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Astrobiology in a societal context

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1.1 Introduction

In 2003 the American Association for the Advancement of Science, Program of Dialogue on Science, Ethics, and Religion, invited over twenty scholars from diverse fields, scientists active in astrobiology, as well as philosophers, historians, ethicists, and theologians, to explore together the philosophical, ethical, and theological implications of research and discoveries in astrobiology. A major motivation for this effort was the recognition that the very questions that define astrobiology as a discipline – Where do we come from? Are we alone? Where are we going? – are multidisciplinary in nature and have broad appeal to the public-at-large.

It is unavoidable that the science of astrobiology will intersect with, and inevitably challenge, many deeply held beliefs. Exploration possibilities, particularly those that may include the discovery of extraterrestrial life, will continue to challenge us to reconsider our views of nature and our connection to the rest of the universe. Much work has already been done in this area.[1] What is unique about our present circumstance is that past theoretical musings may soon benefit from a renewed urgency that is awakened both by new discoveries and by technological advances. Many of the astrobiologists assembled for this workshop have in common another interest, working proactively to provide more opportunities for non-scientists to both share in the excitement of this field, and to be informed participants in a public dialogue that considers the opportunities and challenges associated with astrobiology in the near future. With that goal in mind participants were asked that their work together have a pragmatic focus on the implications of, for example, current origin-of-life research, the discovery of extraterrestrial microbial life in the solar

[1] See, for example, S.J. Dick. *Plurality of Worlds: The Origins of the Extraterrestrial Life Debate from Democritus to Kant* (Cambridge: Cambridge University Press, 1982).

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system (in contrast to the implications of contact with extraterrestrial intelligent life), and the possibility of terraforming Mars.

The astrobiologists who participated in the workshops were charged with laying the groundwork for each topical discussion by presenting a review of the work of their field in a manner that would be accessible to scholars outside of their field. These scientific presentations were followed by presentations that reflected on the topic from a philosophical, ethical, theological or historical perspective. The perspectives included here are not intended to be exhaustive and the volume is skewed toward Christian theological responses. Given the religious demographics in this country (see below) that focus is understandable. Hopefully future work will serve to broaden the dialogue.

Following the general astrobiology themes, the three workshop topics explored were the "Origin of Life," the "Extent of Life," and the "Future of Life," all with the pragmatic focus noted above. The workshops were held over a two-year period and the majority of participants attended all three. This level of commitment and interest in the series enabled a progressively rich and ongoing level of dialogue to take place among the participants. This volume has certainly benefited from that extended dialogue. The chapters collected here were prepared in light of those discussions and each was reviewed by at least one workshop participant outside of the author's field of expertise. A general summary of the key points of each of the three parts of the volume is presented below. I also offer my own thoughts on the unique contributions that astrobiology may bring to the scientific community as it works at fostering a positive relationship between science and society, particularly here in the United States.

1.2 Astrobiology and public engagement

As a scientific discipline, astrobiology works from the assumption that the origin and evolution of life can be accounted for by natural processes, that life could emerge naturally from the physical materials that make up the terrestrial planets. Whether or not life will be a rare or common occurrence on other terrestrial planets is yet to be determined. However, with the growing number of extrasolar planets being discovered, and the development of technologies and missions to specifically search for Earth-like planets, we are progressing ever closer to determining how common or rare life is in the universe [1]. For the time being the greatest possibility of discovering past or present life on a planet other than Earth probably lies with our exploration of Mars. Indeed the focus of Mars exploration has been to understand the history of water on Mars, as the assumption is that this history will be intimately linked to the history of life on Mars, if life has ever been there or is present there now.

The focus on water reflects the decision to search for life "as we know it." The only life we currently know of is the life found on Earth, and for the scientific community the shared common ancestry of all Earth life, and its astounding diversity, is explained by the theory of evolution. The work of astrobiology, at its very core, is fueled by the theory of evolution. However, the dubious position that science holds with at least half of the American public is perhaps nowhere better illustrated than by the controversy over the teaching of evolution in this country.

A survey by the Pew Forum on Religion and Public Life (2005) [2] revealed that 42% of those surveyed believe that "life has existed in its present form since the beginning of time" (pp. 7–11). This answer persists nearly 150 years after the publication of Charles Darwin's *On the Origin of Species*, the landmark work in which Darwin proposed that living things share common ancestors and have "descended with modification" from these ancestors through a process of natural selection [3]. Perhaps even more distressing is the fact that these numbers have not changed in decades, despite the astounding advancements in science that have resulted over this same time period, i.e. from space exploration, both manned and robotic, to sequencing the human genome and imaging the brain in action. Knowledge about the physical world gained through science has certainly increased, but at least half the public is failing when it comes to science literacy, or at least evolution literacy.

