

An Eastern Orthodox Perspective on Microbial Life on Mars

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Abstract *Recent efforts to explore the geology and climate of planets within our own solar system, especially Mars, have prompted a renewed interest in the search for microorganisms as the most plausible forms of extraterrestrial life. As the scientific search for evidence of microbial life on Mars intensifies, there has been a perceived need to examine the theological implications in advance of such a possible discovery. Religious considerations, thus far, have focused mainly on Western Christianity as represented by the Roman Catholic and various Protestant traditions. Although Eastern Orthodoxy represents the second largest group of Christians worldwide, to date, there is very little information available from these ongoing discussions concerning an Eastern Orthodox perspective. Therefore, we first review the case for the possibility of microbial life on Mars and then explore its fundamental Orthodox theological meaning. The apprehension of any form of extraterrestrial life by the Orthodox Church will be rooted in its collective interpretation of the Holy Scriptures, Patristic and contemporary religious writers, and in the ancient liturgical expression of its worship.*

Key words: Extraterrestrial microbial life; Eastern Orthodoxy; Exobiology; Mars exploration; Religious implications; Religion and space exploration

Introduction

Humanity's interest in the possibility of the existence of extraterrestrial life is reflected in the intense scientific efforts exemplified by the various ongoing international space exploration programs initiated by the U.S. National Aeronautics and Space Administration (NASA) and the European Space Agency (ESA) in the latter half of the twentieth century. There has been a great deal of speculation in the media and popular literature about the impact the discovery of extraterrestrial intelligence would have on religion, especially, on contemporary Christianity. Some argue that Christianity, being fragile and too dependent on older and outdated imagery, would be completely undermined by such a discovery.¹

Ted Peters refutes this notion, providing a succinct historical survey of Western religious thought concerning the existence of more than one inhabited world, beginning with the ancient Greeks and finishing with contemporary

theologians such as Krister Stendahl, Paul Tillich, Karl Rahner, and Lewis Ford. Far from extraterrestrial life being a threat to the whole of Christianity, Ted Peters, basing himself on his historical survey, concludes that an encounter with an extraterrestrial intelligence would be readily accommodated by all but the most fundamentalist of the Western Christian denominations. Some fundamentalists dismiss the very notion of intelligent life on other planets as being anti-Biblical, as promoting biological evolutionary theory, and as demonic in origin. Ted Peters cautions the theological community at large against complacency in the face of scientific exploration and advocates a thoughtful reflection and speculation on the theological significance of extraterrestrial life.²

In response to this challenge, Sjoerd L. Bonting, who is both ordained Anglican priest and biochemist, brings both his science and Christian theology to bear on this topic. Since the same chemical elements and physical laws observed on this planet are presumably universal, Sjoerd Bonting reasons that extraterrestrial life would most likely be carbon-based and, therefore, share similar molecular and physiological characteristics with life on Earth. He goes on to suggest that if intelligent extraterrestrials share a similar biology to humans, it is within the realm of possibility that these aliens possess a "religious awareness." If so, we may expect that they are also inheritors of divine revelation and are subject to and part of a universal plan.³

While most of these theological discussions are centered on humanity's hypothetical encounter with an extraterrestrial intelligence and what that would mean for the Christian understanding of doctrines such as the Covenant, Incarnation, and Salvation, little has been published concerning the theological implications of the discovery of non-intelligent, extraterrestrial microbial life. For reasons we shall discuss later in this paper, Mars remains the most accessible and likely candidate for providing evidence of either extinct or extant extraterrestrial microbial life-forms in our solar system. Although NASA's Viking lander experiments failed to detect definitive signs of life in the Martian soil in 1976, the announcement and subsequent publication of a paper describing possible Martian microfossils by David S. McKay and his colleagues in 1996 once again brought the possibility of life on Mars to the forefront. The geological analysis and electron microscopy of Martian Meteorite ALH84001 recovered from the Antarctic revealed a number of chemical and structural characteristics that, when considered together, were consistent with ancient microbial life signatures.⁴ These findings have remained controversial and inconclusive over the last 10 years, but one need only visit the websites of NASA and the ESA in order to discover the magnitude and focus of the current search for non-intelligent extraterrestrial life in our solar system.

As the search for Martian microbes intensifies and the potential for their discovery becomes more feasible, there have been calls from among theologians and scientists alike for a preliminary, interdisciplinary dialogue concerning possible theological and ethical implications in response to such a scientific discovery. In order to facilitate a useful dialogue between science and religion, Christopher J. Corbally recommends that a proper relationship of mutual

understanding be established and maintained by implementing a two-step process. First, each discipline must recognize and stay within the limits of its own methodology. Science can not presume to be able to determine "meaning" and "purpose," any more than theology can describe the "how" of a physical phenomenon. Second, each discipline must be open to both the "discoveries" and the "insights" of the other. When confronting a major discovery such as extraterrestrial microbial life on Mars, science has the potential to provide us with further insight into a theological truth, while theology has the potential to provide us with a broader interpretation of a physical phenomenon.⁵

Richard O. Randolph, Margaret S. Race, and Christopher P. McKay carefully reflect on the different expectations and scientific methodologies used in the ongoing searches for extraterrestrial life, both intelligent (SETI) and non-intelligent (exobiology). These authors are also concerned that potential theological and ethical outcomes normally affiliated with the possible discovery of microbial life on Mars may be inadvertently overlooked because our contemporary society tends to dwell on the search for extraterrestrial intelligence. One of their theologically rooted ethical questions asks this: If a second genesis of life took place on Mars, does humanity have a God-given mandate for some form of stewardship over it? If we answer in the affirmative, then in practice what does that really mean for the potential use of Mars and its resources? They also probe the very serious ethical questions surrounding the possibility of accidental contamination of either Earth with Martian microbes or Mars with microbes from the Earth.⁶ In order to grapple with some of these potential ethical issues, Margaret S. Race and Richard O. Randolph more recently suggested a set of working guidelines for international consideration prior to an exobiological discovery. These guidelines seek to protect the Earth and its life-forms from alien contamination, preserve the integrity of any alien ecosystems, insure proper scientific procedures are followed, and promote the full cooperation and participation of the international community on behalf of all humanity.⁷

