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ASTROBIOLOGY PERSPECTIVE ON LIFE OF THE UNIVERSE

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Astroethics for Earthlings: Our Responsibility to the Galactic Commons

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Abstract

The Astroethics of Responsibility proposed here is founded on a substructure of quandary-responsibility ethics, supported by a theological notion of the common good plus a naturalistic justification for response and care. Within the sphere of the solar neighborhood, ten already articulated quandaries are addressed: (1) planetary protection; (2) intrinsic value of off-Earth biospheres; (3) application of the Precautionary Principle; (4) space debris; (5) satellite surveillance; (6) weaponization of space; (7) scientific versus commercial space exploration; (8) terraforming Mars; (9) colonizing Mars; and (10) anticipating natural space threats. Within the sphere of the Milky Way metropolis in which the “galactic common good” becomes the astroethical norm, engagement with intelligent extraterrestrials is analyzed within three-categories: (1) ETI less intelligent than Earth’s *Homo sapiens*; (2) ETI equal in intelligence; and (3) ETI superior in intelligence. Superior ETI may come in both biological and postbiological forms. Our ethical mandate: respond with care.

Keywords: Astrobiology, astroethics, astroethics, astroethics, quandary-responsibility ethics, intrinsic value, dignity, common good, galactic commons

2.1 Introduction

Astrobiologists along with astronomers and astrophysicists are ready to take the next step in refining astroethics, ethics for space exploration. Might

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we consider thinking of space beyond Earth as a commons, a domain to be shared by both earthlings and space neighbors? Might we lift up a vision of the common good that includes yet transcends our home planet?

Apollo 11 astronaut, Buzz Aldrin, says the time has come in which “Space offers us, or rather has allowed us to adopt for ourselves, a new dimension of freedom, which we must use for the benefit of humanity, to enrich and not degrade our lives” [2.1]. The time has come because space explorers need policies, policies that are ethically informed and formed. SETI astrobiologist Margaret Race identifies this need to add ethics to our science. “There are no specific policies or statements regarding ethical considerations or the broader impacts of human activities, particularly in relation to ET life and environments. Moreover, there is no guiding framework for considering any non-scientific issues” [2.69]. The need for foundational ethical—especially astrobioethical—deliberation has arisen [2.13].

In this chapter we will entertain a series of quandaries in “astroethics,” sometimes called *space ethics*. We will divide the universe into two concentric spheres of moral concern, our solar neighborhood and the Milky Way metropolis. Because of the untraversable distances between galaxies, and because we have virtually no hope of ever devising a technology by which we could communicate faster than the speed of light, the largest sphere of moral concern we can seriously consider is the Milky Way. We will rely on the term “astroethics” to encompass the full scope of space ethics; the term “astrobioethics” will be employed when dealing specifically with off-Earth life forms.¹

In addition to applying the common good to the Milky Way galaxy, this astroethical investigation will require identifying the moral agent. Here I nominate for the role of moral agent: Earth as a single planetary society. However, this raises a problem. Designating all the peoples of Earth functioning together as a moral agent is problematic because a single planetary society does not currently exist. Our planet Earth is governed formally by independent nations or, more materially, by competing economic and social interest groups. The very formation of a planetary society to deal with off-Earth matters is itself an ethical ideal and goal to pursue. As we pursue this vision of a cooperative human race, we must overcome the presumption of national sovereignty and the individuated interests

¹“Astrobioethics is an emerging discipline that studies, evaluates, and analyzes the moral, legal, and social issues of the search for life in the Universe” [2.13] [2.15].

competing in the economic sector.² In addition, this vision of a single planetary community of moral deliberation must draw into the center of participation those who today are marginalized due to poverty, race, or gender. Astroethics is first of all earthling ethics, and then it becomes galactic ethics [2.59].

In what follows we will lay the foundation and begin the superstructure for a refined astroethics to aid in formulating public policy. In laying the foundation we will pose three quandary questions: Who are we? What do we value? What should we do? The cumulative answers to these three questions will lead to a foundation we will label "Astroethics of Responsibility" [2.63].

Atop this foundation we will frame a superstructure of quandaries regarding specific astroethical issues. The load-bearing vertical supports will include: (1) the moral agent: Earth; (2) the moral norm: the galactic common good; (3) the moral spheres: the solar neighborhood and the Milky Way metropolis; (4) the moral justification: a theological apprehension of the common good combined with a naturalistic apprehension of the Golden Rule.

The floor plan will designate a conference room for each of thirteen previously formulated ethical quandaries. Ten of these quandaries lie within the sphere of the solar neighborhood: (1) planetary protection; (2) intrinsic value of off-Earth biospheres; (3) application of the Precautionary Principle; (4) space debris; (5) satellite surveillance; (6) weaponization of space; (7) scientific versus commercial space exploration; (8) terraforming Mars; (9) establishing human settlements on Mars; and (10) anticipating natural space threats [2.63]. Three quandaries lie within the sphere of the Milky Way metropolis: engagement with intelligent extraterrestrials who are (1) less intelligent than Earth's *Homo sapiens*; (2) ETI equal in intelligence; and (3) ETI superior in intelligence in both biological and postbiological forms [2.58].

²I rely on philosopher Eric Voegelin to grasp the notion of a universal humanity both as an ideal and promise. "Universal mankind is not a society existing in the world, but a symbol which indicates [human] consciousness of participating, in this earthly existence, in the mystery of a reality that moves toward its transfiguration. Universal mankind is an eschatological index." [2.90]. There is a proleptic component to the vision of a universal humanity. The biblical symbol of the imminent Kingdom of God enjoins us in the present moment to anticipate the eschatological consummation which will entail a new creation unified in justice and love.