It may appear that the other half is doing a bit better, after all 48% reported that "life has evolved over time," but only 26% of those were willing to credit natural selection as the process responsible [2] (p. 7). At least 18% of this group, who preferred "evolution guided by a supreme being" might welcome the latest challenge to evolution, the so-called Intelligent Design theory or ID. The basic premises behind ID are that some structures or processes associated with life are irreducibly complex, or are evidence of complex specified information, both of which imply that an intelligent designer is responsible for their production, and that evolution through natural selection simply could not have done the job.[2] An astounding majority of those surveyed, 64%, regardless of their own acceptance or rejection of evolution, feel that both evolution and creation science or ID should be taught in the public science classroom because that is the "fair" solution [2] (p. 10). How will these facts bear on the usefulness of astrobiology as a tool for encouraging a US public to share in the excitement of scientific discovery and be informed participants in a public dialogue concerning next steps? The answer, I believe, depends in large part on whether or not astrobiology as a discipline has something unique to offer society when it comes to working on the relationship between science and religion. We

[2] For a critique of Intelligent Design as well as other creationist positions see E.C. Scott. *Evolution vs. Creationism* (Westport, CT: Greenwood Press, 2004).

know precisely where the evolution illiteracy problem is rooted, in the 2005 Pew survey quoted above when people were asked "to identify the biggest influence on your thinking about how life developed," the response chosen most frequently, 42%, was "my religious beliefs" [2] (p. 10). Before considering how astrobiology might contribute to public engagement issues, we must first turn to a brief review of the religious landscape in the United States.

A few years ago I accepted an invitation to speak at a local meeting of the Secular Humanist Association. The group was interested in the general topic of science and religion, and more specifically, why the American Association for the Advancement of Science sponsored a program of Dialogue on Science, Ethics, and Religion. The secular humanists were puzzled by the fact that the scientific community would even put energy into engaging religious communities. As our discussion continued, it became clear to me that this group viewed religion as a relic on its way out and contributed its demise in large part to the success of science in revealing "the truth." Clearly one of the ideological roots of this group was the secularization theory. Simply put, this theory holds that as society becomes increasingly modernized and secular, religious belief, and the influence of religious institutions, will decline. The theory was a popular one with sociologists of religion in the 1960s but has now largely been abandoned because it is not supported by the empirical data [4, 5]. If secularization is not on the rise, how has the religious landscape, particularly in the USA, but also globally, changed?

A 2005 survey conducted by the Baylor Institute for Studies of Religion and the Department of Sociology at Baylor University directly addresses the question in terms of American piety [6]. The goal of the Baylor Religion Survey is to understand religion in America. It is a work in progress with additional surveys to be conducted over the next several years. Initial results speak directly to the question of secularization. The survey's authors note that previous national studies seemed to indicate that over the past quarter century there was an increase in the percentage of the population subscribing to no religion, rising from 8% to over 14%. However, they note that these previous studies asked people to identify their religious affiliation based on a list of possible dominations. Given the growth in non-denominational congregations, as well as congregations that do not emphasize their denominational identity, the authors suspected that this type of survey may have incorrectly equated declining denominational ties with declining religion. To test this assumption, in addition to requesting information on denomination, their survey also asked for the name and address of the respondent's place of worship. In this way the researchers could use the information to locate the place of worship within a denominational structure, even if the respondent did not recognize this connection.

Using this approach, only 10.8% of the population is determined to be religiously unaffiliated, versus the 14% of previous surveys, and the previously unaccounted

for 3% belong to Evangelical denominations. The denominations with the greatest affiliation include Catholic (21.2%), Evangelical Protestant (33.6%), and Mainline Protestant (22.1%). Furthermore, of the 10.8% that report being unaffiliated with organized religion, 62.9% report believing in God or some higher power [6] (pp. 7–8, 12). Religion is not in decline in the US and is experiencing growth similar to that found in other areas of the world, namely an increase in Evangelical Protestantism, Charismatic Christianity and "spirituality" [7].

