Cosmotheology Revisited: Theological Implications of Extraterrestrial Life

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Resumo

Neste artigo, sustenta-se a tese de que precisamos de tomar a sério a componente relativa à evolução cultural da equação de Drake, Concluindo-se que a evolução cultural ao longo de vastos períodos temporais terá resultado, em muitos casos, num universo pós-biológico, no qual a inteligência artificial substituiu a biológica. Esta evolução da inteligência artificial resultou numa inteligência semelhante a Deus, mas não sobrenatural. Ora, quer o universo esteja povoado de inteligências biológicas ou posbiológicas, é necessário proceder a um reexame dos novos conceitos teológicos correntes. De facto, num artigo recente (Dick 2000), concluiu-se que, provavelmente, a evolução cósmica deu como resultado um universo biológico cheio de inteligência, e que este facto deveria modificar, expandir ou mudar completamente a nossa visão teológica. A Cosmoteologia deve ter em conta aquilo que sabemos acerca do universo, especialmente o facto de a humanidade não ser o centro biológico desse universo, mas situar-se, possivelmente, no nível inferior da cadeia dos seres inteligentes. Assim, a Cosmoteologia também deve estar aberta a novos conceitos radicais de Deus, baseados na evolução cósmica.

Theology, Cosmic Evolution and Worldview

Theology – the relationship between humans and a superior intelligence with the attributes of God – should be intimately tied to the three possible outcomes of cosmic evolution. In a physical universe where there is no extraterrestrial life, the only Gods possible are the anthropocentric Gods of

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human imagination, the concept that has given rise to so many theologies over the last 5 millennia. In a biological universe full of life, God may be a highly evolved superior intelligence, a natural rather than a supernatural entity, and non-anthropocentric in the sense that humans would be only one of many intelligent species and not the most highly evolved. In a postbiological universe, cultural evolution may have produced artificial intelligence, the most highly evolved version of which might have many of the properties of what we call “God”. A fourth possibility is that none of these is true, that there is no human-superior extraterrestrial intelligence relationship except in the minds of humans, and that there is no God in reality and has never been.

Since in this way of thinking cosmic evolution is the key to understanding the nature of God, it is important to understand how the concept of cosmic evolution originated. The intellectual basis for this guiding principle of cosmic evolution had its roots in the 19th century when a combination of Laplace’s nebular hypothesis and Darwinian evolution gave rise to the first tentative expressions of parts of this worldview. The British philosopher Herbert Spencer spread the idea to the social arena, and the evolution of society. In England and America popularizers like Richard A. Proctor, and in France Camille Flammarion, also spread evolutionary ideas to illuminate the question of life on other worlds. Such a set of general ideas was a long way from a research program. Astronomers recognized and advocated parts of cosmic evolution, as in the study of stellar evolution beginning in the early 20th century. But even Percival Lowell with his infamous Martian canals limited his evolution of worlds to physical, not biological evolution. For the most part, biologists were also reluctant cosmic evolutionists.

Cosmic biological evolution first had the potential to become a research program in the 1950s and 1960s when its cognitive elements had developed enough to become experimental and observational sciences, and when the researchers in these disciplines first realized they held the key to a larger problem that could not be resolved by any one part, but only by all of them working together. Harvard College Observatory Director Harlow Shapley was an early modern proponent of this concept, and already in 1958 spoke of it in now familiar terms (Shapley, 1958). The Earth and its life, he asserted, are “on the outer fringe of one galaxy in a universe of millions of galaxies. Man becomes peripheral among the billions of stars in his own Milky Way; and according to the revelations of paleontology and geochemistry he is also exposed as a recent, and perhaps an ephemeral manifestation in the unrolling of cosmic time." Shapley went on to elaborate his belief in billions of planetary systems, where "life will emerge, persist and evolve." Shapley's belief in life was unproven then, and remains to be proven today. The transition from belief to proof is tantamount to discovering whether cosmic evolution commonly ends with planets, stars and galaxies, or with life, mind and intelligence. Put another way, does cosmic evolution produce not only a physical universe, but also a "biological universe"?

