

Chapter 2

Astrobiology and Astrotheology in Creative Mutual Interaction

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Abstract

By placing astrobiology and astrotheology into creative mutual interaction (CMI), the theologian can offer an internal critique of the science. According to CMI proponent, Robert John Russell, CMI mandates that theology point out in science any hidden ideological or religious factors that befoul the research. At work among some astrobiologists is the extraterrestrial intelligence (ETI) myth. The ETI myth assumes that biological evolution is progressive and that progressive evolution over a longer period of time on exoplanets will have produced alien creatures with higher intelligence than Earth's human race. The more intelligent aliens, according to the ETI myth, will be more advanced than earthlings in science, technology, medicine, ethics, and secularization. When contact is made, Earth will be blessed by the aliens. In short, science saves, and more advanced extraterrestrial science will bring salvation to the less highly evolved Earth. This chapter will demonstrate that the ETI myth is not sound science. Evolutionary biologists deny that biological speciation is progressive. By projecting progressive evolution on to alien life, the speculation of space researchers departs from what is scientifically reliable. If the field of astrobiology would eliminate the ETI myth, its scientific research program might become more demonstrably scientific. Science should stick to science rather than practice theology without a license.

Introduction

When formulating the editorial policy of the journal, *Theology and Science*, the editorial team at Berkeley's Center for Theology and the Natural Sciences considered multiple options. We finally elected *creative mutual interaction* (CMI). Here is what one will find inside the front cover:

The primary editorial goal of *Theology and Science* is to publish critically reviewed articles that promote the creative mutual interaction between the natural sciences and theology.

On the journal's cover stands the Golden Gate bridge (Figure 1), signaling traffic between science and faith. The traffic on the bridge can go two directions. On the one hand, the traffic travels from science to theology. The theologian draws upon one or another field within the natural sciences to challenge or enrich his or her religious vision. On the other hand, openings do appear from time to time where the traffic travels from faith to science. On occasion the theologian may offer an internal critique of a

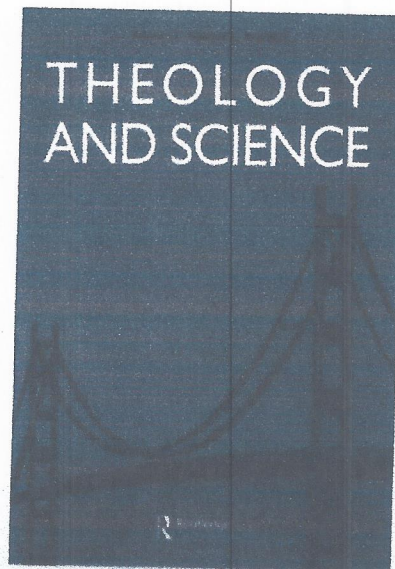


Figure 1. *Theology and Science* journal's cover with the Golden Gate bridge signaling traffic between science and faith.

scientific discipline or, on other occasions, suggest a research agenda to be followed up by scientific research. Here is what CMI looks like from the perspective of Pope John Paul II (1988).

Science can purify religion from error and superstition; religion can purify science from idolatry and false absolutes. Each can draw the other into a wider world, a world in which both can flourish.

Might CMI provide a fitting method for relating astrobiology with astrotheology? Certainly theologians must give attention to the fast moving research frontier of astrobiology and related space sciences. New discoveries energize interest everywhere. The fires of excitement have been kindled. A new and wider picture of the cosmos is being painted in our minds. For the theologian, God's creation looks bigger, more magnificent, and increasingly mysterious. Yet, we must also ask: might the theologian have anything important to say to the space scientist?

In what follows, we will define and describe the fast moving field of *astrobiology*. This will be followed with a definition of *astrotheology*. We will turn then to a critique of astrobiology from the perspective of the astrotheologian, demonstrating that some scientific research programs can *sub rosa* incorporate a hidden myth. In this case, it's the extraterrestrial intelligence (ETI) myth. The ETI myth assumes that biological evolution is progressive and that progressive evolution over a long period of time on exoplanets has produced alien creatures with higher intelligence. The more intelligent aliens, according to the ETI myth, will be more advanced than earthlings in science, technology, medicine, ethics, and secularization. When contact is made, Earth will be blessed by the aliens. In short, science saves, and extraterrestrial science will bring salvation to the less highly evolved Earth. In practice, this myth functions as a hidden religious ideology at work in the heart of science.