Religious and ethical perspectives on the possibility of extraterrestrial microbial life on Mars have, for the most part, focused mainly on the responses of Western Christianity as represented by the Roman Catholic Church and the various mainstream, liberal, and evangelical Protestant traditions. However, it has been suggested by the prominent twentieth-century Orthodox theologian, Vladimir Lossky, that the existence of other life-bearing worlds is not precluded from the interpretations of either the Genesis narratives or the writings of the Church Fathers.⁸ Although Eastern Orthodoxy represents the second largest group of Christians worldwide, there is, to date, very little information available concerning an Eastern Orthodox Christian perspective on these ongoing discussions. Therefore, in this paper we briefly review the major reasons why microbial life on Mars is a distinct scientific possibility and then clarify how Eastern Orthodoxy is reconciled with such a discovery. To this end, we present an Eastern Orthodox response to certain fundamental theological questions posed by the hypothetical existence of Martian microbial life.

Why is microbial life on Mars plausible?

As the fourth planet in our solar system, Mars is situated approximately 49 million miles further away from the sun than the Earth is. According to NASA and ESA, Mars is roughly half the size of the Earth, with an average temperature of -81°F (-55°C) compared with an average temperature of 57°F (14°C) on Earth. The relatively thin Martian atmosphere is composed of almost 95% carbon dioxide, with the remainder consisting of small amounts of other gases such as nitrogen, argon, oxygen, water vapor and even traces of methane. Mars exhibits two well-developed, large polar ice caps composed primarily of substantial amounts of frozen water as well as some frozen carbon dioxide. The cold, dry surface of Mars is also characterized by a substantial amount of groundwater ice, as well as being subjected to lethal ultraviolet radiation from the sun, which presumably renders the exposed terrain biologically sterile.

The question of whether or not life, as we know it, ever existed or still exists on Mars must be framed within our understanding of biology on the Earth.⁹ The fundamental requirements for life on Earth will normally include energy derived from the sun, chemical oxidation-reduction reactions, or hydrothermal sources, along with the presence of carbon compounds and liquid water. The molecular structure and associated physical properties of water enable life on Earth not only to exist, but to thrive. Liquid water is considered the “medium of life,” as most living cells are composed of between 70% and 95% water.¹⁰ Essentially, the search for life on Mars begins and remains focused on the availability of liquid water in the planet’s past as well as in the present. As we shall briefly discuss below, there is mounting scientific evidence that Mars has, in the ancient past, met—and may continue to meet—all of the minimal criteria for sustaining life.

Early Mars hypotheses

It is generally accepted that the planets in our solar system formed around a relatively young sun approximately 4.6 billion years ago; therefore, the Earth and Mars would be roughly the same age. As these two planets developed, water condensed on the surface on both planets. The early Earth remained covered by liquid water and had a relatively thick, warm atmosphere; but the environmental outcome of early Mars is the subject of much discussion and debate in the scientific literature. There is an abundance of evidence in the form of ancient geological features resembling dried-up river valley networks, lakes, and even oceans, indicating that there were periods of significant liquid water flow. The heart of the debate centers on whether these physical features were formed under cold and dry or warm and wet environmental conditions on Mars some 3.5 to 4.5 billion years ago. The type of ancient environment would have a substantial influence on how the observed Martian geomorphology came into being and, therefore, have implications for the possibility of microbial life.

In a thorough review of the scientific literature concerning the geological, geochemical, and climatic data available for Mars, Robert A. Craddock and Alan

D. Howard consider the evidence and the arguments explaining the substantial valley networks and the erosion-infilling and modifications of craters from meteoritic impacts observed in the Martian highlands.¹¹ Their analyses and thoughtful reflection have led these scientists to conclude that only substantial precipitation in the form of rain could account for the contentious Martian topography. They concur with others who advocate the general hypothesis that early Mars maintained a substantial atmosphere and temperatures warm enough to sustain large bodies of liquid water on the surface capable of evaporation, condensation, and subsequent rainfall. Mars would also have had sufficient sources of solar and chemical energy as well as carbon in the form of methane, carbon dioxide, and carbonates. Similar to that of early Earth, this warm, wet period characterized by rainfall and surface runoff may have lasted 2.8 billion years after Mars was initially formed, but began to diminish about 1.5 billion years ago due to decreases in volcanic activity and a relatively weak gravitational pull eventually resulting in the cold, dry climate observed today. If the appropriate environmental conditions indeed lasted for nearly 3 billion years, it is conceivable that some form of primitive life could have emerged on Mars as it did on Earth.¹²

In contrast, Eric Gaidos and Giles Marion argue that the best evidence to date supports the more widely accepted, alternative hypothesis that it is indeed possible to account for the major valley networks and other surface features on a Mars that never experienced the warm, wet period as described above.¹³ They postulate a cold, dry environment resulting from the depletion of the substantial Martian atmosphere as early as 4.45 billion years ago, leaving only the remnant observed today. This relatively thin atmosphere prevents the retention of heat and contributes to decreasing temperatures, which in turn help to establish and maintain a permanent global system of ice (cryosphere) on the Martian surface. Trapped beneath the Martian cryosphere, subsurface aquifers heated from geothermal sources below would build up pressure and eventually erupt, sending liquid water to the surface. The emergence and flow of groundwater is capable of facilitating substantial erosion sufficient enough to explain the surface features on Mars. In this scenario, the authors maintain that it is still possible that life may have originated in subterranean hydrothermal pockets where primitive life-forms may have relied on chemical energy processes other than photosynthesis.¹⁴

More recently, Dirk Schulze-Makuch and his colleagues conclude that the best interpretation of the scientific data available more appropriately corresponds to some sort of combination of the two hypotheses mentioned above.¹⁵ Mars and Earth had been similar in the beginning, but Mars eventually lost its atmosphere and became cold and dry. These environmental conditions are periodically interrupted by volcanic activity and meteoritic bombardment, which generate a temporary thicker atmosphere with sufficiently high temperatures to melt ice and sustain substantial bodies of liquid water on the surface. As the more lengthy cold and dry episodes return, any existing microbial life-forms may have been forced to either retreat with the water to geothermally heated reservoirs below the surface or develop surface survival strategies such as becoming dormant until wet, warm conditions once again prevail.