Already as the Space Age began the concept of cosmic evolution – the connected evolution of planets, stars, galaxies and life – provided the grand context within which the enterprise of exobiology was undertaken. The idea of cosmic evolution spread rapidly over the next 40 years, both as a guiding principle within the scientific community and as an image familiar to the general public (Chaisson, 2001; Delsemme, 1998). NASA enthusiastically embraced, elaborated and spread the concept of cosmic evolution from the Big Bang to intelligence as part of its SETI and exobiology programs in the 1970s and 1980s. When in 1997 NASA published its Origins program Roadmap, it described the goal of the program as "following the 15 billion year long chain of events from the birth of the universe at the Big Bang, through the formation of chemical elements, galaxies, stars, and planets, through the mixing of chemicals and energy that cradles life on Earth, to the earliest self-replicating organisms – and the profusion of life". With this proclamation of a new Origins program, cosmic evolution became the organizing principle for most of NASA's space science effort.

Today, the Big Question remains – how far does cosmic evolution commonly go? Does it end with the evolution of matter, the evolution of life and intelligence, or the evolution of culture? In this sense two astronomical world views hang in the balance in modern astronomy, just as they did four centuries ago when Galileo wrote his *Dialogue on the Two Chief World Systems*. The two chief world systems in 1600 were the geocentric and the heliocentric, and Galileo's *Dialogue* marshaled all the arguments for and against the geocentric and heliocentric theories. The two chief world systems today, in my view, are the physical universe, in which cosmic evolution commonly ends in planets, stars and galaxies, and the biological universe, in which cosmic evolution routinely results in life, mind and intelligence (Dick, 2000). We are on the brink today of being able to decide between these

two world views. And that is why the new science of astrobiology is so important. The third world view opened up by cosmic evolution – the postbiological universe based on cultural evolution – has not been widely discussed. But as we shall see, it may be very important for theology.

Scientific worldviews such as the biological universe are controversial with regard to their theological implications. We need only recall the heliocentric theory; in the Piazza Campo dei Fiori in Rome stands the statue of Giordano Bruno, burned at the stake by the Roman Inquisition in part for his belief in other worlds. There is a long legacy of controversy on this subject of life on other worlds and, as with the heliocentric theory, there will continue to be controversy. Moreover, as with heliocentrism, we should not expect proof of the biological universe over a short time: it is a long-term problem. A famous depiction of world systems in the *Almagestum Novum* of the Jesuit J. B. Riccioli in 1651 – more than a century after Copernicus – shows the discarded geocentric system, but the heliocentric system still being outweighed on the balance beam of truth by a hybrid system due to Tycho Brahe. World views do not change overnight. The idea of a biological universe is controversial, it is a long-term problem and, as with heliocentrism, there will be tremendous implications for humanity because it has the status of a worldview. Theology is one of those implications.

Three Outcomes of Cosmic Evolution and their Theological Implications

Of the three cosmic evolution scenarios – the physical universe, the biological universe, and the postbiological universe – which one has Nature chosen? This is not the place to sift the evidence for these worldviews, but I offer my thoughts based on recent developments in astrobiology, on the probable effect of cultural evolution over long timespans, and on the apparent biofriendly nature of the universe.

Almost all of the history of astronomy deals with our understanding of the physical universe, from Babylonian and Greek models of planetary motion, to medieval commentaries on Aristotle and Plato, the astonishing advances of Galileo, Kepler, Newton in the Scientific Revolution, thermodynamics, and the physics of stellar energy and stellar evolution. This physical universe, in which humans are the sole intelligence, is all that we know exists with certainty. The problem is that our knowledge is certainly incomplete; we are only beginning to grasp the possibilities of the universe.

