from multiple analyses of present populations thus leads to surprising discoveries. We tend to think of dark skin, dark hair, and dark eyes as typical of Africa and the tropics of South Asia and blue eyes and blond hair as European. The blue-eye mutation has been dated to approximately 30,000 BP in the *Homo sapiens* population of prehistoric Europe. This led to an interesting combination of features: "western hunter-gatherers around eight thousand years ago had blue eyes but dark skin and dark eyes, a combination that is rare today" (Reich, 96). Thus the dark skin coloring of African migrants persisted in Europe for tens of thousands of years after departure from Africa.

Nearly twenty years ago, the distinctive markers of Native Americans were some of the earliest haplogroups identified and were thus designated A, B, C, and D. The migrations of people into the Beringian land bridge around 30,000 years ago and subsequent migration south into North America around 16,000 years ago followed the last glacial maximum. Here geological constriction simplified New World migration to a linear route in contrast with the interwoven maze of Eurasian migration. For half a century, this linear route was identified with a hypothetical "ice free corridor" from Alaska, through the Yukon and the Candadian province, Alberta, east of the Rockies into Montana. In the new millennium this route has fallen victim to precise genotemporal dating: dated remains of archaic migrants reveal they had reached North and South America centuries before an ice-free corridor was available. Meanwhile, a Western Coastal Route has come into prominence (Fahrenkamp-Uppenbrink, 2017). Genetic connections have been discovered down the Pacific coast of the Americas and these account for Native American

DNA similarities in the Southern United States and most of Central and South America. Some distinctive genetic differences mark a later migration into central and eastern Canada, perhaps following a much later opening of an ice-free terraine. Still later, as migrants moved along the Arctic Coast to Baffin Island and Greenland, they gave rise to Inuits and Eskimos. Unlike Eurasia where genetic analysis has identified ghost populations in certain areas that have suffered extinction, genetic evidence often supports continuity of a population in a region; as Reich puts it, "both the genetic and linguistic evidence support a scenario in which many of the present-day Native American populations are direct descendants of populations that plausibly lived in the same region shortly after the first peopling of the continent" (175).

Reich's discussion of genetics in India appears in a chapter called "The Collision that Formed India"—an interesting analogy since the Indian subcontinent—a triangular adjunct to South Asia—was formed when a tectonic plate from the ancient supercontinent Pangea drove north from what is now Antarctic regions, initiating a collision with the Eurasian plate that began 50 million years ago and continues today. The result is a crushing and rippling of the Asia landmass that has raised the highest mountains in the world, the Himalayas, which are still buckling upward. Reich's treatment of India's populations focuses on the past 3,000 to 5,000 years, thus bypassing discussion of ancient southern-route migrants that entered India from the west sometime after 75,000 years ago, with some settling for the long term while others moved on to Southeast Asia.

Reich's metaphorical "collision" applies to the much more recent incursion of Indo-European language speakers who migrated from the steppe-lands north of the Black and Caspian Seas through what are now Iran and Afghanistan, settling for several thousand years in the Indus River Valley, then moving on to northern India. This collision occurred when the indigenous Indian speakers of Dravidian languages were gradually pushed south where they now occupy the lower third of the Indian triangle. This division of cultures was recognized more than two centuries ago when Sir William Jones identified Sanskrit cognates of European languages and proposed the Indo-European language family as common to Europe and India. What was recognized culturally in the eighteenth century can now be documented genetically. The arriving Indo-Europeans were of supreme cultural importance for the worldview they brought and developed in India, notably the two major religions, Hinduism and Buddhism, which eventually spread to Southeast Asia, and the epic literature that forms the foundation of today's Indian culture: *The Mahabharata* and *The Ramayana.* They also brought a social caste system that marks a cultural divide between tribal people descendant from the ancient Dravidians and the higher status Brahmins and ruling elites.

Toward the end of *Who We Are and How We Got Here*, Reich tackles the issue of "rejoining Africa to the human story" (206-225). But this placement belies what we now know: that Africa is not the end of the story but the beginning—the original homeland of *Homo sapiens*. The "African Genesis" first unpacked by Robert Ardrey (1961) unfolded from 200,000 to 100,000 years ago, corresponding to the first half of *Homo sapiens'* history. Reich's interest, however, is on the much more recent period, particularly times when farming transformed the former forager-hunter populations of sub-Saharan Africa.

A limitation that affects genetic analysis makes African human ancestry particularly difficult to untangle. Africa's tropical location leads to more rapid deterioration of genetic material. Thus the sequencing of ancient DNA from northern Eurasia is virtually impossible in Africa. For insight into the first hundred millennia of *Homo sapiens'* history, one has to turn to paleoarchaeology, the human remains and tools of South African cave dwellers and the kinds of material-culture analysis of anthropologists such as Curtis Marean (2007) and Kyle Brown (2009). Consequently, Reich's findings about human interaction and migration in Africa focuses on the past 10 to 15

thousand years. His contribution is in providing a foundation for human movement; as he notes, "It is in the area of shedding light on human migration—rather than in explaining human biology—that the genome revolution has already been a runaway success" (22). But innovative methodologies applied to recent DNA sometimes uncover situations of the more distant past. One such discovery is another ghost population in East Africa. Now extinct, this east coast population may be absent because of transitory presence during *Homo sapiens* migration from South Africa to the Horn of African and the Gate of Grief water crossing to southern Arabia.

In addition, as he points out in "The Genomics of Race and Identity," genetic analysis provides a scientific tool for dismantling long standing prejudices about race. Theoretically this has been a theme on the agenda since the Emancipation Proclamation. De-mythologizing race received a boost, as Reich points out, by Ashley Montague in *Man's Most Dangerous Myth: The Fallacy of Race* (1942). Now, study of the human genome has removed all physical grounds for racial distinctions and provides a new foundation for racial equality and opportunity for everyone.

Making reference to Walter Libby's development of Carbon 14 dating (Libby 1955), Reich refers to the genotemporality made possible by genetic analysis as the Second Revolution in Archaeology. Libby raised dating from the guesswork of Darwin, Lyell, and Kelvin to a scientifically grounded dating of biological remains. The innovations of the genetic revolution have added a relational dimension: "by sequencing the whole genomes from ancient people, it is now possible to understand in exquisite detail how everything is related. . . . There is every reason to expect an avalanche of major discoveries from ancient DNA over the coming years."

Reich's interest is on ancient DNA and specific clarifications that have come from sequencing it. Since the methodology is recent and samples of ancient DNA scarce, clarifications are discrete; most regions have not and cannot yet be accessed by analyzing ancient DNA. The result is a series of illuminating discoveries with cursory connection. His book makes a useful companion for Alan Rutherford's *Brief History of Everyone Who Ever Lived* (2017), previously reviewed in this journal (Wood 2018). It is worth noting again that *Who We Are and How We Got Here* is a densely-packed book; it pulls no punches in its explanations of the most advanced techniques of ancient DNA analysis. It has already spawned a 50-page Zip Read summary of its main ideas; as one reader writes, "All the info without all the time." But plowing through Reich's fuller treatment is advisable for anyone wishing to keep up with genetic analysis which is likely to become even more complex in the future.

The tradeoff for Reich's richly dense explanations of methodology is a certain lack of continuity. Reich states his interest in migration and argues that migration is the theme most illuminated by his kind of analysis, but we should note that his separate clarifications do not yet cohere as a *sequential* narrative of the peopling of the Earth. This narrative will require connecting studies such as Reich's and numerous others. The result should be a continuous narrative that begins in Africa and traces *Homo sapiens'* migration to the most remote reaches of the planet.

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