We will demonstrate that the ETI myth is not sound science. Evolutionary biologists deny that biological speciation is progressive. By projecting progressive evolution on to alien life, the speculation of space researchers departs from what is scientifically reliable. If the field of astrobiology would eliminate the ETI myth, its scientific research program might become more demonstrably scientific. Science should stick to science rather than practice theology without a license.

What is astrobiology?

On one end of the telescope we find stars and galaxies. On the other end of the telescope we find the eye of the astronomer. A balcony full of scientists await to hear what the astronomer sees. The handy term *astrobiology* connotes the entire collection of connected space sciences. "Astrobiology is the scientific study of life in space. It happens when you put together what astronomy, physics, planetary science, geology, chemistry, biology, and a host of other disciplines have to say about life and try to make a single narrative," says Mix (2009, p. 4).

NASA (2003) began using the term, *astrobiology*, in the 1990s to refer to its work on life in the universe. NASA's *Astrobiology Roadmap* designates the research program.

ASTROBIOLOGY ADDRESSES THREE BASIC QUESTIONS that have been asked in various ways for generations: how does life begin and evolve, does life exist elsewhere in the universe, and what is the future of life on Earth and beyond? Accordingly, the discipline of astrobiology embraces the search for potentially inhabited planets beyond our Solar System, the exploration of Mars and the outer planets, laboratory and field investigations of the origins and early evolution of life, and studies of the potential of life to adapt to future challenges, both on Earth and in space. Interdisciplinary research is required that combines molecular biology, ecology, planetary science, astronomy, information science, space exploration technologies, and related disciplines. The broad interdisciplinary character of astrobiology compels us to strive to achieve the most comprehensive and inclusive understanding of biological, planetary, and cosmic phenomena (NASA, 715).

The most fascinating destination on the Astrobiological Roadmap is the "the search for potentially inhabited planets beyond our Solar System." Of particular interest here will be radio astronomy and the research pursued at the SETI (Search for Extraterrestrial Intelligence) Institute. Among the SETI approaches is the use of radio telescopes to listen for narrow-bandwidth radio signals from space. Such signals are not known to occur naturally, so a detection would provide evidence of extraterrestrial technology (SETI). SETI researcher Shostak (2011, p. 41) registers the excitement of the SETI ambiance. "Proof of thinking beings beyond Earth would be one of the most profound discoveries ever".

With 3500 confirmed exoplanets now discovered plus speculations that 100 billion more are out there, the prospects of finding an earth-like planet with extraterrestrial neighbors seems high. Astrobiological expectations also include the prospect of finding "superhabitable worlds," that is, planets with more bio-longevity than ours. "Earth is past its prime, and the biosphere is nearing its end," observes Heller (2015, p. 35), writing for *Scientific American*. So, life might get a better shake on an exoplanet. "Some exoplanets, quite different from our own, could have much higher chances of forming and maintaining stable biospheres" (Heller, 34). In our terrestrial minds, the scope of our cosmos is about to undergo a quantum expansion. Just who might be living on one of these superhabitable planets?

What is astrotheology?

Astrotheology responds to astrobiology. And more.

In principle, one could propose a definition of *astrotheology* specifically for a Muslim or Hindu theologian, or someone beginning from a parallel religious point of departure. Here is the definition I work with: *Christian Astrotheology* is that branch of theology which provides a critical analysis of the contemporary space sciences combined with an explication of classic doctrines such as creation and Christology for the purpose of constructing a comprehensive and meaningful understanding of our human situation within an astonishingly immense cosmos (Peters, 2013a; 2014). Astrotheology is not an isolated pond set off in a field of its own. Rather, it is a tributary flowing within the larger stream of systematic theology.

Astrotheology is a theology of space science. The astrotheologian monitors the discoveries of the astrobiologist, especially speculations regarding the possibility of extraterrestrial life. The possibility of engaging extraterrestrial life, either microbial life within our solar system or intelligent life on exoplanets, challenges the theologian to re-think traditional commitments. Challenges become opportunities, we have learned over the centuries. And, the space sciences may provide opportunities for faith enrichment within an expanding worldview.