2.2 Laying the Foundation for an Astroethics of Responsibility

When NASA launched the New Horizons probe to Pluto in 2006, the Earth-relative launch speed was 36,000 miles per hour. After its sling from Earth's orbital motion, it sailed toward the edge of our Solar System at 100,000 miles per hour. By 2018 the NASA launch of the Parker Solar Probe included an orbital velocity of 430,000 miles per hour. Science moves fast. Can ethics keep up?

"Space ethics appear today as a new *terra incognita*, an unknown country," writes Jacques Arnould, astroethicist at France's *Centre National d'Etudes Spatiales* (CNES). For this reason Arnould likens space ethicists to pioneers. As pioneers, space ethicists should begin their journey with humility, seeking first to learn the new territory. "That is the reason too why the first challenge is not to organize, to legalize and to reduce ethics to its repressive aspect. At the present time, we need to explore the field of space ethics. We need to determine the responsibilities; and to debate them. Major decisions about space cannot remain in the hands of individual leaders or the property of politic, scientific or financial lobbies" [2.2]. Here I intend to "determine the responsibilities" by constructing an Astroethics of Responsibility.

Astroethicists are pioneers. While astrobiologists are exploring the heavens, the ethicists are exploring the astrobiologists. Astrobiology needs more than science to explore astroethics. Astrophysicist Neil deGrasse Tyson puts a fence around science. "The methods of science have little or nothing to contribute to ethics, inspiration, morals, beauty, love, hate, or aesthetics. These are vital elements of civilized life, and are central to the concerns of every religion. What it all means is that for many scientists there is no conflict of interest" [2.84]. For ethical inspiration, the astroethicist must draw upon extrascientific sources. In this case, we will draw on the religious notion of the common good and the naturalistic notion of responsibility.

The core maxim derived from a naturalistic contribution to responsibility ethics is this: *respond with care*. I rely for this core maxim on the late Hans Jonas, a Jewish philosopher who parses the role of the "ought" when envisioning what "ought" to be done. Responsibility responds to the "forward determination of what is to be done," he observes. "First comes the ought-to-be of the object, second the ought-to-do of the subject who, in virtue of his power, is called to care" [2.36]. As living creatures, we are called by the natural domain to care. We are to care for all that lives. "Only what is alive, in its constitutive indigence and fragility, *can* be an object of

responsibility" [2.36].³ In this treatment I explore the question: can Jonas' notion of responsibility help us lay the foundation for an Astroethics of Responsibility [2.63]? My answer is affirmative.

2.2.1 First Foundational Question: Who Are We?

How do we ground our ethics when we earthlings are looking at the sky? By grounding I mean justifying. Ethics, as the theory underlying moral action, cannot simply ride the winds of whim or personal preference. Its foundation needs to be cemented down. How are we going to do this?

We can begin the planting process by asking three fundamental questions: Who are we? What do we value? What should we do? Let us address each of these in turn; and then we will address the issues already on our list.

Who are we? Evolution has made us into responders. According to theologian H. Richard Niebuhr, responsibility ethics is grounded in human nature. "What is implicit in the idea of responsibility is the image of man-the-answerer, man engaged in dialogue, man acting in response to action upon him" [2.54]. An astroethics of responsibility could be grounded in the responsive trait belonging to our human nature.

Who are *we*? By *we* here I mean the entire human race on planet Earth. Inherent in asking about astroethics for earthlings is the question: Who speaks for Earth? [2.83]. How could we justify a moral agent that does not build on responsibility to humanity and of humanity in the form of a single planetary society?

A single planetary society becomes a community of moral deliberation when addressing the relationship between Earth and what is off-Earth. Our solar neighborhood or the Milky Way metropolis is not the private property of one nation; nor is an off-Earth site the claim of whichever team of astronauts arrives first. The competition and rivalry that plague our everyday territorial claims on Earth must be superseded by a global community about to enter the space environment which surrounds all of us.

This single Earth community does not exist yet, even though the United Nations has been working with this concept of the *we* at least since 1967. The 1967 UN Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other

³Human nature derives via evolution from pre-human nature, and pre-human life already exhibits the "ought" imperative. According to Jonas, because living creatures struggle to survive and thrive, they presuppose it is "worth the effort." If it is worth the effort, then this "must mean that the object of the effort is *good*, independent of the verdict of my inclinations. Precisely this makes it the source of an 'ought'" [2.36].

Celestial Bodies, stipulated: “§ 1. The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interest of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind. § 2. Outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law, and there shall be free access to all areas of celestial bodies” [2.85]. After looking toward the heavens, we earthlings look back at each other and recognize a newly founded unity. Octavio Chon-Torres notes: “The treaty of outer space is a good example of how our expansion in the Universe should help us to conceive [of] ourselves as a united humankind” [2.13].

Our first moral responsibility is to work toward the establishment of a single planetary society, which may in time become expanded into a galactic moral community. Here is the warrant: virtually every decision regarding what earthlings do in space will have repercussions for every resident of Earth. Therefore, the concept of planetary ethics includes, among other things, representative participation. We can envision a future replete with a single universal humanity; and we can incarnate that vision proleptically by acting now out of that vision. *Our first obligation is to become who we are: the one people of Earth, diverse in the past but united in the future.*

2.2.2 Second Foundational Question: What Do We Value?

Life. Like cream in ol’ fashioned milk bottles, life floats to the top of the astrobiologist’s value bottle. “I suggest that the long-term goal for astrobiology and society is to enhance the richness and diversity of life in the Universe,” avers NASA’s Christopher McKay [2.47].