Theological systems based on a physical universe, in which the attention of gods or God is limited to life on Earth, have been invented throughout human history. To take only one major example, for millennia theology was tied to the geocentric system associated with Aristotle, the Earth at the center and the heavens above. This cosmological worldview provided the very reference frame for daily life, religious and intellectual, as codified in literature such as Dante's *Divine Comedy*. Curiously, these theologies have not changed much, even after the dawn of the heliocentric system, and despite our knowledge of the increasing physical decentralization of the Earth in space. It seems to me very unlikely that we live in a purely physical universe, in which humans are the sole inhabitants, deserving the unique attention of a superior intelligence.

Ideas about a possible biological universe date back to ancient Greece, in a history that is now well known (Dick, 1982; Crowe, 1986; Guthke, 1990; Dick, 1996; Dick, 1998). The Copernican revolution, which made the Earth a planet and the planets potential Earths, provided the theoretical underpinnings for extraterrestrial life. Much of the history of exobiology is an elaboration of the theme trying to show just how similar to the earth the other planets really are. The idea of planets beyond the solar system also has a deep history stretching back at least to the 17th century works of Rene Descartes and Bernard le Bovier de Fontenelle. Theoretical ideas about the formation of planets, and empirical searches for them, are an elaboration of this theme.

Over the last 40 years scientists have begun to examine substantially the possibilities of this new worldview of the biological universe. Despite false starts like Lowell's canals of Mars, in the 1950s and 1960s four cognitive elements – planetary science, the search for planetary systems, origin of life studies, and SETI – converged to give birth to the field of exobiology. At first quite separate in terms of researchers, techniques and common goals, these fields over four decades gradually became integrated. With Oparin and Haldane in the background, origin of life studies took a giant leap forward with the Urey-Miller experiment in 1953 – the 50th anniversary of which we celebrate this year. Already in 1959 Urey and Miller saw the relevance of space to their work, arguing that the discovery of life beyond Earth was a test bed for theories of the origin of life. The following year

Drake undertook project Ozma, and began another thread in the new discipline of exobiology: SETI. The early 1960s saw the first planetary probes to Mars. And the early 1960s also saw Peter van de Kamp's claim of planets around Barnard's star. The Space Age gave major impetus to all these studies, not only from spacecraft studies of the planets, but also by funding of origin of life studies.

The Viking landers were the highlight of exobiology. And although it might be thought that the negative result for life on Mars caused a period of decline in the field, the years from 1976 to the 1990s were a time of even greater ferment in exobiology than the 1950s to 1975. The exobiology program funded research related to the three domains of life, Gaia, the primitive Earth atmosphere, the role of extraterrestrial impacts on life, life in extreme environments, among other subjects. By the 1990s many events conspired to revitalize exobiology, events with which you are all familiar: the Mars rock, the Mars Global Surveyor observations of the gullies of Mars and the Mars Odyssey detection of water near the surface, the Galileo observations of Europa, circumstellar matter, extrasolar planets, life in extreme environments like hydrothermal vents, complex interstellar organics. All these elements fed into NASA's new Astrobiology Program, which emerged from a deep organizational restructuring at NASA in 1995.

Astrobiology involved much more than renaming a discipline; it was much more broadly defined than exobiology, and was to include research in cosmochemistry, chemical evolution, the origin and evolution of life, planetary biology and chemistry, formation of stars and planets, and expansion of terrestrial life into space. Astrobiology now is a much more robust science than exobiology was 40 years ago. Astrobiology places life in the context of its planetary history, encompassing the search for planetary systems, the study of biosignatures, and the past, present and future of life. Astrobiology science added new techniques and concepts to exobiology's repertoire, raised multidisciplinary work to a new level, and was motivated by new and tantalizing evidence for life beyond Earth.

Despite recent advances, the bottom line is that we do not yet know whether or not life is common or rare in the universe. My speculation is that life is a normal part of cosmic evolution and is common in inverse proportion to its complexity. Microbial life may well be more common than intelligent life, but intelligence does arise. And given the immensity of the universe, intelligence could be quite common also.