With challenges and opportunities in mind, I recommend the astrotheologian take up four tasks. First, Christian theologians along with

intellectual leaders in a variety of religious traditions need to reflect on the scope of creation and settle the persisting issue of geocentrism. Even though the late medieval church was less geocentric than critics claim, recent schools of thought such as liberation theology and eco-theology are adopting Earth-centricism while ignoring our planet's solar system context. Second, the astrotheologian should set the parameters within which the ongoing debates over Christology (Person of Christ) and soteriology (Work of Christ) are carried on. In the Christian *ordu salutis* (order of salvation), might God require multiple incarnations, one for each extraterrestrial civilization? Third, theologians should analyze and critique astrobiology and related sciences from within, exposing extra-scientific assumptions and re-assessing the larger value of the scientific enterprise. We will return to this third task momentarily. Fourth, theologians and religious intellectuals should cooperate with leaders of multiple religious traditions plus interested scientists to explicate ethical issues and, perhaps even more dramatically, to prepare the public for the eventuality of extraterrestrial contact. This fourth task begins with enumerating the ethical issues arising from the space sciences such as planetary protection, satellite surveillance, space debris, weaponization of space, the intrinsic value of off-Earth biospheres, and such (Peters, 2013b, 2013c). By identifying and formulating ethical issues attached to space exploration, the theologian can contribute to public discussion and policy formulation.

Taking up tasks one, two, and four recognize that traffic across the bridge of dialogue begins with science and drives toward theology. The third task, in contrast, travels the opposite direction. Might the theologian offer to the astrobiologist something of value? Is it too audacious to suggest such thing?

From dialogue to creative mutual interaction

Perhaps the dominant model for the interaction between science and religion is what I call *Two Languages* (Peters, 2003, pp. 18–19) or what Ian Barbour calls *Dialogue* (Barbour, 1997, pp. 90–98). If scientists and theologians speak different languages, then dialogue is fitting. Dialogue becomes a form of interaction which respects and honors each field. Dialogue, accordingly, relies on a bridge in which the traffic from both directions drives to the

middle and stops. If we would like to see the two-way traffic actually cross the bridge, then the CMI model would be more protean.

On the bridge of dialogue the traffic seems stopped, as I have just mentioned. Schwarz (2002, viii) at Regensburg yearns to see it get going again. "While religion and the sciences are no longer on a collision course, still wanting is the mutual enrichment one might expect from meaningful dialogue between these worthy partners". By *meaningful* dialogue, I believe Schwarz is looking for CMI to get traffic moving again.

Tübingen's Moltmann explains why we currently have a traffic jam. "Up to now the attempt to bring *pure science and scientific, or scholarly, theology* into direct dialogue has borne only limited fruits. For this there are two main reasons. For one thing, scientists do not expect this dialogue to bring them any increase of knowledge in their own field. For another, many scientists, and a good many theologians too, lack the knowledge of philosophy which would provide a mediating level" (Moltmann, 2003, p. 25). Moltmann believes philosophy will strengthen the dialogue bridge. With or without philosophy, the theologian has the resources to offer the scientist an internal critique of his or her theory to flush out hidden philosophical presuppositions. Frequently, scientific theories incorporate non-scientific assumptions which are either theological or anti-theological in nature. Perhaps the theologian could blow a referee's whistle to alert us all to what is happening. The result for the scientist just might be a refinement of his or her theory and a modification of the research program.

To open up the traffic jam, we should augment the dialogue model; we should modify it by adding creative mutual interaction or CMI. Robert John Russell, founder and director of the Center for Theology and the Natural Sciences, has refined CMI so as to take us beyond dialogue to increased engagement and greater productivity. CMI describes and urges "the development of research programs in theology and science that make novel moves from theology to science as well as standard moves from science to theology" (Russell, 2008, p. 132). What seems universally acceptable is that science ought to influence theology. But, what about the reverse? "Theology can now have an influence on science: it can play a constructive and heuristic role within the implicit philosophy of nature that undergirds science and within the explicit context of scientific discovery" (Russell, 2002a, p. 17).

Astrotheology's third task: Exposing the ETI myth

Recall astrotheology's third task: theologians should analyze and critique astrobiology and related sciences from within, exposing extra-scientific assumptions and re-assessing the larger value of the scientific enterprise.

Astrobiologists and their colleagues are producing scientific knowledge that the entire globe can be proud of. The populace of our planet sits on the front of its chair, waiting for the next discovery news. This is science worth celebrating.

Yet, the field of astrobiology requires a close examination. A close analysis will uncover some extra-scientific even disguised religious commitments that could skew interpretations of data. By exposing what is extra-scientific within the science of astrotheology could be of value to the researcher as well as to the wider public.