Regardless of which of the scenarios describing the history of climate change on Mars is the more likely, Dirk Schulze-Makuch and his co-workers realistically and thoroughly consider how life could have arisen in each case.¹⁶ Although speculative, their ideas reinforce those reached previously by Frances Westfall and his numerous collaborators associated with the ESA regarding the “nature” of the microbes on Mars, if any.¹⁷ The almost universal expectation among scientists is that Martian microbial life would most likely be comparable with the relatively simple prokaryotic microbes on Earth. Prokaryotes are unicellular organisms without the more complex cytoplasmic organelles and compartmentalization characteristic of the cells of higher organisms. As we shall discuss below, prokaryotes on Earth are unsurpassed in their ability to adapt to harsh environments.

Extremophilic microbes on Earth

The majority of the macrobiota on Earth (including humans) thrive within a particular range of limits for environmental conditions such as temperature, water availability, barometric pressure, etc. that are generally accepted as the “norm for life” by the scientific community. The term “extremophile” is a general term used to designate any organism that not only survives, but flourishes outside of the “norm” in an environment considered too harsh for most known organisms. There are three recognized Domains or Super Kingdoms for classifying all life on Earth, based on cellular organization and biochemical characteristics: Archaea, Bacteria, and Eukarya.¹⁸ While extremophiles are found in all three biological domains, Archaea and Bacteria have the most representatives and are of particular interest to exobiologists because they are prokaryotic, as any microbial life on Mars is expected to be. The hope is that a better understanding of the biology of microorganisms thriving in extreme environments on Earth that are analogous to those on Mars will enable scientists to determine suitable landing sites and develop more appropriate tests for similar life signatures.

The ever-expanding diversity and growing interest in extremophilic microbes and their possible use in biotechnology and exobiology have been thoroughly reviewed in 2005 by T. Satyanarayana and colleagues,¹⁹ and more recently (in 2006) by Amalie Pakchung and her colleagues.²⁰ These two groups of researchers describe how extremophilic microbes may be further subdivided and categorized on the basis of their specific environmental preferences and associated adaptations, which generally include: thermophiles (heat), psychrophiles (cold), halophiles (high salt), acidophiles (acid), alkaliphiles (alkaline), barophiles (high pressure), xerophiles (drought), and UV radiophiles (high resistance to the effects of ultraviolet radiation).

The availability of resources in extreme environments often requires extremophilic microorganisms to develop various alternative metabolic strategies to those utilizing oxygen as an electron acceptor in the breakdown of carbon compounds derived from photosynthesis to generate energy. A prime example is the community of extremophilic microbes discovered in an ancient, isolated aquatic

ecosystem nearly 3 km below the surface of the Earth in the vicinity of a South African gold mine.²¹ This microbial community thrives in a pressurized, hot, alkaline, salt-water environment that may have been isolated from any contact with the surface for several million years. This unique ecosystem of extremophiles derives its ultimate energy not from the sun via photosynthesis, but from the radioactive decay of uranium, potassium, and thorium facilitating the production of hydrogen and sulfur compounds used by the microbes for their normal energy requirements.²²

Hypothetically, this subterranean ecosystem reflects the conditions characteristic of early Earth and, perhaps, even early Mars. If true, then is it possible that similar ecosystems survive as refugia for microbial life in subsurface Martian aquifers? There is compelling evidence that such aquifers exist on Mars. In December 2006, Michael Malin and his colleagues reported the occurrence of what appears to be recent water flow in preexisting gullies on the steep slopes of impact craters on the surface of Mars within the last seven years or so.²³ They reason that liquid water erupting from a subsurface aquifer could run down a very steep slope for several hundred meters before the liquid portion would simultaneously freeze and boil off, leaving some sort of salty residue or fine-grained soil sediments. If it can be demonstrated that these flow signatures are in fact from water, then these observations would indicate substantial pockets of liquid water relatively near the surface of Mars, reinforcing the latest exobiological speculations and exploration planning.

It has often been suggested that we should look to Antarctica for habitats analogous to those on Mars because of the extreme cold and dry conditions.²⁴ Previously, various locations in Antarctica deemed to be "cold deserts" and "dry valleys," where ambient temperatures may reach in excess of -32°C with a relative humidity of zero, were thought to be too extreme and devoid of terrestrial life.²⁵ Upon closer examination, isolated communities of microorganisms are known to inhabit rock fissures and dwell inside various porous rocks, enabling them to survive in otherwise inhospitable circumstances.