Within the USA the growth of Charismatic Christianity can be seen within both Catholicism as well as within Protestantism. In its earliest phase the Charismatic movement was referred to as "Pentecostalism" and within the US it originated in the early twentieth century within a marginalized urban community in Los Angeles, the Asuza Street Apostalic Faith Mission. "Charismatic" is the more general term used to describe the movement in the later twentieth century. Charismatic Christianity is characterized by an emphasis on a direct personal experience of the Spirit of God, often evidenced in worship services by "speaking in tongues" and "healings." In addition to the rise of Charismatic Christianity within the US, another notable, and related trend, is the increase in "spirituality." Recall that even of the 10.8% of individuals in the Baylor Survey who report being unaffiliated with organized religion, 62.9% report believing in God or some "higher power." This finding is revealed even more dramatically in the results of a recent Gallup Poll, *The Spiritual State of the Union: The Role of Spiritual Commitment in the United States* [8]. This survey, consisting of 1004 interviews with US adults conducted in February and March 2006, reports that 40% of the respondents described themselves as "spiritual but not religious" and this percentage has increased by 10% since a similar survey conducted in 1999. The majority of respondents (49%) still define themselves as "religious"; however, another 7% describe themselves as "both" and only 3% as "neither." When asked more specifically about their beliefs, 82% reported believing in God whereas 13% chose instead belief in a "universal Spirit." Note then that of the 40% who chose to describe themselves as "spiritual but not religious" 26% still identify with theism.

Spirituality is also a factor in the UK, where Steve Bruce has shown that over a 40-year time span belief in a personal God may have fallen by 8%, but at the same time belief in "some sort of spirit or vital force which controls life" has risen by 3% [9]. Paula Heelas uses this work as well as data on religious belief in Sweden and the United States to argue that the middle ground, between those who regularly attend church and those who are declared atheists and agnostics, is increasing, and this increase is due at least in part to the growth of spirituality [10]. What exactly do we mean by "spirituality"? Heelas defines the term by contrasting it with religion, which she describes as being centered on a transcendent God whose will is mediated through tradition. Spirituality, in contrast,

is not concerned with institutionalized authority, but on a direct experience of the divine immanent in life:

> "Spirituality" has to do with the personal; that which is interior or immanent; that which is one's experienced relationship with the scared; and that wisdom or knowledge which derives from such experiences. At heart, spirituality has come to mean "life" [10] (p. 358).

It appears that those who define themselves solely as spiritual actually share a common ground with the Charismatic branches of Evangelical Christians, Mainline Protestants, and Catholics, and it is this common ground that is growing within the USA. Heelas refers to this common ground as the "HS" factor, which for non-traditionalists, or non-theist spiritualists, implies "the 'higher self' within" that is pursued. For more traditional or theistic spiritualities, "HS" refers to the quest for the indwelling of the Holy Spirit; for both the focus is on empowering this life in the here and now. Can astrobiology actually provide a bridge to engaging a religious US public that increasingly, both within and outside of theistic traditions, describes itself as spiritual? Maybe, if we are willing to build more than one type of bridge.

How would the goals of astrobiology be viewed by those subscribing to theistic spirituality, specifically the increasing numbers of Charismatic Christians in the United States? As this group places more emphasis on interpreting the Bible as an authoritative historical document than liberal Christian communities, we can predict that the greatest tension might be between what astrobiology learns about the origin and evolution of life and the Biblical creation story. The same would be true for conservative Evangelical Protestants. However, it would be incorrect to assume that either all Charismatic Christians or all Evangelical Protestants will insist on a literal reading of Genesis; not all are fundamentalists and in fact Charismatic Christianity in the United States is characterized by the importance it places on a direct experience of the divine, over a strict adherence to doctrine. For more liberal Charismatic Christians and Evangelical Protestants the challenging theological questions will be the same as those for liberal mainline Christians: what was God's role in an origin of life that arose naturally, or, put another way, how does God act in nature?

Emphasizing the nature of science and the differences between science and religion (see below) is one effort the scientific community can make to help alleviate this tension, but serious theological work remains to be done as well. Whereas some of this work is beginning to take place in liberal mainline Christian circles,[3]

[3] See, for example, C. Baker. *The Evolution Dialogues: Science, Christianity, and the Quest for Understanding*, ed. J. B. Miller (Washington DC: American Association for the Advancement of Science, 2006).

the very nature of Charismatic Christianity, with its focus on individual experience at the expense of institutionalized doctrine, will be counterproductive in terms of building a theological framework that incorporates what science has learned about the world. Much work remains for the Evangelical Protestant community as well.