In the case of SETI and related searches for life on exoplanets, at work among scientists is a set of presuppositions that constitute a myth. Here we will call it the *ETI Myth* (Peters, 2009, 2014). In brief, the ETI myth presupposes that on each habitable planet life will begin, evolve, and progress as it has on Earth until it produces intelligence. Once extraterrestrial life has evolved to Earth's level of intelligence, it will progress further in science, technology, and solving the problems of social life. If life on an exoplanet has evolved a million years longer than on Earth, one can expect a million years more progress in science and technology. This progress may include medical advance, social harmony, and the elimination of war. If such extraterrestrials come into contact with those of us who live on Earth, they will bring blessings, healing, and the secular equivalent of salvation. So goes the ETI myth.

The myth is covert, not overt. In order to spot the myth at work, one needs to read between the lines and tease out the presuppositions at work.

One of the most informative and encyclopedic scholars in the field of Science and Religion is the indefatigable Davies (2010). Since taking a position on the faculty at Arizona State University, he has devoted his research to astrobiology. Davies displays the logic of the ETI myth.

Any alien civilization the SETI researchers might discover is likely to be much older, and presumably wiser than ours...Indeed, it might have achieved our level of science and technology millions or billions of

years ago....it is more likely that any civilization that had surpassed us scientifically would have improved on our level of moral development, too. One may even speculate that an advanced alien society would sooner or later find some way to genetically eliminate evil behavior, resulting in a race of saintly beings. (Davies, 2003, 114–115; see Davies, 1977, 209–210).

If we ask about the presuppositions at work here, this one stands out: evolution is progressive. Evolution, Davies assumes, leads over time to the development of science and technology. Further, evolution leads to advances in morality and even in saintliness. We notice another subtle theme: the advance beyond evil in Davies' extraterrestrial scenario is not achieved spiritually, but genetically — that is, scientifically. In short, science saves. This is the redemptive gospel of the ETI myth: science saves. Because science is the most evolutionarily advanced achievement so far on Earth, an extraterrestrial science with a longer time to evolve would be even more advanced and more perfect than ours. The theologian must press the question: is this science or is it myth?

Tarter, former director of SETI, adds secularization to the ETI myth. She anticipates that secularization has already taken place in an advanced exo-society. Exo-secularism will trump our primitive terrestrial religions. "An information-rich message from these extraterrestrials will, over time, undermine our own world's religions" (Tarter, 2000, p. 147). To be more highly advanced is to jettison religion and replace it with science. After all, science saves.

Davies and Tarter are scientists. Curiously, we can find the ETI myth at work in some theologians as well. For Boston University theologian Hart, the myth begins with an affirmation of evolution in its progressive form. "In the vastness of space and over its eons of time, life on other worlds, too, might have evolved to be intelligent life. Extraterrestrial intelligent life (ETI) might be billions of years older than terrestrial intelligent life (TI) — and considerably more advanced biologically, intellectually, socially, and spiritually" (Hart, 2014, p. 20). When we see terms such as *evolution* and *advanced* used together, we see the foundations of the ETI myth being laid. Evolutionary advance might take ETI beyond the primitive stage of religion where retarded religious believers here on Earth remain.

If the gospel message of the ETI myth is that science saves, then the highly evolved extraterrestrials must have passed through religion and arrived at the more progressive stage of secularized science and technology. "ETI might even have evolved to a higher spiritual understanding in which institutional forms of religion have become irrelevant" (Hart, 2014, p. 177). Those of us who remain religious today represent a lower step on the evolutionary ladder, a childish and immature stage of development. When we step up, we will advance beyond our religious adolescence into a scientific and spiritual maturity.

The theologian must interrogate the ETI myth and ask: is this good science? Is it science at all?

The doctrine of evolutionary progress: Is it good science?

The ETI myth is founded on two premises. First, biological evolution is progressive. Second, we can imaginatively export evolutionary progress from Earth to other habitable planets. The first of these two premises does not conform to what most evolutionary biologists think. The matter is debatable, to be sure; but the prevailing view is that the first premise — evolution is progressive — is false.