These so-called endoliths have been isolated and studied from a variety of arid environments. They reveal unique survival strategies that provide shelter, minimize desiccation, and take advantage of the occasional presence of liquid water in order to sustain life.²⁶ Although the surface of Mars is very cold and devoid of liquid water, there is a great deal of water ice concentrated in both polar regions and along the surface as permafrost. Ice provides possibilities other than an endolithic lifestyle for microbial survival at extremely cold temperatures. As a leading researcher in the area of molecular adaptations to cold environments, Ricardo Cavicchioli reports that several psychrophilic microorganisms have been recovered from deep ice that are known to continue metabolic activity at temperatures as low as -40°C and will survive conditions colder than -45°C .²⁷ As it turns out, several species of microbial psychrophiles from certain Antarctic locations and as well as from Alaska are also well-known methanogens. Microbes that reduce carbon dioxide or other carbon-containing substrates, resulting in the release of methane in various Earth environments, are called methanogens. Pertinent to this discussion is the fairly recent detection of methane gas in the thin

atmosphere of Mars, which has stimulated a great deal of speculation and debate among scientists as to its source.²⁸

On Earth, methane production may be the result of either specific types of water-rock reactions or microbial metabolic activity; but because of the complexity of the Mars situation, only laboratory analyses of Martian soils will be definitive.²⁹ Regardless of the outcome, these possibilities have tremendous relevance to planning future exobiological investigations, given the known environmental conditions and the recent evidence for some form of methanogenesis on Mars.

There may yet be extremophilic microbes thriving in environments neither conceived of nor comprehended by present-day scientific thinking. Each new discovery expands our current concepts of both life and the limits of the biosphere on Earth. What relevance does this have for the possibility of microbial life on Mars? First, environmental conditions previously thought to be untenable for life as we know it have been proven to be otherwise. Extreme environments on Earth have been shown to nurture a myriad of microbial life-forms, giving credence to the notion that microbes may also have either been able to establish themselves or have taken refuge in those analogous habitats on Mars. After all, the resilience and adaptability of prokaryotic organisms appears to be nothing less than astounding. Second, the ongoing explorations and resulting reports of newly discovered extremophilic ecosystems worldwide suggest that Mars also may not yield its biological secrets after only a few cursory searches. The search for life on Mars, as on Earth, may never really come to a completion even after several generations of exhaustive investigations. All in all, whether in the near or the far distant future, finding microbial life on Mars—or even beyond—is a very real possibility. Should this possibility become a reality, then theology must be prepared and willing to deal with it.

An Eastern Orthodox theological perspective

Finding microbial life on Mars poses neither an intellectual nor a spiritual threat to either Orthodox theology or its Holy Tradition. It has been stated above that both science and theology must recognize and stay within the limits of their own methodologies; science cannot determine “meaning” and “purpose,” nor can theology describe the “how” of a physical phenomenon. That principle having been established, it is not difficult to determine the role of the scientist in examining such microbial life. However, the role of the theologian may not be so clear and certain. It is tempting simply to map out a “plan of approach” and state that science must discover and describe the nature of what is found, while theology attempts to see it in relationship to its place in that order which faith regards as the sphere of the Creator. The theologian, however, must be willing to accept and deal with valid scientific information, and not simply dismiss it as being non-Biblical or non-Orthodox.

When, however, theology concerns itself with the created order, is the theologian’s realm of comprehension subject to any physical or spatial limits? Although it may appear simple enough to answer this question by suggesting that

the whole of Creation is the concern of the theologian, it is necessary first to deal with the problem arising from the fact that the Scriptural imagery of Creation is far different from the image suggested by the knowledge and science of the present day and age. Scripture and Holy Tradition are the foundation stones of all Eastern Orthodox theology, and therefore the imagery and concepts of Scripture must retain their places in any Orthodox theological assessment of the world and of the wider cosmos. Without these foundation stones, the Orthodox theological system would find itself in a void, detached from all context and perspective. This, however, does not mean that Scriptural imagery is to be taken literally and in a fundamentalist manner. Imagery is of necessity essentially symbolism and must always be regarded as such, in order that its deeper significance may not so much be understood intellectually, but rather apprehended through faith and the religious experience of the human personality in its never-ending movement toward God.

Orthodox theology of Creation is based on the opening words of the Book of Genesis: "In the beginning, God created the heavens and the earth." Although the Hebrew verb *bara'*, which expresses the divine creative action, is translated in the Greek Septuagint by a term—*epoiesen*—which is relatively neutral and could be used of any action which implies the making of something, the original Hebrew verb *bara'* is, throughout the whole of the Old Testament, used to indicate the creative action of God alone. Thus, the action of Creation, ascribed to God, is expressed in a term that is non-anthropomorphic and implies the holiness—the total otherness—of divine creativity. The fact that God's creative action is described in terms of His speaking must be understood in a symbolic sense,³⁰ and hence the Creation of the universe is to be seen as a phenomenon which is in a class by itself and has no parallel or analogy in human creativity. The whole pericope may aptly be described as a theological myth intended to give articulation to the basic emergence of all being without providing any scientific insights into the manner or mechanics through which it was accomplished.

The final result of an Orthodox understanding of the Genesis Creation narrative, and indeed of all expressions of Creation in Biblical tradition, is to state that the totality of the environment in which man lives and which he experiences depends solely on the Creator for its existence. The question, however, now arises as to what is meant by "the environment in which man lives." This question cannot be lightly or easily answered, for as human awareness and knowledge has developed over the centuries and millennia, so has man's concept of his environment. At the beginning of the twenty-first century, man's consciousness of his environment normally takes in his immediate surroundings, the geographical and political area in which he lives, and probably also includes a relatively strong awareness of the rest of the globe. However, at the same time we are in effect leaving the confines of our planet as a result of our technological advances in space exploration. Furthermore, with some exertion of the imagination, the human powers of perception and apprehension may become quite conscious that the solar system is also part of man's environment; a distant part, but still having some vague relationship to

humanity. No doubt, as time progresses and human knowledge of the solar system and the universe increases, the awareness of man's relationship with the wider universe will become even more of a reality. In brief, the environment in which man lives will continue to expand, perhaps indefinitely. As our environment expands due to the growth of scientific knowledge, so also the Orthodox theological perception of the human environment expands and would of necessity embrace extraterrestrial microbial life. In the light of this consideration, it is obvious that the whole issue is of no minor importance; rather it presents a significant opportunity and duty for Orthodox theology to develop and expand the scope of its concern.