The implications of such a biological universe have been discussed sporadically for more than 500 years. The idea of life in the universe has already generated a long history of discussion of potential impact, especially in the theological arena (Crowe, 1986; Dick, 2000d). In the Christian tradition, for example, discussion of the implications of extraterrestrial life for the doctrines of Redemption and Incarnation now have a 500-year history. More recently NASA itself has sponsored a number of societal impact studies, in accordance with the National Aeronautics and Space Act goal of identifying the impact of the space program on society. In conjunction with the launching of the NASA SETI program, in 1991-1992 NASA sponsored a systematic series of workshops on the cultural aspects of SETI (Billingham et al., 1999). And shortly after the astrobiology endeavor was launched, another group gathered to include broader concerns (Dick, 2000c; Harrison and Connell, 1999). Although the cultural impact of discovering primitive life has received little attention, the impact of contact with intelligent life has been the subject of much speculation, and some serious study. One approach is that historical analogs form a useful basis for discussion, not in the form of the usually disastrous physical cultural contacts on Earth, but by studying the transmission of knowledge across cultures and the reception of scientific worldviews (Dick, 1995). The Foundation for the Future, which focuses on the question of the state of humanity a thousand years hence, sponsored a meeting on the implications of deciphering a message with high information content (Tough, 2000). And the American Association for the Advancement of Science Program on the Dialogue between Science has launched a series of workshops on the societal implications of astrobiology. Thus the societal impact of extraterrestrial life has been recognized from a variety of viewpoints, but much remains to be done.

But we are not yet finished with the possibilities of cosmic evolution. If intelligence arises and has a significant lifetime, then we must take into account cultural evolution and its outcome – what I have called the postbiological universe. In the remainder of this paper I want to argue that there is another option aside from the physical and the biological universe, an option that thus far has not been taken seriously. But if we take seriously physical and biological cosmic evolution, we also need to take seriously cultural evolution as an integral part of cosmic evolution and the Drake Equation. For those of you familiar with the vast sweep of time in Olaf Stapledon's *Last and First Men*, you will know what I mean when I say that

we need to think in Stapledonian terms. While astronomers are used to thinking on cosmic time scales for physical processes, we are NOT used to thinking on cosmic time scales for biology and culture. But cultural evolution now completely dominates biological evolution on Earth. Given the age of universe, and if intelligence is common, it may have evolved far beyond us. I have recently argued (Dick, 2003) that cultural evolution over thousands or millions of years will likely result in a "postbiological universe" populated by artificial intelligence, with sweeping implications for SETI strategies and for our world view. It also has implications for the destiny of life, indeed, artificial intelligence may be the destiny of life on Earth if it has already happened throughout the universe. We may see our future in the evolution of extraterrestrial civilizations. This is another motivation for searching.

MacGowan and Ordway (1966), Davies (1995) and Shostak (1998), among others, have broached the subject, but it has not been given the attention it is due, nor has it been carried to its logical conclusion. The two methodological principles are those I have already mentioned: that long--term Stapledonian thinking is a necessity if we are to understand the nature of intelligence in the universe today, and that cultural evolution must be seen as an integral part of cosmic evolution and the Drake equation. The three scientific premises are 1) that the maximum age of ETI is several billion years; 2) the lifetime of a technological civilization is > 100 years and probably much larger; and 3) in the long term cultural evolution will supersede biological evolution, and produced something far beyond biological intelligence. Let's look at each of these premises in turn.

It is widely agreed that the maximum age of ETI, if it exists, is billions of years. Recent results from the WMAP place the age of the universe at 13.7 billion years, with a 1% uncertainty, and confirm that the first stars formed at about 200 million years after the Big Bang. The oldest Sun-like stars probably formed within about a billion years, or 12.5 billion years. By that time enough heavy element generation and interstellar seeding had taken place for the first rocky planets to form. Then, if Earth's history is any guide, it may have taken another 5 billion years for intelligence to evolve. In a universe 13.7 billion years old, this means that the first intelligence could have evolved 7.5 billion years ago. Norris (2000), Livio (1999), and Kardashev have all argued that extraterrestrial civilizations could be billions of years old, and it is commonly accepted among SETI practitioners.