Nobel Prize winning biochemist de Duve is a contact optimist who affirms that evolution is progressive. "Life is the product of deterministic forces," writes de Duve. "Life was bound to arise under the prevailing conditions, and it will arise similarly wherever and whenever the same conditions obtain. There is hardly any room for 'lucky accidents' in the gradual, multistep process whereby life originated. This conclusion is compellingly enforced when one considers the development of life as a chemical process" (de Duve, 1995, p. xv). Similarly, astrobiologist Chela-Flores is a convergence theorist who thinks evolutionary forces conspire to follow a direct path from simple eukaryotic cells to brains and intelligence. And this path would be followed by life on any habitable planet. This means that "the evolution of intelligence as searched in the SETI program is a rational scientific pursuit" (Chela-Flores, 2011, p. 205). As long as the right chemical conditions exist on an exoplanet, one can expect life to begin, evolve, develop, and progress into an

intelligent form we would recognize. In short, at least two evolutionary biologists provide support for the ETI myth.

However, de Duve and Chela-Flores are in a minority, a tiny minority. The prevailing view among the world's leading evolutionary biologists is that evolution has no inner *telos*, direction, or meaning. The prevailing view does not embrace de Duve's determinism. Rather, it embraces contingency, randomness, accident. Evolution is not progressive. Simple life forms do not automatically develop into complex forms let alone intelligent species. Rather, at each juncture, evolutionary changes are random. Harvard biologist Mayr put it this way: "At each level of this pathway there were scores, if not hundreds, of branching points and separately evolving phyletic lines, with only a single one in each case forming the ancestral lineage that ultimately gave rise to [humanity]" (Mayr, 1985, p. 27). This suggests that Earth is unique, that terrestrial evolution is not likely to be repeated anywhere else in the universe. Most evolutionary biologists hold the unique Earth position: we are alone in the universe. Simple life forms may exist on other celestial bodies, but not intelligent ones. This is the unique Earth position.

Former AAAS president and evolution researcher, Ayala agrees with Mayr. When Ayala poses the question regarding the possible existence of ETI, he says, "My answer is an unequivocal 'no'." Ayala's strong opposition is based on what has happened in our planet's evolutionary history, wherein every biological event has been contingent. The direction of speciation has not been guided by any internal purpose or entelechy (Ayala, 2004). It would be unscientific to believe a longer period for evolution would lead to increased intelligence or to advanced levels of science.

Philosophers of biology cannot stress strongly enough that evolutionary theory does not include progress. This undermines any speculation that ETI would be more advanced than earthlings. Philosopher of biology Michael Ruse (1985) trumpets: "There is absolutely no guarantee of an upward progression on our hypothetical planet to intelligent life forms....evolution of intelligence is not a necessary consequence of life appearing: not at all" (Ruse, 50). Even if life appears on an exoplanet, no scientific reason exists to expect that it will have evolved to a more highly advanced civilization with superior science and technology let alone more advanced medicine, politics, ethics and secularized spirituality.

Biologists Lazcano and Hand (2012) discern the extra-scientific assumptions influencing the astrobiological vision. "Astrobiology seems to include everything from the chemical composition of the interstellar medium to the origin of evolution of intelligence, society and technology — as if the Universe is following an inevitable upward linear path leading from the Big Bang to the appearance of life and civilizations capable of communication" (Lazcano). Theologians Losch and Krebs (2015) conclude, "there is indeed a religious undertone to much of the SETI supporter's statements" (Losch).

What we in this chapter want to gain from the testimony of evolutionary biologists is not the unique Earth hypothesis. Rather, what is important to observe is that our leading biologists repudiate the foundational doctrine on which the ETI myth is constructed, namely, the doctrine of progress. This means that, even if there exists life elsewhere in the universe, we have no scientific basis for speculating that this life would turn out like us. Even more preposterous is the speculation that ETI will be more advanced than earthlings in science, technology, society, ethics, and secularization. Like removing the chair from beneath an obese diner, the ETI myth will simply crash to the floor. So also will its central message: extraterrestrial science will save us.

Theologian Herrick employs the term, "Myth of the Extraterrestrials," when labeling the conceptual set out of which these astrobiologists work. Those who justify looking for life on exoplanets commonly adopt "the idea that intelligent extraterrestrials exist and that interaction with them will inaugurate a new era in human existence". He adds, "this Myth is certainly closely connected to, is perhaps the offspring of, the most powerful scientific idea of the last two hundred years, evolution" (Herrick, 2008, p. 51). On Earth, evolution is a fact. On an exoplanet, if the prevailing view holds, evolution most likely follows a path different from that on Earth. There is no good biological reason to expect that extraterrestrial science will save us earthlings from our bad habits.