The world and the time-frame in which Creation theology was devised and in which it developed had a different and simpler outlook on and perception of the universe. The Hebrew mind of Biblical times and the Christian mind in the early centuries of the developing Church had a certain impression of the universe, but it could have come in no way close to the magnitude of modern understanding. At the same time, it is possible to see that ancient man was aware of standing in a certain relationship even to that space which lay beyond the Earth on which he dwelt. Psalm 8: 4–9 provides an excellent description of the Biblical concept of the man's place in the universe and of his response of wonder before it:

When I gaze upon Thy heavens, the work of Thy fingers,
Moon and stars which Thou hast set in their place,

What is man, that Thou thinkest of him,
And the son of man, that Thou carest for him?
Thou hast placed him only a little below the angels,
And with glory and honour dost crown him.
Thou hast made him master over the works of Thy hands,
And all things Thou hast placed under his control,
Sheep and oxen—all of them—
And even the wild beasts,
The birds of the air and the fish of the sea,
And whatever passes through the paths of the seas.

The psalmist here shows an emotion which the modern world has to a great extent lost—the ability to stand in awe and wonder at the majesty of Creation—and it is this awe and wonder which give rise to the need for a theological account of the universe. Such awe and wonder are even further increased when man realizes the role that has been assigned to him by the Creator who brought the universe into being: man has been appointed as master and lord over the Creation, at least over that part of it which he has the capability of controlling.

However, it is of the utmost importance here to realize that to the Hebrew mind, to be master and lord of anything implies the responsibility to care for and protect it. The created order, given over to the dominion of man, becomes a sacred trust, not an entity to be exploited and used for his own ends and purposes. Indeed, exploitation of the environment is totally in opposition to the Orthodox way of viewing the created order, for the whole of the created order is directed, not towards humanity, but towards God Himself. This is nowhere more evident than

in the prayer for the Great Blessing of the Waters celebrated by the Orthodox Church on the Feast of the Theophany:

Great art Thou, O Lord, and marvellous are Thy works: no words suffice to sing the praise of Thy wonders. For Thou by Thine own will hast brought all things out of nothingness into being, by Thy power Thou dost hold together the Creation, and by Thy providence Thou dost govern the world. [...] All the spiritual powers tremble before Thee. The Sun sings Thy praises; the moon glorifies Thee; the stars supplicate before Thee; the light obeys Thee; the deeps are afraid at Thy presence; the fountains are Thy servants. Thou hast stretched out the heavens like a curtain.³¹

Liturgical texts, insofar as they constitute the practical expressions of Orthodox theology, may be regarded as of an even greater authority than Patristic statements. The above quotation well exemplifies the Orthodox theological attitude towards the totality of the Creation. Not only the Earth, but the whole of the universe in which the Earth is situated, is shown to be the Creation and dominion of God. From this it follows naturally that everything within that universe—including any forms of life, microbial or otherwise—is a revelation of the existence and being of God.

It now appears to be a real possibility that there is extraterrestrial microbial life on Mars, and, should that possibility prove true, a very significant question will arise and require a double answer. The question will be: "From where did such microbial life come?" and the answer will be the concern of both the scientist and the theologian. The scientific answer will be based on further research and possible speculation founded on existing knowledge, while the theological answer, which is the concern here, will be based on faith and the Holy Tradition in which that faith is held. In the present context we are concerned basically with the answer as it may be formulated within an Eastern Orthodox context.

It is, of course, possible that some could be prone to deny the possibility of divine creative activity, especially the creation of life, outside the confines of the planet Earth. Such a denial would be the result of a literal acceptance of what may appear to be the Biblical view of Creation. It cannot be denied that those who framed the Creation narratives did so with a very restricted view of the form and structure of the universe. In such a context, there was no place for created life beyond the boundaries of Earth, and hence no such life could have been conceived even as a possibility. (It should, however, be noted that in no place is the possibility of extraterrestrial life categorically denied in the Bible, there being no need to deny that which logically does not exist.) The Old Testament theology of Creation was of necessity geocentric, and this characteristic carried naturally over into the thought of the early Christian Church and from there into the Orthodox tradition as it developed over the following centuries.

The question arises at this point as to whether or not the Fathers of the Church understood the Old Testament accounts of Creation and the structure of the created universe as literal, or did they view them as mythological or analogical? Such a question cannot be answered with any real accuracy, but it is safe at least to say that the cosmology of the Fathers had to be expressed in the terms familiar to their own age. This, however, does not necessarily imply a *literal* acceptance of

that cosmology. Indeed, the writings of the Fathers were intended to be theological, not historical or scientific, and it is in the theological realm that they have their importance. The twentieth-century Orthodox theologian, Vladimir Lossky, expresses this very clearly:

In the face of the vision of the universe which the human race has gained since the period of the renaissance, in which the Earth is represented as an atom lost in infinite space amid innumerable other worlds, there is no need for theology to change anything whatever in the narrative of Genesis; any more than it is its business to be concerned over the question of the salvation of the inhabitants of Mars. Revelation remains for theology essentially geocentric, for it is addressed to men and confers upon them the truth as it is relative to their salvation under the conditions which belong to the reality of life on Earth.³²