As for the other questions astrobiology poses, concerning the extent of life and the future of life, I would argue that these are less threatening, assuming that our greatest possibility for discovering life in the near future is microbial life on Mars, and that they can provide unique opportunities for outreach. The discovery of a second genesis of life on Mars most likely would ignite origin and evolution issues; microbial life related to Earth life would undoubtedly be an exciting discovery, but not one that is particularly challenging to religious beliefs. Future of life questions, in the broadest interpretation, might appear as an irrelevant question for Charismatic Christians and Evangelical Protestants in general, as the Biblical account of history promises a future salvation. On the other hand, interpreting this question in terms of sustainability issues on Earth can resonate with both liberal and more conservative Christians, as recently evidenced by the agreement initiated by prominent members of the Evangelical community to work collaboratively with the scientific community on global climate change [11].

I suggest above that we should not expect Charismatic Christianity to be encouraging of developing theologies that incorporate scientific findings, not because of a negative attitude toward science, but because the focus of spirituality is on individual experience, not the development of doctrine. However, I also suggest that particular assumptions and possible discoveries of astrobiology will most likely be met with resistance by members of this group, as well as Evangelical Protestants in general, and even many liberal Christians, because of the challenges they raise concerning God's role in nature and creation. That said, I am still intrigued by the identification of "spirituality" with "life," quoted above, and what this might imply for a research and exploration program focused on life. Does astrobiology present a unique opportunity for the scientific community to engage with religious communities, whose members are increasingly defining themselves as spiritual, through a shared interest in "life"?

There is evidence that the answer for non-theist spiritualists, admittedly a smaller percentage than the theist spiritualists (13% vs. 26%), is yes. Consider, for example, the work of Ursula Goodenough [12]. Her main premise, eloquently expressed in her work, *The Sacred Depths of Nature*, is that a modern understanding of nature can give rise to religious emotions, which she defines as "shared cosmology and shared morality." Through the story that science tells about the cosmos, with an emphasis on the origin and interconnectedness of life on this planet, a planetary ethic may emerge that will provide a guideline for addressing global concerns, including sustainability issues. For the non-theist spiritualist the story about life

that astrobiology is both telling, and striving to discover, might serve to encourage an interior experience of the divine, that is, "The Sacred Depths of Nature." Can the same be true for a theist spiritualist, particularly if their worldview stems from conservative Christianity? Perhaps the answer depends on how the astrobiology community engages these individuals.

The scientific community at large, despite unfortunately the opinion of some of its most vocal members, is taking great effort to remind the public that science and religion do not need to be in conflict. One recent example is the new publication by the National Academy of Science, *Science, Evolution, and Creationism* [13]. This publication emphasizes the "non-overlapping magesteria" or contrast view of science and religion which was popularized within the scientific community especially by Stephen J. Gould and his book *Rock of Ages: Science and Religion in the Fullness of Life* [14]. Simply put, this model assumes that there can be no conflict between science and religion since they respond to different questions; science tells us how, religion tells us why. The Clergy Letter Project is another recent effort that promotes the contrast view of science and religion [15]. The letter was initiated on the part of the scientific community (in response to the controversy over the teaching of evolution in public science classrooms) but seeks the help of clergy to spread the message. To date over 11,000 clergy members have signed the letter, which includes the plea, "We ask that science remain science and that religion remain religion, two very different, but complementary forms of truth." This is a message the scientific community is comfortable with and one that fits nicely within a broader program that encourages the scientific community at large to pay careful attention to how they "frame" their public statements [16].

Certainly, in regards to engaging a religious public around what science is learning about the world, this model is preferable to one more commonly assumed, a conflict model, which depicts science and religion as two endeavors inherently at odds with one another (a model which historians of science and religion have shown to be oversimplified).[4] When we speak as science educators we use the contrast model when we desperately try to help people understand what science is and can do, and what it isn't and can't do. This is an important message and one that scientists need to keep conveying. That said, I would argue that another approach has its time and place as well and that the astrobiology community would do well to embrace that approach – namely one that looks for dialogue and interaction.[5] In order to participate in that approach, we need to be able to listen, and to recognize

[4] For a review of the interaction between science and Christianity through history see D.C. Lindberg and R. Numbers (eds.). *God and Nature: Historical Essays on the Encounter between Christianity and Science* (Berkeley, CA: University of California Press, 1986).