No one debates whether or not to value life. Yet, just how we value life has become a quandary. “Whether secular or theological, the most important question about the foundations for ethical value turns on the distinction between intrinsic value—value independent of a valuing agent—and instrumental value—value in relation to something else like the needs of humans” [2.26]. Steven Dick, former holder of the Baruch S. Blumberg NASA/Library of Congress Chair in Astrobiology, turns on this distinction to develop a cosmocentric ethic. The cosmos has intrinsic value, concludes Dick. Or, perhaps more modestly, a cosmocentric ethic will stretch the scope of terrestrial human valuing beyond anthropocentrism or even geocentrism to incorporate extraterrestrial life in both microbial and intelligent forms. Dick’s cosmocentric ethic “establishes the universe and all or part of its life as a priority rather than just humans or even terrestrial life in

general" [2.26]. Where Dick puts cosmocentrism, I put the galactic common good.

Is it possible for anthropocentric and geocentric earthlings to transcend their own myopia? Yes, according to astrotheologian Andreas Losch, "We cannot avoid some anthropocentric bias, but we humans are also the ones who can speculate beyond the bounds of our experience" [2.41]. The shift toward a galactic or even cosmocentric perspective will require a realistic respect for the tension existing within our human nature: our proclivity toward self-centered myopia in tension with our capacity to speculate broadly and altruistically.

Dick's proposal of a cosmocentric ethic—in conjunction with my proposal for a galactic common good—compels us to ask: What do we already value? Do we actually value the safety, welfare, and future health of Planet Earth? Our ecoethicists say, no. They complain bitterly that *de facto* the human race values its home planet too little. Even with enlightened self-interest as a motive, we planetary citizens have befouled our terrestrial home. One might reasonably ask: If we terrestrials have befouled our own planetary nest, might we do the same for every off-Earth site we visit? [2.9].

Geocentric values are constantly assaulted by rival greeds. Even high-minded Enlightenment values—freedom, equality, justice, dignity, peace—are left orphaned by the vicious competition for economic survival if not domination. Arnould, using the metaphor of evolution, fears that what has happened on Earth may be repeated in space [2.4] [2.5]. The human attitude of domination of the fittest (or, sometimes also, of survival) leads to growing terrestrial pollution, toxic waste, even climate change which will modify, in a few decades, the level of the oceans, the rain pattern, the distribution of the deserts and the cultivatable zones.

To avoid the same polluting of space with earthling myopia, Arnould draws on the equivalent of intrinsic value and proposes that we "sanctuarize" outer space. By recognizing that space "transcends all our actual economic motivations It is probably the role of national and international space agencies to devise and introduce rules of effective control, and create conditions that would govern any form of exploitation still to come from space" [2.2]. In short, Arnould recommends that, by "sanctuarizing" space, our policy-setting transcends the vested interest of nations and businesses.

If "sanctuary" here connotes precedents already set on Earth for wildlife sanctuaries or protected parks, then I concur that setting a policy of sanctuarization of space would be consistent with our fundamental values. Yet, it could mean more. It could imply communion between what is natural and what is distinctively human; and this communion spawns moral power. Ecoethicist Cynthia Moe-Lobeda testifies how "human moral power flows

primarily from deep communion between God, human creatures, and the broader community of life” [2.51]. Or, “the sacramental *communion*—God incarnate in us and among us as human communities and as a planetary or even cosmic community of life—is a locus of moral power” [2.51]. In a moment I will lift up the concept of a “galactic commons,” one way in which such values can empower us and lead to policy formation.

2.2.2.1 *Science and Value*

The question—What do we value?—takes on complexity and nuance when drawing science into the picture. The place of science raises two challenges. First, if science is value-neutral, then all the ethicist can do is paint values over science, distorting science. Second, whichever moral color the ethicist selects will seem to be arbitrary, merely the color of the moral painter’s subjective choice. Let us look at these two challenges in turn.

First, should we paint science with an ethical brush? If we do, would ethical deliberation distort value-free science? Or, should we ask a bit critically: Can science actually claim to be value-neutral in the first place? Scientists certainly strive for objectivity, employing multiple tests by blind referees to confirm or disconfirm a hypothesis. Such honest rigor is to be commended, even applauded. Yet, beneath the value-free patina, scientific research is always guided by either a worldview or by someone’s vested interests. Big science as practiced today requires funding, and funding is supplied only by funders who are expressing their agendas.

Money talks. Power speaks. Space Studies researcher Mark Bullock alerts us to the force of financial influence. “The role science will play in determining the quality of life for every human being on the planet is of course determined by the elite that funds science. In this way all scientific enterprise is embedded in the greater moral problem of how individuals and groups should conduct themselves” [2.10].⁴ In short, follow the money.

However, following the money is not enough. All moral issues cannot be reduced to money. A more subtle concern must be addressed. We must ask whether values or morals or obligations are inherent to scientific research and technological development, or if the ethicist must add it. Alternatively, we might ask whether values are inherent to the subject matter science studies—namely, nature—so that, even if science is value-neutral, nature

⁴We are not working here specifically with scientific ethics; rather, we are working with terrestrial social and ecological ethics with the contributions of scientific research to formulate the issues. “The term *scientific ethics* may refer to the ethics of doing science” [2.11].

is not?⁵ Might we find value concerns rising up either from nature itself or from the science we employ to explain nature? If the answer is affirmative in either case, then science and value come together in a single package; and to separate science from value would constitute an abstraction.