Of the various Patristic theological commentaries on the Creation, the nine homilies contained in the *Hexaemeron* of St. Basil of Caesarea are the most elegant and most profound. In elaborating on the Biblical narrative in Genesis, Basil describes the emergence of the created universe in highly descriptive terms intended to arouse the same wonder and awe as the psalmist expresses. Beyond the rhetorical power of his words, however, lay two main purposes: to refute the philosophical and mythological Creation stories of the contemporary world and, more important, to give expression to the basic doctrine that all created things depend on God for their existence: "I intend to tell of the Creation of heaven and Earth, which was not spontaneous, as some have supposed, but derived its origin from God."³³ The central truth of Basil's *Hexaemeron* is, therefore, theological, and the importance of this is not diminished by the inaccuracy of his "scientific" knowledge. For example, of the place of the Earth in the universe he states that "it holds the centre of the universe, its natural position."³⁴ Although the Earth does not in fact hold such a central spatial position in the universe, nevertheless in the divine plan of salvation, which is one of the fundamentals of Basil's thinking—and of Orthodox thought in general—the Earth does indeed hold the central position, for it is the realm toward which God's love and the redemptive work of Christ is directed. The doctrines of the Orthodox Church transcend scientific knowledge and theory and hence cannot be diminished or threatened, even by the discovery of an extraterrestrial life-form. In the words of Vladimir Lossky:

The Church always freely makes use of . . . the sciences for apologetic purposes, but she never has any cause to defend these relative and changing truths as she defends the unchangeable truth of her doctrines . . . Modern cosmological theories cannot affect in any way the more fundamental truth which is revealed to the Church.³⁵ Christian theology . . . is able to accommodate itself very easily to any scientific theory of the universe, provided that this does not attempt to go beyond its own boundaries and begin impertinently to deny things which are outside its own field of vision.³⁶

Science and theology are indeed two separate disciplines, and there are two ways in which this fact can be approached. On the one hand, it is possible to maintain that science and faith have nothing to do with one another and that they

must remain, if not in conflict, then at least totally separate from one another. On the other hand, Eastern Orthodoxy maintains that there is no conflict between true science and true faith, only between pseudo-science and pseudo-faith. One might even go so far as to state that true science may automatically become incorporated into true faith. Both disciplines may look at the same entity (i.e., the world and universe around us), and both may comment, but those comments need not be contradictory. Indeed, if such comments are based on true understanding and on authentic faith, it is highly possible—and even probable—that they may well be complementary. With regard to extraterrestrial microbes, science may soon be able to tell us for certain that they exist, and perhaps eventually delve deeper into the past from which they came. Orthodox theology will complement this knowledge with its certainty that, whatever may have been the natural history of such microbes, in the final analysis they were created by an act of the divine will.

The discovery of such extraterrestrial microbial life would be a major breakthrough, but it could prove to be a disturbance to some Christian traditions, particularly those based on a literalist interpretation of Scripture. Fundamentalism, with its word-for-word interpretation of the Biblical Creation narratives, produces an attitude and a theology that are fully geocentric, and this geocentricity applies not only to the symbolism used in theological expression, but to the actual doctrinal content of that theology. According to such an interpretation, the created order that came from the action and Word of God is wholly focused and centered on the Earth, and the rest of the universe must remain a lifeless expanse. While it must be accepted that the wider universe is also part of the Creation, the sole area of God's interest and concern is the Earth, and as a result, fundamentalist Christianity must make one of two choices. It must, on the one hand, either categorically deny the possibility and/or reality of extraterrestrial life, or, on the other hand, abandon any claims that its own position is true and admit that scientific knowledge has once and for all disproved the validity of Scripture. This may appear to be a somewhat drastic choice, but it is an inherent weakness within fundamentalist thought.

To a theological system that is non-fundamentalist, however, the discovery of extraterrestrial life not only poses no threat, but even enhances that system and presents it with an opportunity to expand its vision and concept of God and Creation. The system of symbolism used by Orthodox theology can still remain geocentric, insofar as it is recognized as symbolism rather than literal truth, but it can also lead naturally and easily into a cosmocentric understanding of the basic truth of the Orthodox theological system. As long as the wider universe is thought to be devoid of any life-forms, it is an easy matter to see the will and activity of God as directed almost exclusively at the Earth, the sole place where life exists. However, if life is seen to exist elsewhere in the universe, the natural implication is that the life-creating power of God is also active there, and hence Earth to a great extent loses its centrality.

In the light of our present knowledge of the universe with its multiple solar systems and galaxies, we must already say that the centrality of Earth is not a viable reality. This is obviously correct on the purely physical plane—i.e., the actual place occupied by Earth in the whole complex of intergalactic space—but it

is not necessarily correct on the spiritual level. The Biblical account of Creation, and all the succeeding events of both Old and New Testaments, are not to be read as factual history. Instead, they should be regarded as *Heilsgeschichte* (Salvation History), and hence read as a symbolic account of the mystery of Creation, the actions—both human and divine—which take place within the created order, and finally the eventual destiny of that Creation.

Heilsgeschichte is neither secular history nor science. Hence, the non-central place of Earth within the galactic system does not contradict its central place within the wider sphere of Redemption and the priestly role of the Church in accomplishing the ultimate sanctification of all things even to the furthest reaches of the universe. From an Eastern Orthodox point of view, the loss of spatial centrality would not diminish the importance of terrestrial life; rather, it would expand it, just as it would expand the life-creating power of God into an endless space and time. The infinity of God has always been expressed in an abstract intellectual and theological formula, but it could now be seen in the extension of the divine creative power out into the wider universe, and the mystery of Creation would be expanded well beyond the bounds of human experience and understanding, virtually into eternity itself. The question could be framed thus: What does the existence of created life beyond the limits of Earth say about God? And the answer could be given: His infinity and omnipotence are revealed anew throughout the universe, and an infinitely greater significance is given to the words of the psalmist, “The heavens are telling the glory of G-d” [Psalm 18(19):1].