Even if astrobiologists supportive of SETI are pursuing good research, the assumptions built into their conceptual set are ideological rather than scientific. If astrobiologists would take the arguments of evolutionary biologists such as de Duve or Chela-Flores and defend them against the prevailing view, at least this would count in justifying the astrobiological

research agenda. But, this defense remains silent. Instead, the field of astrobiology works with evolutionary progress as a presupposition rather than a supposition. Such a presupposition becomes, thereby, ideological or mythical rather than scientific. In addition, this presupposed ideology includes a value system that ranks science and secularization above outdated religion. Astrobiology's mission — science saves — cannot itself be scientifically justified. The theological community might consider assuming a prophetic role to point out that this field of science is trying to stand on non-scientific legs.

Does astrotheology's third task include demythologizing the ETI myth?

Demythologizing

Theologians are used to demythologizing. By no means does this require elimination of the myth, at least when interpreting scripture. Rather, demythologizing *interprets* myth. The aim of *demythologizing*, according to New Testament scholar Bultmann, "is not to eliminate the mythological statements but to interpret them" (Bultmann, 1958, p. 18).

Interpreting myths belongs within a religious tradition. What about myths within science? They should be expunged! Science weakens its own research programs if it fails to acknowledge its unscientific presuppositions. The third task of the astrotheologian is to point out the ETI Myth toward the end of purifying the scientific research program.

"I work with models. Not myths." This is what we want to hear from the lips of our scientists. Models are cognitive structures that organize data in a meaningful fashion. Scientific theorizing relies upon model construction. Models tend toward rational or even mathematical form (Barbour, 1974). Most importantly for this discussion: in a conceptual model all of the presuppositions are acknowledged. The problem with the ETI myth is that too many presuppositions — such as the gospel that science saves — constitute a hidden ideology. Bringing the hidden ideology to light permits a purification of the scientific model so that it can function with greater precision when drawing out a research hypothesis. To put it crassly: scientists should pursue science and not try to practice theology without a license.

Conclusion

Civilization should be grateful for astrobiologists, because these scientists are discovering and teaching so much that is valuable. But, we cannot ask science to provide ultimate truth or to promise a salvation it cannot deliver. "The best science, to its great merit," write Vatican Observatory researchers Coyne and Omizzolo (2002), "does not pretend nor presume to have the ultimate answers" (Coyne, 7). Recall how His Holiness, Pope John Paul II, reminded us that "religion can purify science from idolatry and false absolutes." The ETI myth borders on "idolatry and false absolutes." Even if this claim may seem like an exaggeration, one could at minimum claim that the ETI myth adds nothing constructive to astrobiological research and may even contaminate its scientific status. May we ask astrobiology to pursue the best science and only the best science?

In this chapter, we have placed astrobiology and astrotheology into a relationship of creative mutual interaction. The wondrous discoveries of astrobiology are expanding the scope of creation for the astrotheologian and enriching the faith of religious believers. The traffic flows unimpeded from science to theology here. Yet, we have asked for some traffic to flow back from theology to science. This has led to exposing the ETI myth at work within the scientific conceptual set of some astrobiologists.

Russell describes the method of creative mutual interaction this way: "The theologian must first face the challenge of science to his or her cognitive claims; yet the scientist may find that philosophical elements pervade his or her work in creative ways and stem, in turn, from implicit theological positions" (Russell, 2002b, p. 288). This has led to our conclusion: astrobiology should pursue the best of science while leaving theology to the theologians.

References

- Ayala, F. J. (2004). The evolution of life on earth and the uniqueness of humankind. In S. Moriggi and E. Sindoni (Eds.), *Perché esiste qualcosa invece di nulla? (Why There Is Something rather than Nothing?)* ITACAlibri: Castel Bolognese, Italy, pp. 57-77.