To say it another way: human life is fundamentally and inextricably embedded in nature; and this embeddedness is already value-laden. Therefore, when the scientific method excises only objective data from our already value-rich experience with nature—drawing a picture of nature as valueless—this amounts to an abstraction. The value-free conclusion of science is actually an assumption; it is a circular argument that does not account for our fundamental relationship of the human within nature.

Despite the abstractive component to this method, we will operate here with the hypothesis that ethics and what science learns about nature are co-original; they belong together in the relationship between nature, science, and the wider culture.

When nature herself emits value, the ethicist does not simply paint values over an otherwise neutral physical world. The ethicist needs to demonstrate that the values already at work in scientific discovery can be subjected to analysis, their presuppositions exposed and made available for ethical critique. With existing value assumptions then out in the light, the ethicist can coax the researcher toward self-conscious realism, authenticity, and care. Research scientists, in large part, concur. UNESCO rejoices in that “the world of scientific and technical research now regards ethical reflection as an integral part of the development of its own domain” [2.30]. An Astroethics of Responsibility will rely on the hypothesis that science and ethics belong intrinsically together; and we will see just how illuminating this exercise might be.

2.2.2.2 *Religious Reliance on the Common Good*

In addition to hypothesizing that ethics is inherent within the scientific interpretation of nature, should the scientific enterprise allow itself to be painted with a religious brush? Do ethicists working within a specific religious orientation have any right to speak to the direction taken by science?

Durham University astrotheologian and astronomer David Wilkinson [2.92] relies on the hypothesis that science and its subject matter, the natural world, already emit moral valence. With the prospect of meeting extraterrestrial life on an exoplanet, Wilkinson reminds us that “theology will want to stress

⁵Hans Jonas listens as nature speaks. Life says that it seeks to live; and Jonas hears this cry as evidence of a supreme good. “Without the concept of good, one cannot even begin to approach the subject of behavior. Whether individual or social, intentional action is directed toward a good [even a] highest good, the *summum bonum*.” [2.35].

the importance of an ethical dimension in any contact with life-forms elsewhere in the Universe" [2.67]. Note that Wilkinson will not simply paint religious values over an otherwise value-free scientific discovery. Rather, as a theologian-scientist hybrid, he will recognize values as they arise from the new situation. It is inherent to the theological task to engage in ethical speculation and moral commitment and, in this case, theological speculation responds to what we will learn through science about the natural realm.

With such a theological perspective, a Christian moral posture would be erected on God's plan for a promised new creation [2.67]. That new creation entails an important moral norm, namely, the "common good." A middle axiom that connects God's promised new creation to the present moment is our vision of the common good, symbolized biblically as the eschatological Kingdom of God.

Pope Paul VI defined the common good as "the sum of those conditions of social life which allow social groups and their individual members relatively thorough and ready access to their own fulfillment" [2.89]. Saint Pope John XXIII previously said clearly that "the attainment of the common good is the sole reason for the existence of civil authorities" [2.94]. The Lutherans have extended the common good to embrace all of life without directly specifying extraterrestrial life.

"Today, the meaning of 'common good' or 'good of all' must include the community of all living creatures. The meaning also should extend beyond the present to include consideration for the future of the web of life. The sphere of moral consideration is no longer limited to human beings alone" [2.29].

What the Holy See and the Lutherans make explicit is already implicit within naturally derived ethical insights, namely, the moral responsibility of governments and all persons of good will is to serve the common good.

Let me entertain two likely objections to this theological input into astroethics. First, one might object that this is only what Christians think. Christianity is only one religion among many; and adherents to other religious beliefs have their own ethical groundings and norms. To make matters more complicated, moral values are relative to one's culture and context and personal preferences. A Christian has no right to superimpose sectarian morality on those who do not freely affirm the same basic commitment. To put it another way: the ethical ground on which a Christian stands is shifting sand for the non-Christian.

Let me respond. Christians live in neighborhoods with Muslims, Jews, Hindus, Buddhists, agnostics, and atheists, among others. Despite this diversity, however, we all live in a shared planetary community, or at least

within a worldview that makes a shared planetary community plausible. At some level, shared ethical commitments and responsible moral behavior are indispensable for any communal cooperation in pursuit of the common good.

When it comes to space ethics, we must think of the entire human race on the third planet from the sun as a single community of moral deliberation. "The world common good demands the existence of a world community, a planetary public consisting of all those affected by the actions of others on earth," writes Georgetown University political scientist, Victor Ferkiss [2.31]. What this implies is that public ethical reasoning—the ethical reasoning by Christian ethicists as well as ethicists coming from any other tradition—must be sufficiently transparent as to make sense for a collection of diverse perspectives while lifting up a vision of the common good. This is what I am attempting here, even if briefly.

A second objection might come from postcolonial or postmodern critics who decry the ideal of a single global community of moral deliberation. Why do they object? Because such an ideal of a universal humanity is a distinctively "modern" and, therefore, outdated idea. The problem is this: Such a global ethic would rely upon universal thin values apart from any tradition-specific thick values. The thick traditional practices of specific moral communities might become marginalized if we develop a single moral community and an astroethic based on the lowest common denominator. "Rather," comments Kenyan theologian Gavin D'Costa, "I would suggest that it is important to allow different communities to advance their own thick descriptions, and then to work with what arises at that point" [2.23]. The assumption at work here is that thin values unite while thick values divide. Is this hopeless?