Reflections and conclusions

To be sure, there is nothing in Orthodox theological tradition that would affirm the possibility of life on other planets. In fact, to the Biblical writers, to the Church Fathers, and to the framers of the Orthodox liturgical texts, this would be a non-question. The geocentric attitude of the tradition essentially has no interest in life elsewhere, due to the actual portrayal of Creation in the Biblical texts and due also to the lack of knowledge in earlier ages about the extent, structure, and shape of the universe. This “structure” does not have a place for extraterrestrial life, mainly because it does not imagine, nor can it possibly conceive of, the possibility of such life. It must, however, be remembered that this is the result of ignorance about the wider universe, not a voluntary decision to reject such a possibility. At the same time—and *very* importantly—that same Biblical portrait of the universe, when combined with modern scientific knowledge, need not preclude the possibility of extraterrestrial life. Although all other knowledge beside the reality of God is of lesser importance for the Orthodox theological synthesis, scientific knowledge continues to reveal—even on a very rudimentary level—the secrets of a universe theologically apprehended as the work of the divine Creator. Eastern Orthodox theology can comfortably embrace that knowledge as a guiding light on its journey towards the Divine Source of all being.

At the onset, one must bear in mind the fact that the “structure” of the created universe as seen in the Biblical and Orthodox tradition is essentially symbolic in

nature and hence more fluid and open. This establishes, within an Eastern Orthodox mind-set, a much more flexible attitude, one that would be readily able to accept all extraterrestrial life-forms.³⁷ Far from threatening Orthodox theology and tradition, the discovery of extraterrestrial microbial life on Mars would, therefore, actually enhance them by expanding their horizons and opening new avenues for further growth and development. The Eastern Orthodox Church may—and probably will—continue to be geocentric in its symbolism, but, enriched by the ongoing discoveries of science, it will have the ability to reconcile the wider cosmos with its fundamental and basic goal and purpose: eternal life in union with, and knowledge of, the Holy Trinity.

Endnotes

- 1 To say that Christianity is actually dependent on such imagery is a gross overstatement. If Christianity is actually dependent on anything, it is the theological traditions that have developed over the centuries. Imagery is exactly what its name implies—a system of symbolism used for convenience in expressing abstract concepts and ideas. Such imagery is not absolutely essential to the substance of religious content, and can thus remain viable even when scientific knowledge makes further advances. Imagery is basically the language of myth; and myth, being a means of expression in its own right, is able to function independently of scientific understanding. As a result, any conflict that may seem to exist between Christian imagery and scientific knowledge is the result of a superficial understanding on side or the other.
- 2 Ted Peters, "Exo-Theology: Speculations on Extra-Terrestrial Life," *CTNS Bulletin* 14 (1994): 1–9.
- 3 Sjoerd L. Bonting, "Theological Implications of Possible Extraterrestrial Life," *Sewanee Theological Review* 4 (2004): 420–435.
- 4 David S. McKay, Everett K. Gibson Jr., Kathie L. Thomas-Keprta, Hojatollah Vali, Christopher S. Romanek, Simon J. Clemett, Xavier D.F. Chillier, Claude R. Maechling, and Richard N. Zare, "Search for Past Life on Mars: Possible Relic Biogenic Activity in Martian Meteorite ALH84001," *Science* 273 (1996): 924–930.
- 5 Christopher J. Corbally, "Religious Implications from the Possibility of Ancient Martian Life," paper presented at the Annual Meeting of the American Association for the Advancement of Science, in Seattle, Washington, February 13–18 (1997): available at http://www.aaas.org/spp/dser/03_Areas/cosmos/perspectives/Abstract_Corbally.shtml.
- 6 Richard O. Randolph, Margaret S. Race, and Christopher P. MacKay, "Reconsidering the Theological and Ethical Implications of Extraterrestrial Life," *CTNS Bulletin* 17 (1997): 1–8.
- 7 Margaret S. Race and Richard O. Randolph, "The Need for Operating Guidelines and a Decision-making Framework Applicable to the Discovery of Non-intelligent Extraterrestrial Life," *Advances in Space Research* 30 (2002): 1583–1591.
- 8 Vladimir Lossky, *The Mystical Theology of the Eastern Church*, translated from the Russian by the Fellowship of St. Alban and St. Sergius (London: James Clarke and Co., 1957), 106.
- 9 Life, as we know it on Earth, must meet several criteria. The smallest organized unit of life is the cell. Whether a single cell or composed of many cells, organisms will utilize some source of energy in order to maintain constant internal conditions as they grow, develop, and reproduce. All organisms demonstrate the ability to respond to various stimuli from their immediate environment, subjecting their populations to evolutionary pressures. Our expectations and experimental design for detection of extraterrestrial life-forms are based on these same general criteria.