- Barbour, I. G. (1974). *Myths, Models, and Paradigms: A Comparative Study in Science and Religion*. Harper, New York.
- Barbour, I. G. (1997). *Religion and Science: Historical and Contemporary Issues*. New Harper, New York.
- Bultmann, R. (1958). *Jesus Christ and Mythology*. Scribner's, New York.
- Chela-Flores, J. (2011). *The Science of Astrobiology: A Personal View on Learning to Read the Book of Life*. Springer, Heidelberg.
- Coyne, G. and Omizzolo, A. (2002). *Wayfarers in the Cosmos: The Human Quest for Meaning*. Crossroad, New York.
- Davies, P. (1977). *Space and Time in the Modern Universe*. Cambridge University Press, Cambridge UK.
- Davies, P. (2003). E.T. and God. *The Atlantic Monthly* (September), pp. 114–115.
- Davies, P. (2010). *The Eerie Silence: Renewing Our Search for Alien Intelligence*. Houghton Mifflin, Boston.
- de Duve, C. (1995). *Vital Dust: The Origin and Evolution of Life on Earth*. Basic Books, New York.
- Hart, J. (2014). *Encountering ETI: Aliens in Avatar and the Americas*. Cascade Books, Eugene, Orlando.
- Heller, R. (2015). The Hunt for Planets Better than Earth. *Scientific American* 312(1), 32–39.
- Herrick, J. A. (2008). *Scientific Mythologies: How Science and Science Fiction Forge New Religious Beliefs*. IVP Academic, Downers Grove, Illinois.
- Lazcano, A. and Hand, K. P. (2012). Astrobiology: Frontier or Fiction. *Nature* 488(7410), 160.
- Losch, A. and Krebs, A. (2015). Implications of the Discovery of Extraterrestrial Life: A Theological Approach. *Theology and Science* 13(2), 230–244.
- Mayr, E. (1985). The probability of extraterrestrial intelligent life. In Edward Regis, Jr. (Ed.), *Extraterrestrials: Science and Alien Intelligence*. Cambridge University Press, Cambridge U, pp. 23–30.
- Mix, L. J. (2009). *Life in Space: Astrobiology for Everyone*. Harvard University Press, Cambridge, Massachusetts.
- Moltmann, J. (2003). *Science and Wisdom*. (Trans.) Margaret Kohl. Eerdmans, Grand Rapids, Michigan.
- NASA. (2003). The NASA Astrobiology Roadmap by David J. Des Marais (Co-Lead), Joseph A. Nuth III (Co-Lead), Louis J. Allamandola, Alan P. Boss, Jack D. Farmer, Tori M. Hoehler, Bruce M. Jakosky, Victoria S. Meadows, Andrew Pohorille, Bruce Runnegar, and Alfred M. Spormann. *Astrobiology*

- 8(4), 715–730. https://astrobiology.nasa.gov/media/medialibrary/2013/09/AB_roadmap_2008.pdf (accessed 11/14/2015).
- Peters, T. (2003). *Science, Theology, Ethics*. Ashgate, Aldershot, UK.
- Peters, T. (2009). Astrotheology and the ETI myth. *Theology and Science* 7(1), 3–30.
- Peters, T. (2013a) Astrotheology, Chapter 72. In C. Meister and J. Beilby (Eds.), *The Routledge Companion to Modern Christian Thought*. Routledge, London and New York, pp. 838–853.
- Peters, T. (2013b). Astroethics: Engaging extraterrestrial intelligent life-forms. In C. Impey, A. Spitz and W. Stoeger (Eds.), *Encountering Life in the Universe*. Univ. Arizona Press, Tucson, pp. 200–221.
- Peters, T. (2013c). Would the Discovery of ETI Provoke a Religious Crisis? In D. Vakoch (Ed.), *Astrobiology, History, and Society*. Springer, Heidelberg, pp. 341–355.
- Peters, T. (2014). Astrotheology: A Constructive Proposal. *Zygon* 49(2), 443–457.
- Pope John Paul II (1988). Letter to the Reverend George V. Coyne, S.J.. In R. J. Russell, R. William, S. J. Stoeger and G. V. Coyne (Eds.), *Physics, Philosophy, and Theology*. Vatican Observatory, Vatican City State.
- Ruse, M. (1985). Is rape wrong on andromeda? an introduction to extraterrestrial evolution, science, and morality. In E. Regis, Jr. (Ed.), *Extraterrestrials: Science and Alien Intelligence*. Cambridge University Press, Cambridge, UK, pp. 43–78.
- Russell, R. J. (2002a). Bodily resurrection, eschatology, and scientific cosmology. In T. Peters, R. J. Russell and M. Welker (Eds.), *Resurrection: Theological and Scientific Assessments*. Wm. B. Eerdmans, Grand Rapids, Michigan, pp. 3–30.
- Russell, R. J. (2002b). Eschatology and physical cosmology: A Preliminary Reflection. In G. F. R. Ellis (Ed.), *The Far-Future Universe: Eschatology from a Cosmic Perspective*. Templeton Foundation Press, Philadelphia, pp. 266–315.
- Russell, R. J. (2008). *Cosmology from Alpha to Omega*. Fortress Press, Minneapolis.
- Schwarz, H. (2002). *Creation*. Eerdmans, Grand Rapids, Michigan.
- SETI homepage. http://setiathome.berkeley.edu/sah_about.php (accessed 11/14/2015).
- Shostak, S. (2011). Are We Alone? Estimating the Prevalence of Extraterrestrial Intelligence. In D. A. Vakoch and A. A. Harrison (Eds.), *Civilizations Beyond Earth: Extraterrestrial Life and Society*. Bergbahn Books, New York and Oxford, pp. 31–42.