In response to D'Costa, I suggest that an Astroethics of Responsibility should enlist each existing tradition-rich moral community into a common planetary endeavor. This shared endeavor would then deal with a matter that concerns all earthlings equally, namely, our planet's relation to what is beyond our planet. Given the existing competition between moral groups on Earth, and given the urgency of a unitary approach, perhaps a thin yet shared set of moral values would be the best we could practically ask for. A distinctively modern ethic that avoids top-down tyranny and encourages bottom-up participation would provide the requisite foundation for a planetary approach to space ethics [2.25].

2.2.2.3 *A Secular Grounding for Astroethics?*

We have just reviewed a distinctively Christian approach to ethics based upon a vision of the common good; and we have reviewed some religious

alternatives. What about an avowedly non-religious or secular public agenda for astroethics? One admirable attempt is offered by Kelly C. Smith of Clemson University.

How does Smith answer our grounding questions? Who are we? According to Smith, we are human beings who have evolved into social creatures and have constructed culture. What do we value? We value reason. Smith describes the human race as "ratiocentric." This leads to a "package deal" in which the "sociality-reason-culture triad (SRCT) is the proper basis for intrinsic moral value" [2.78]. What should we do? We should search for the extraterrestrial equivalent of ourselves—for SRCT aliens—and then expect that both the aliens and ourselves would share the same basic ethical structure. "The SRCT linkage may be so strong that it constitutes a universal property of other intelligent species in the universe" [2.78] [2.68].

Rather than of fashioned manifest destiny, Smith advocates "manifest complexity," a doctrine according to which rational intelligence should come to rule in the universe. Our purpose as rational beings is to "maximize universal complexity" [2.78], something SRCT aliens would understand and share with us.

This is a secular ethic grounded in a selected human trait, rational capacity or intelligence. Reason is lifted up as morally foundational, not an uncommon move in our post-Enlightenment era. In principle, any ethicist could lift up any trait to serve as the ground for intrinsic value. Christian ethicists are not likely to embrace Smith's ratiocentrism. Much higher on the Christian value scale than reason are affections such as compassion, love, service, and justice. For the Christian, mentally disabled or socially inept or culturally marginalized persons each have dignity; each has intrinsic value and should be treated as a moral end and not merely a means. Smart humans are not more valuable than dumb ones on the Christian scale of values. This commitment to universal human dignity is grounded in God's conferral of dignity on us in the incarnation. In sum, Smith's astroethic may seem persuasive only to that segment of society which is already ratiocentric.

Despite this demur, Smith has provided a laudably coherent argument, in my judgment. The fact that Smith's program seems arbitrary is by no means his fault. It is due to the fact that we live in a pluralistic world with moral relativity. It is difficult to ground any ethic that could be universal in our situation. Therefore, what a theological ethicist should do is promulgate a religiously grounded point of departure and then look for overlap with others representing differing perspectives toward the end of seeking sufficient common grounds to launch a single global community of moral deliberation. Smith's naturalistic justification for valuing life provides an enticing overlap if not partnership.

As just suggested, a secular astroethics of responsibility is likely to seek some level of grounding in one or another form of naturalism. The ethicist will ask nature to provide foundational insights for human valuing. This method risks committing the naturalistic fallacy—that is, drawing a moral “ought” out of an already existing “is.” Yet, without a transcendent grounding in the divine, nature is about all that is left to undergird an ethical vision.

Kelly Smith and Steven Dick, along with Hans Jonas, bring to the astroethical construction site a welcome supply of nature’s building materials. When we pour an aggregate of naturalistic gravel and theological stones into the concrete, the resulting foundation will be firm. “While theology can provide potentially universal principles such as compassion and dignity that will be useful in the context of astroethics, the problematic naturalistic fallacy should not stand in the way of secular ethics playing an important and perhaps predominant role” [2.26]. In short, theological and secular ethicists should link arms in constructing a superstructure of quandaries that lead to fitting moral responses.

2.2.3 Third Foundational Question: What Should We Do?

2.2.3.1 *From Quandary to Responsibility*

What should we do? We have already asked: Who are we? And we asked: What do we value? Now, to answer this third question—What should we do?—we draw on a pair of concepts: quandary and responsibility. No doubt communities and traditions find themselves frequently confronted with a quandary accompanied by a sense of responsibility. Such communities must work through the quandary by drawing practical applications out of their fundamental ethical orientation. Perhaps we can build on this common phenomenon as a foundation for multicultural ethics. We will call it the “Quandary-Responsibility method” within an Astroethics of Responsibility.

First, to demonstrate, today we are confronted by a quandary: How should we think ethically about the prospect of sharing the cosmos with space neighbors? Roman Catholic ethicist Charles Curran provides a framework. “Quandary ethics deal with concrete, objective human situations. In addition, it is here that human reason, science, and human experience predominate” [2.22]. This quandary regarding space exploration and ETI is not religion-specific. It does not begin with dogma and then seek application; rather, it begins with an astroethical question and then surfs the tradition for a helpful answer.

Second, we approach the quandary with a sense of moral responsibility. As the etymology of the Latin, *respondere*, meaning *to answer*, suggests, responsibility ethics answers questions raised by our changing situation [2.37]. Responding or answering belongs to the “primordial experience of the Judeo-Christian-Islamic tradition: a call from God that human beings accept or reject” [2.50]. In the present discussion, what calls to us for a response or answer is the quandary posed by new space knowledge.