But what about the second premise, the L, the lifetime of a technological civilization, could be billions of years? It is true that the only data point we have is ourselves. Sagan, Drake and others generally assigned L values in the neighborhood of a million years, and even some pessimists admit 10000 years is not unlikely. Of course there are a variety of natural and societal catastrophes that could prevent civilizations from reaching ages in the millions or billions of years. But the key point is the age of ETI does not have to be large for cultural evolution to do its work. Even at our low current value of L on Earth, biological evolution by natural selection is already being overtaken by cultural evolution, which is proceeding at a vastly faster pace than biological evolution (Dennett, 1996). Technological civilizations do not remain static; even the most conservative technological civilizations on Earth have not done so, and could not given the dynamics of technology and society. Unlike biological evolution, L need only be thousands of years for cultural evolution to have drastic effects on civilization.

But how can we possibly predict the course of cultural evolution? We certainly cannot predict anything, least of all cultural evolution on Earth, much less in the universe. Darwinian models of cultural evolution have been the subject of much recent study (Aunger, 2000; Dyson, 1997; Lalande & Brown, 2000; Richerson and Boyd, 2001), but they are fraught with problems and controversy – think of sociobiology, behavioral ecology, evolutionary psychology, gene-culture co-evolution and memetics.

While theoretical and empirical studies hold hope for a science of cultural evolution, lacking a robust theory of cultural evolution to at least guide our way, we are reduced at present to the extrapolation of current trends supplemented by only the most general evolutionary concepts. Several fields are most relevant, including genetic engineering, biotechnology, nanotechnology, and space travel. But one field – artificial intelligence – may dominate all other developments in the sense that other fields can be seen as subservient to intelligence. Biotechnology is a step on the road to AI, nanotechnology will help construct efficient AI and fulfill its goals, and space travel will spread AI. Genetic engineering may eventually provide another pathway toward increased intelligence, but it is limited by the structure of the human brain. In sorting priorities, I adopt what I term the central principle of cultural evolution, which I refer to as the Intelligence Principle: **the maintenance, improvement and perpetuation of knowledge and intelligence is the central driving force of cultural evolution, and**

that to the extent intelligence can be improved, it will be improved. The Intelligence Principle implies that, given the opportunity to increase intelligence (and thereby knowledge), whether through biotechnology, genetic engineering or AI, any society would do so, or fail to do so at its own peril. I have elsewhere attempted to justify this principle, but what it comes down to is this: culture may have many driving forces, but none can be so fundamental, or so strong, as intelligence itself.

The field of AI is a striking example of the Intelligence Principle of cultural evolution. Although there is much controversy over whether artificial intelligence can be constructed that is equivalent or superior to human intelligence – the so-called Strong AI argument (Searle, 1980) – several AI experts have come to the conclusion that AI will eventually supersede human intelligence on Earth. Moravec (1988) spoke of "a world in which the human race has been swept away by the tide of cultural change, usurped by its own artificial progeny." Kurzweil (1999) also sees the takeover of biological intelligence by AI, not by hostility, but by willing humans who have their brains scanned uploaded to a computer, and live their lives as software running on machines. Tipler (1994), well known for his work on the anthropic principle and the Fermi paradox, concluded that machines may not take over, but will at least enhance our well-being. But the self-reproducing von Neumann machines that Tipler foresaw in his explanation of the Fermi paradox may well exist if his view of the Fermi paradox is wrong.

It may well be that Moravec, Kurzweil and their proponents underestimate the moral and ethical brakes on technological inertia. But such objections fail to take into account cultural evolution, and may lost their impact over the longer term, as the Intelligence Principle asserts itself. When one considers the accelerating pace of cultural evolution as we enter the third millennium of our era, radical change of the sort foreseen by Moravec and Kurzweil does not seem so far-fetched.