- 10 That liquid water is considered the “medium of life” is not only a scientific point, but also a theological one. In the Old Testament, water is used as one of the most significant symbols of life and the sustaining of life, a usage that is quite obviously based on actual experience and might therefore be considered as a type of scientific knowledge. From this “practical” scientific knowledge, the symbolism of water is very easily transferred to the spiritual realm, where it becomes a medium for expressing the fullness of human life in unity with God, a concept very clearly seen in New Testament theology. One might consider, for example, the narrative of Christ and the Samaritan woman, where, referring to the actual water from the well of Samaria, Christ states, “Everyone who drinks from this water will be thirsty again” (John 4:13). Then, making the transition from the natural to the spiritual, He adds, “But whoever drinks from the water which I shall give him will never thirst, but the water which I shall give him will become in him a spring of water springing up unto eternal life” (John 4:13). This theological usage of water as a symbol of eternal life is more than coincidence; it is rather a reflection of the fact that theological expression is frequently based on the observance of natural phenomena and is, therefore, much more than mere speculation and/or imagination. From a theological stance, one might be tempted to say that the presence of water on Mars—either past or present—is a symbol of divine creative action.
- 11 Robert A. Craddock and Alan D. Howard, “The Case for Rainfall on a Warm, Wet Early Mars,” *Journal of Geophysical Research* 107, E11 (2002): 5111, doi:10.1029/2001JE001505.
- 12 Ibid.
- 13 Eric Gaidos and Giles Marion, “Geological and Geochemical Legacy of a Cold Mars,” *Journal of Geophysical Research* 108, E6 (2003): 5055, doi:10.1029/2002JE002000.
- 14 Ibid.
- 15 Dirk Schulz-Makuch, Louis N. Irwin, Jere H. Lipps, David LeMone, James M. Dohm, and Alberto G. Fairen, “Scenarios for the Evolution of Life on Mars,” *Journal of Geophysical Research* 110 (2005): E12S23, doi:10.1029/2005JE002430.
- 16 Ibid.
- 17 Frances Westfall, Andre Brack, Beda Hofmann, Gerda Horneck, Gero Kurat, James Maxwell, Gian Gabriele Ori, Colin Pillinger, Francois Raulin, Nicolas Thomas, Brian Fitton, Paul Clancy, Daniel Prieur, and Didier Vassaux, “An ESA Study for the Search for Life on Mars,” *Planetary and Space Science* 48 (2000): 181–202.
- 18 Although prokaryotic microbes resemble each other morphologically on the basis of their relatively simple cellular organization, molecular genetics and biochemical analyses have shown that there are two very distinct groups: the Domain Bacteria and the Domain Archaea. The two groups of prokaryotic microbes differ significantly in various characteristics such as the sequence of their ribosomal ribonucleic acid nucleotides and associated proteins, the types of lipids found in their plasma membranes, and the chemical composition of their cell walls. It should also be noted that on the basis of substantial molecular evidence, the Archaea are evolutionarily closer to the Domain Eukarya than to Domain Bacteria. Cells of the Eukarya characteristically have a well-defined nucleus and other membranous organelles. All other living organisms belonging to the protists, fungal, plant, and animal kingdoms are all members of the Domain Eukarya.
- 19 T. Satyanarayana, Chandralata Raghukumar, and S. Shivaji, “Extremophilic Microbes: Diversity and Perspectives,” *Current Science* 89 (2005): 78–90.
- 20 Amalie A.H. Pakchung, Philippa J.L. Simpson, and Rachel Codd, “Life on Earth: Extremophiles Continue to Move the Goal Posts,” *Environmental Chemistry* 3 (2006): 77–93. doi:10.1071/EN05093.
- 21 Li-Hung Lin, Pei-Ling Wang, Douglas Rumble, Johanna Lippmann-Pipke, Erick Boice, Lisa M. Pratt, Barbara Sherwood Lollar, Eoin L. Brodie, Terry C. Hazen, Gary L. Anderson, Todd Z. DeSantis, Duane Moser, Dave Kershaw, and T.C. Onstott, “Long-term Sustainability of a High-energy, Low-diversity Crustal Biome,” *Science* 314 (2006): 479–482.
- 22 Ibid.

- 23 Michael C. Malin, Kenneth S. Edgett, Liliya Posiolova, Shawn M. McColley, and Eldar Z. Noe Dobrea, "Present-Day Impact Cratering and Contemporary Gully Activity on Mars," *Science* 314 (2006): 1573–1577.
- 24 D.D. Wynn-Williams and H.G.M. Edwards, "Antarctic Ecosystems as Models for Extraterrestrial Surface Habitats," *Planetary and Space Science* 48 (2000): 1065–1075.
- 25 Susana E. Jorge Villar, Howell G.M. Edwards, and Charles S. Cockell, "Raman Spectroscopy of Endoliths from Antarctic Cold Desert Environments," *Analyst* 130 (2005): 156–162.
- 26 Jacek Wierzchos, Carmen Ascaso, and Christopher P. MacKay, "Endolithic Cyanobacteria in Halite Rocks from the Hyperarid Core of the Atacama Desert," *Astrobiology* 6 (2006): 415–422.
- 27 Ricardo Cavicchioli, "Cold-Adapted Archaea," *Nature Reviews Microbiology* 4 (2006): 331–343.
- 28 V. Formisano, S. Atreya, T. Encrenza, N. Ignatiev, and M. Giuranna, "Detection of methane in the atmosphere of Mars," *Science* 306 (2004): 1758–1761.
- 29 M. Allen, B. Sherwood Lollar, B. Runnegar, D.Z. Oehler, J.R. Lyons, C.E. Manning, and M.E. Summers, "Is Mars Alive?" *Eos Transactions American Geophysical Union* 87 (2006): 433, doi:10.1029/E0410001.
- 30 In ancient Hebraic thinking, the term that indicates the spoken word (*davar*) has the significance of an actual effective force. That which is spoken is not simply a statement which conveys information or gives a command, but rather it actually brings into being that which is spoken. Hence, to say, "And God said, 'Let there be light'" is tantamount to saying "And God created (*bara'*) light," for the spoken word and the creative action are not only inseparable but even one and the same.
- 31 *The Festal Menaion*, translated by Mother Mary and Archimandrite Kallistos Ware (London, 1969), 356.
- 32 Lossky, *Mystical Theology*, 105. This assessment was first written in 1944, and since that time our knowledge of the wider universe has expanded tremendously. While Lossky's view is still valid, it may nevertheless be time for theology to start expanding the scope and range of its interpretation. As our connection with the universe becomes more clearly delineated, a fully geocentric theological outlook may no longer be sufficient.
- 33 *In Hexaemeron* I, 1.
- 34 *Ibid.*, I, 10.
- 35 Lossky, *Mystical Theology*, 104.
- 36 *Ibid.*, 106.
- 37 It must be noted that this flexible and open attitude can be maintained only if one is willing and able to go beyond the literalist and fundamentalist interpretation of Scripture. In order to arrive at a richer and more comprehensive theological understanding, the man of faith has to search for the basic meanings and insights of Scripture. Dwelling only on the literal statements of the text does nothing but hinder both rational and spiritual growth, causing Scripture and the faith to become outmoded and outdated.

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