The Quandary-Responsibility method provides a keeled river raft to navigate the rapids, a stable boat to ride the rushing whitewater of science, technology, and social change. When the quandary is prompted by a situation that lies beyond Earth and more than likely will affect our entire planet, then perhaps we need to think of a single planetary moral agent. It is our global community that should be morally responsive and responsible. To work with the notion of responsibility for earthlings and to work with the idea of a shared commons in space, we will need to commit ourselves to a vision of universality. The universe requires universality.

2.2.3.2 *From Space Sanctuary to Galactic Commons*

Earlier we introduced Arnould’s proposal to treat outer space as a sanctuary; and we introduced the Roman Catholic notion of the common good. In extending these ideas [2.66] we ask: Is it fitting to think of circumterrestrial space as a commons, as belonging to us all and not to any person or nation in particular? [2.62]. Boston University theologian John Hart would answer in the affirmative. “The sacred cosmic commons is a communion of commonnesses cosmically interrelated and integrated. It is stardust become spirit; it is atoms become life and thought, all in the presence of a transcendent-immanent Being-Becoming, creating Spirit” [2.33].

Let’s return for a moment to what the United Nations has said. “The exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development, and shall be the province of all mankind” [2.85]. This has come to be known as the Common Heritage of Mankind Principle or CHP. The principle “confers on a region the designation of *domino util* or beneficial domain that should be legally defined as a *res communis humanitatis*, a common heritage that is not owned by any nation, but from which all nations may garner profits and benefits” [2.71]. Rather than national interests, the UN works with planetary interests. What about the interests of extraterrestrials?

Hart lifts up for us the ethical norm of a cosmic commons which takes into account the interest of the extraterrestrials.

"The *cosmic commons* is the spatial and local context of interactions among corporeal members of integral being who are striving to meet their material, spiritual, social, and aesthetic needs, and to satisfy their wants....The cosmic commons includes the aggregate of goods which, beyond their intrinsic value, have instrumental value in universe dynamics or as providers for the well-being of biotic existence. In the cosmic commons, goods that will eventually be accessible on the moon, asteroids, meteors, or other planets should prove useful to humankind, to other intelligent life, and to biokind collectively" [2.32].

Might Hart's notion of a cosmic commons help us move forward from quandary to responsibility? Yes.

Perhaps some elements of the Roman Catholic concept of the "common good" could bleed over into our concept of the cosmic commons. "The common good as sum of the goods possessed by many and directed toward the utility of individuals," writes Sergio Bastianel, "will be the *common reaching out* to realize a way of living together that can be accurately called *communio*" [2.6]. Or, the common good "indicates an *ultimate goal* of society, its *utopia*, in such a way that the intermediate aims will be critically evaluated in their being conformed toward such an aim of communion" [2.6]. For the near future, the commons will be shared by all of us who live on planet Earth. Perhaps in the more distant future, after we will have encountered extraterrestrial life and incorporated that life into our commons, the community of moral discernment will broaden. In short, our ethical vision directs our gaze toward a future communion shared by earthlings and spacelings.

Hart is not alone in proffering the idea of a cosmic commons as an ethical category. Like Hart and Dick, Mark Lupisella at NASA's Goddard Space Flight Center proposes a "cosmocentric ethic," which he contends "may be helpful in sorting through issues regarding the moral considerability of primitive extraterrestrial life as well as other ethical issues that will confront humanity as we move into the solar system and beyond" [2.42].

Arnould uses the term "Greater Earth" to communicate the same basic notion, although perhaps more limited in space. "Greater Earth defines the area, the space territory that surrounds the Earth and where most future space activities could take place" [2.3]. The Greater Earth within our solar system would host economic activities and provide the sphere of terrestrial moral responsibility. What we see here is a growing convergence toward the vision of a cosmic commons—whether called "Greater Earth" or a "cosmocentric ethic"—that makes the entire human community on Earth responsible for ethical deliberation and includes in our sphere of moral responsibility everything in space we can influence.

My preferred term, as I've already indicated, is "galactic commons" or "galactic common good."

2.3 Astroethical Quandaries Arising Within the Solar Neighborhood

The discipline of astroethics responds to earthlings going to space whether or not we meet new extraterrestrial neighbors. "Clearly, the 'holy grail' of astrobiology would be the actual discovery of life elsewhere in the Universe, and such a discovery would have profound scientific and very likely also philosophical and societal implications," exclaims Ian Crawford; "Needless-to-say, there will also be significant scientific and philosophical implications if extraterrestrial life is not discovered, despite ever more sophisticated searches for it" [2.20]. If "astrobioethics" within "astroethics" would focus directly on quandaries arising from engaging off-Earth life, then the more encompassing category of "astroethics" would include matters that may or may not involve off-Earth life forms.

We turn now to ten astroethical quandaries arising within our solar neighborhood, quandaries already familiar to astrobiologists: (1) planetary protection; (2) intrinsic value of off-Earth biospheres; (3) application of the Precautionary Principle; (4) space debris; (5) satellite surveillance; (6) weaponization of space; (7) scientific versus commercial space exploration; (8) terraforming Mars; (9) colonizing Mars; and (10) anticipating natural space threats [2.65].

2.3.1 Does Planetary Protection Apply Equally to Both Earth and Off-Earth Locations?

Our mandate for Planetary Protection (PP) is made clear in Article IX of the 1967 UN Outer Space Treaty. "Parties to the Treaty shall pursue studies of outer space including the Moon and other celestial bodies, and conduct exploration of them so as to avoid their harmful contamination and also adverse changes in the environment of the Earth resulting from the introduction of extraterrestrial matter and, where necessary, shall adopt appropriate measures for this purpose..." [2.85]. This version of the PP principle seems to make it clear: we are morally obligated to protect both Earth and other celestial bodies.