[5] For a review of models relating Science and Religion see, for example, J.F. Haught. *Science and Religion: From Conflict to Conversation* (New York: Paulist Press, 1995).

that different religious constituencies will require different engagement models – we must be building multiple bridges.

Let me illustrate that point with a quote from the *Washington Post Magazine* in January 2006. The cover from that edition read, "Darwin vs. God, what the war between evolution and Intelligent Design is really about." I believe the author, who interviewed students, teachers, and scientists for this story, expresses quite nicely why we need more than a contrast approach in dealing with science and religion, "If intelligent design advocates have generally been blind to the overwhelming evidence for evolution, scientists have generally been deaf to concerns about evolution's implication" [17].

1.2.1 Who is it that feels we are not listening and what can we do to reach them?

The 2005 Pew Survey responses, when broken down according to the broad Christian religious affiliation categories of "Evangelical," "Mainline Protestant," and "Roman Catholic," illustrate that all affiliations, even secular, have a percentage of individuals who believe that "life has existed in its present form since the beginning of time." This view is, however, predominant among those who classified themselves as Evangelicals (70% of Evangelicals). Mainline Protestants and Catholics are more accepting of life evolving over time (60%) with nearly equal amounts attributing the process to natural selection or guidance by a supreme being [2]. The contrast view of science and religion is particularly appealing to Mainline Protestants as is demonstrated, for example, by the positive response these congregations have given to another outreach effort associated with the Clergy Letter Project, "Evolution Sunday."

Evolution Sunday, held near Darwin's birthday, encourages clergy to devote one Sunday to emphasizing that science and religion complement one another [15]. Assigning denominations to the same broad religious affiliations used in the Baylor Survey [6], we find that of the 558 congregations that participated in Evolution Sunday in 2007 the majority (78%) represented Mainline Protestant churches; the next largest category (18.1%) consisted predominantly of Unitarian Universalist congregations (a liberal religion with Judeo-Christian roots). Evangelical Protestant congregations accounted for less than 2% of the participating congregations.

The success story of the Clergy Letter Project, Evolution Sunday, and the contrast approach in general, is that mainline Christian denominations are being vocal about supporting the teaching of evolution. This is good news. A remaining and serious challenge is to engage evangelical communities on this issue and a contrast approach to science and religion is unlikely to accomplish this end. We need to honestly ask ourselves, is our goal limited to keeping creationism out of the

science classroom, perhaps by majority rule, or are we interested in working long term towards a widespread acceptance of evolution? A widespread acceptance of evolution in the United States will require that the scientific community go beyond a simple contrast approach and be willing to encourage, and participate in, a program of in-depth and long-term engagement with theologians and religious community leaders.

We are correct in helping people understand that science can't by itself answer questions about meaning. But in doing only this, without a broader conversation, are we also suggesting that what science learns about the world, what the world is, has absolutely no relevance for our thoughts about what the world means? Are we condoning a focus on life as an interior experience, disconnected from the larger context? If astrobiology has done anything for the scientific community it has at minimum encouraged us to expand our vision beyond that of our immediate discipline, to see the larger context and to struggle to find a way to participate in a multidisciplinary scientific dialogue. This is the very contribution that I suggest makes astrobiology the ideal discipline for expanding the dialogue into an even broader context with a specific invitation to theologians and religious leaders to participate. We may even be able to build on the interest of theistic spiritualists in "life" so that through astrobiology in particular we may engage their interest in what science has learned about the world.

Securing a religious public's support for space science research and exploration, so that it merits a high enough priority to claim resources, though vital, is only the beginning. It is in the sharing of what we learn from the exploration that the process comes full circle, and then, only when the discoveries are owned by both the religious and the spiritual, both the liberal and conservative. Hopefully this volume provides one example of the broadening of context that can occur for all involved when members of the astrobiology community invite theologians, ethicists, historians and philosophers to learn about astrobiology, to reflect on its work from the perspective of their own discipline, and to share their findings with the scientific community and the public at large. Summarized below are the key points of the contributors to this volume, organized according to astrobiology themes.

1.3 Origin of life

Where did we come from? Astrobiology includes the study of the origin and evolution of life on Earth and draws on the results of these studies to explore the possibility of life arising and thriving on other planetary bodies. The authors of the first part of this volume, an origins researcher, a historian, a philosopher, and two theologians, specifically address the origins question from the perspective of their discipline. They provide an introduction to the science of life's origin; describe