Thus, it is possible that L need not be billions or millions of years for a postbiological universe scenario. It is possible that such a universe would exist if L exceeds a few hundred or a few thousand years, where L is defined as the lifetime of a technological civilization that has entered the electronic computer age (which on Earth approximately coincides with the usual definition of L as a radio communicative civilization.

The postbiological universe cannot mean a universe totally devoid of biological intelligence, since we are an obvious counterexample. Nor does it mean a universe devoid of lower life forms, as advocated by Ward and Brownlee (2000). Rather, the postbiological universe is one in which the majority of intelligent life has evolved beyond flesh and blood. The argument makes no more, and no fewer, assumptions about the probability of the evolution of intelligence or its abundance than standard SETI scenarios; it argues only that if such intelligence does arise, cultural evolution must be taken into account, and that this may result in a postbiological universe.

The theological implications of a postbiological universe have not been discussed because the concept of cultural evolution over billion-year time scales have not been discussed. But it may well be related to the concept of the biofriendly universe.

Summary: Cosmotheology and the Biofriendly Universe

The likelihood of the biological universe and the postbiological universe may well depend on whether or not the universe is biofriendly. Conversely, why it is biofriendly may be related to these two ultimate outcomes of cosmic evolution. Already in 1912, in his book *The Fitness of the Environment*, Harvard biochemist Lawrence J. Henderson wrote as follows: "The properties of matter and the course of cosmic evolution are now seen to be intimately related to the structure of the living being and to its activities; they become, therefore, far more important in biology than has been previously suspected. For the whole evolutionary process, both cosmic and organic, is one, and the biologist may now rightly regard the universe in its very essence as biocentric." More recently de Duve (1995) and Davies (1998) have been in the forefront of arguing that the universe is biofriendly, that life is built into the laws of nature. This brings us to the anthropic principle, and its point that our universe seems to be finely tuned for life. And it brings us to the recent book by James Gardner entitled *Biocosm* (2003). Gardner argues that life, mind and the fate of the cosmos are closely linked; that the cosmos is selfish in the sense that Richard Dawkins proposes genes are selfish, and that the universe is "selfishly focused upon the overarching objective of achieving its own replication." That objective is achieved when highly evolved intelligence (the Biocosm) gives birth to a new universe, complete with the biofriendly qualities of the mother universe. This is not the equivalent of God in the sense that this is an entirely natural process, not supernatural.

While Gardner's selfish biocosm hypothesis elevates the role of life and intelligence in the universe, it strongly non-anthropocentric. (After all, the "anthropic principle" is an elegant misnomer, because it implies life is common, not solely human life.). In Gardner's replicating universe scenario, humanity is only one embryonic intelligent species in the vast biocosm. As Gardner says, the selfish biocosm perspective "relegates humanity and its probable mechanical progeny to the functional equivalents of mitochondria – formerly independent biological entities whose talents were harnessed in the distant past to serve the greater good of eukaryotic ascendance." (p. 128).

These thoughts reinforce the five cosmotheological principles as originally elaborated:

1) Cosmotheology must take into account the certaintly that humanity is in no way physically central in the universe.

2) Cosmotheology must take into account the probability that humanity is not central biologically in the universe.

3) Cosmotheology must take into account the probability that humanity is near the bottom in the great chain of beings in the universe.

4) Cosmotheology must be open to radically new conceptions of God, not necessarily the God of the ancients, nor the God of human imagination, but a God grounded in cosmic evolution, the biological or postbiological universe, and the three principles stated above.

5) Cosmotheology must have a moral dimension, extended to include all species in the universe – a reverence and respect for life, whether it be biological or postbiological.

As our world view changes and as we become increasingly attuned to our place in the universe (Dick, 2000a; Dick, 2000b), it is time to take cosmotheology seriously. Cosmotheological principles, and the natural God of cosmic evolution, will naturally come to the fore. Considering the history of theology change may take a while. But it will come.

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