The risk of contamination goes in two directions, forward and backward. The possibility of "forward contamination" alerts us to the risk of disturbing an already existing ecosphere; the introduction of Earth's microbes carried by our spacecraft or equipment could be deleterious to an existing

habitable environment. During the SARS-CoV-2 pandemic, NASA issued two interim directives (NIDs) to protect both the Moon and Mars from forward contamination brought by earthlings [2.53]. “Back contamination” would occur if a returning spacecraft brings rocks or soil samples that contain life forms not easily integrated into our terrestrial habitat. When Apollo 11 returned to Earth in 1969 from its Moon landing, it brought Moon Rocks which President Richard Nixon divided into rice grain sized pieces and distributed to each of the 50 states and 135 nations as souvenirs. To this date, no earthling has suffered from back contamination.

Are we earthlings equally concerned about both our own planet and each off-Earth site? Not in practice. In practice, prevention of backward contamination trumps protection against forward contamination. Although forward contamination is a matter of concern, some forward contamination is permissible, opine NASA scientists Catharine Conley and John Rummel. What is not at all permissible is backward contamination. Preventing harmful contamination of the Earth must be of the “highest priority” for all missions [2.73].

Even so, PP in principle includes moral concern for protecting off-Earth bodies from Earth’s contamination. “Planetary protection covers explicitly the search for extraterrestrial life and also the potential for Earth life to interfere with future human objectives” [2.17] [2.18]. As we proceed to refine astroethics, we should ask: Might one or another off-Earth biosphere hold intrinsic value? And, if so, might this heighten our responsibility for protecting it from contaminants from our home planet?

2.3.2 Does Off-Earth Life Have Intrinsic Value?

In 2020 a possible biosignature was spotted on Venus. It is not life itself, to be sure. Rather, it is a spectral fingerprint, a light-based signature of phosphine in Venus’ harsh sulfuric atmosphere. Even if there is no life on the 900-degree surface, perhaps microbes make their home in the Venusian clouds.

NASA scientists have long given credence to the panspermia hypothesis, namely, that a wandering asteroid entered our solar system during planet formation and seeded both Mars and Earth with life. This means life on Mars and Earth would turn out to be sisters, so to speak. But life on Venus and Earth would be strangers.

On the one hand, if the panspermia hypothesis gets confirmed, we could work with the assumption that the universe underwent a single origin of all life. This would make Martian life like Earth life. On the other hand, if the Venusian hypothesis gets confirmed, then this would mark a 2nd genesis

of life. The sulfuric origin of life on Venus would likely differ from the carbon-based life that has evolved on Earth. Would it matter ethically if extraterrestrial life shares our genesis or derives from a second genesis?

Regardless of whether it is due to a shared genesis or a second genesis, astroethicists to date have been leaning toward ascribing intrinsic value to off-Earth biospheres. But they have not leaned far enough to tip completely. With the term "intrinsic value," we intend "value that is truly independent of valuing agents" [2.43]. At work is a widespread assumption that intelligent life would warrant intrinsic value but non-intelligent life would not. Is this assumption sound?⁶

⁶Intelligence establishes moral status. Unless you are Erik Persson, bioethicist at Lund University in Sweden.

Persson appeals to sentience within the larger category of life. "According to sentientism, one has to be sentient to have moral status whether terrestrial or extraterrestrial and whether biological or nonbiological [such as post-biological].... The most plausible theory for moral standing seems to be sentientism that connects directly to the basic idea behind modern ethics: that ethics is about dealing with situations where one's own actions affect others in a way that matters⁶ to them....If we accept sentientism, microbial life and plants do not have moral status, but there are reasons for protecting someone or something other than being a moral object" [2.55]. In my judgment, sentience will not work as a general ethical category, except for vegetarians. Here on Earth we have already committed ourselves to eating meat. Meat-eating requires the death of sentient creatures. We discriminate between pets, which we do not eat, from stock, which we do eat. Vegetarians object to this practice on moral grounds, on the grounds that we have an equal responsibility to all sentient creatures. If we are to export to extraterrestrial realms a categorical respect for all sentient organisms, then for the sake of consistency we would need to adopt vegetarianism back at home. A consistent ethic based upon sentience would require vegetarianism on Earth as well as on all space expeditions.

Sentience will not help for another reason. To date, those contributing to this discussion have drawn on ethical precedents set by environmentalists and eco-ethicists. This ethical posture is oriented holistically toward entire ecosystems, toward protecting entire habitats with their resident living creatures regardless of level of sentience or intelligence. This holistic approach seems intuitively relevant to what we might discover on Mars or a moon orbiting Saturn. Once engaged, we would not discriminate between one species on behalf of another species. Rather, we would assume we are responsible for each entire biosphere with its already established life forms. Entailed in a holistic commitment to an entire ecosystem is an indispensable level of commitment to simple life forms and even to abiotic contributors to this ecosystem.

In sum, we may have to live for a period with a generic respect-for-life's-intrinsic-value principle until we have entered into actual engagement with extraterrestrial life forms. At that point we will rearticulate the quandary and reformulate our responsibility. By no means is this a form of kicking the ethical can down the road. Rather, we are simply marking specific areas where we will need to respond to actual rather than hypothetical situations.