Tarter, J. C. (2000). SETI and the religions of the universe. In S. Dick (Ed.), *Many Worlds: The New Universe, Extraterrestrial Life and the Theological Implications*. Templeton Foundation Press, Philadelphia, pp. 143–149.



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Comments by Editor Richard Gordon:

Ted Peters assumes that religion and science are on equal footings. As we'll see, some of our authors would disagree, placing one over the other. But let's try it Peters' way: "Perhaps the theologian could blow a referee's whistle" becomes also: perhaps scientists could referee theological papers and recommend acceptance or rejection. Let's assume with him that theology ought to influence science. Before global warming advocacy it was widely assumed there is but one science. Perhaps now there are at least four, if we count global warming proselytizers, agnostics and deniers, plus intelligent design advocates, all of whom claim the moniker. On the religion side the current tally is 4351 religions (adherents.com, 2014). As one of our authors put it: "...in contrast to the evolution of science, the evolution of religions has been characterized by a *divergence* of views, dissent instead of consensus" (Sterrenburg, 2018). Science began with open religious commitments, which some scientists still avow and are motivated by (Chela-Flores, 2016; Gordon, 2017). Are they a "tiny minority" as Peters suggests (albeit nearly 50% per Toumey (2009)), or is it simply

politically incorrect in today's left wing universities to allow anyone to know one's deepest motivations? Perhaps we need to more broadly discuss science, religion, and politics. Peters equates progress in evolution with "inner telos, direction, or meaning". But in the grand scheme of evolution, progress in evolution may be but a byproduct of gene and genome duplication, as relentless as the growth of frost on a window pane (Gordon, 1999; Gordon & Gordon, 2016). Both are examples of the dynamics of multiscalar (hierarchical) irreversible processes. Argument by authority, i.e., "The prevailing view among the world's leading evolutionary biologists is...", "our leading biologists repudiate", doesn't wash in science. Scientists do not agree with one another. On the contrary, science progresses by picking apart one another's ideas, testing them against nature. Where the ideas are testable, as the ETI Myth is (ETI = ExtraTerrestrial Intelligence), sooner or later they will stand or fall, or be modified. In fact, that is why astrobiology attracts so many scientists: we are finding ways to test its basic notions, and doing so. Perhaps it is a lack of testability that hinders religion from making much of a contribution to science, beyond motivating a few, or perhaps many, scientists. In a way, it is ironic that Peters decries rather than applauds the "religious undertone" of the ETI hypothesis. In fact, being more open about religious motivation of scientists might be exactly what is needed to attract more youth to science (Bertrand, 2013).

References

- adherents.com. (2014). Main Statistical Database. <http://www.adherents.com>
- Bertrand, R.L. (2013). Rethinking religious under-representation in science. *European Journal of Science and Theology* 9(6), 143–152.
- Chela-Flores, J. (2016). *A Journey with Friends: Dialogues on Astrobiology*: draft.
- Gordon, N.K. & R. Gordon (2016). *Embryogenesis Explained*. Singapore, World Scientific Publishing.
- Gordon, N.K. (2017). Embryogenesis and the G-d Factor. <https://embryogenesisexplained.org/tag/religion-and-science/>
- Gordon, R. (1999). *The Hierarchical Genome and Differentiation Waves: Novel Unification of Development, Genetics and Evolution*. Singapore & London, World Scientific & Imperial College Press.

- Sterrenburg, F.A.S. (2018). Science vs religion — the fallacious conflict. In: *Theology and Science: Discussions about Faith and Facts*. J. Seckbach & R. Gordon, (Eds.), World Scientific Publishing, Chapter 9, 181–195.
- Toumey, C. (2009). God in the lab: Surveys have found that almost half of all scientists in the US are religious. Chris Toumey explores what this might mean for nanotechnology. *Nature Nanotechnology* 4(11), 696–697.