This is our quandary: Does life—even unintelligent life—have intrinsic value? Or, does the value of living organisms depend on the usefulness they have for us? Is worth inherent or instrumental? Do we terrestrial *Homo sapiens* have a responsibility toward extraterrestrial life based upon that life's intrinsic worth or based strictly upon its usefulness to us? [2.64]. Almost no one to date has risen up to defend a brute instrumentalism. The predominant discussion takes place within the intrinsic value option.

Richard Randolph and Christopher McKay believe “that new operational policies for space exploration and astrobiology research must be developed within an ethical framework that values sustaining and expanding the richness and diversity” [2.49]. This applies to entire biospheres, not merely individual organisms. Even so we ask: Just how close to ascribing intrinsic value is this?

Taking a minimalist position, Charles Cockell acknowledges that extraterrestrial microbial life will make some level of demand on us earthlings: “Telospect or teloempathy merely captures our recognition that extraterrestrial life, including life independently evolved from the biology that we know on Earth, placed demands on our behavior if we think it has intrinsic value” [2.16].

Kelly Smith moves one notch closer toward intrinsic value, distinguishing off-Earth species from what we know on our home planet. With the label “Mariophilia,” Smith posits that extraterrestrial “life would be extremely valuable and should be defended against *petty* demands of human beings, but also that human interests can in principle trump those of Martians” [2.79]. With this conditioned appeal to intrinsic value, terrestrial interests still trump extraterrestrial interests.

Octavio Chon-Torres goes beyond Smith. “The proposal that I have presented would include safeguarding the ‘rights’ of the Martian life to exist, that is, having an intrinsic value. And why not? Every form of life follows Darwinian mechanics and seeks to develop, insofar as it has that ‘interest’ has a value in itself. A separate question is whether the human being wants to respect it” [2.14].

We get some help from Oxford ecotheologian Celia Deane-Drummond, who would be satisfied with ranking value. “It is possible to hold to the notion of intrinsic value, while also being able to discriminate between different forms of life and non-life in terms of their worth” [2.24]. Or, to say it another way, even if we impute intrinsic value to all living things, within this broad category we may identify some living things to be of greater value or worth.

Even so, the astrobioethicist will ask: How do we decide? Without appealing to instrumental criteria for discriminating between greater or lesser worth, we should look for criteria within the scope of intrinsic value. Regardless of the answer, an astroethics of responsibility will enjoin us earthlings to care for off-Earth microbes and their respective biospheres.

2.3.3 Should Astroethicists Adopt the Precautionary Principle?

Earth's ecologists are used to debating and embracing the precautionary principle. Might astroethicists borrow it? The astroethical principle might look like this: when in doubt, protect off-Earth life in its respective biosphere [2.65].

The so-called Wingspread definition of the precautionary principle was formulated at the 1998 United Nations Conference on Environment and Development: "When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically" [2.86]. In this context the proponent of the process or product, rather than the public, should bear the burden of proof.

When space scientists and ethicists met at Princeton for a COSPAR workshop in 2010, they embraced a variant formulation: "we define the *precautionary principle* as an axiom which calls for further investigation in cases of uncertainty before interference that is likely to be harmful to Earth and other extraterrestrial bodies, including life, ecosystems, and biotic and abiotic environments" [2.19]. In sum, employment of the precautionary principle for space exploration provides the kind of middle axiom that connects the larger value of life with practical policies that facilitate off-Earth explorations.

2.3.4 Who's Responsible for Space Debris?

According to NASA's count, 22,000 pieces of space junk in the form of defunct human made objects are orbiting Earth. We have turned our upper atmosphere into a trash dump for nonfunctioning space craft, abandoned launch vehicle stages, and fragments of unusable satellites. Do we want to pollute circumterrestrial space just as we have befouled our terrestrial nest? [2.45] [2.77].

The problem with our orbiting landfill is not merely that it is ugly. It is also dangerous. It risks danger to future space flights and future

satellites. The Kessler Syndrome, named after NASA scientist Donald J. Kessler, proffers a scenario: debris in low Earth orbit (LEO) may become sufficiently dense that collisions between objects could cause a cascade where each collision would generate smaller particles in increased number; and the increased number of objects would then increase the number of collisions. The cascade would pulverize anything that comes within its region. The LEO region would become impassable for future launch vehicles.

To date, no one has been held financially responsible for space junk. Those who make profits or who otherwise gain from sending this material into space are not required to recycle or dispose of their waste. Space waste accumulates, but nobody is required to pay for cleaning it up. Nations or corporations treat the Greater Earth as their ashtray, as a public trash dump. Follow the money.

If we define Greater Earth as a part of the galactic commons, then we find ourselves already beset with a classic moral problem: those with power and influence utilize common space for their own profit while the population as a whole absorbs the cost of deterioration or degradation of what is publicly shared. If and when Earth's planetary society consolidates its diversity into a single community of moral deliberation, then responsibility will need to be parsed and parceled according to a renewed principle of distributive justice.

The European Space Agency has set up a Space Debris Office to coordinate research activities in all major debris disciplines, including measurements, modeling, protection, and mitigation, and coordinates such activities with the national research efforts of space agencies in Italy, the United Kingdom, France and Germany. Together with ESA, these national agencies form the European Network of Competences on Space Debris. In parallel, the Japan Aerospace Exploration Agency (JAXA) is testing to see if a tethering technique might begin the process of debris-gathering. What we are missing is a planetwide public policy regarding fiscal responsibility on the part of spacefaring parties.

2.3.5 How Should We Govern Satellite Surveillance?

Earth's residents are losing their privacy faster than politicians lose their scruples. The telescopes on board reconnaissance satellites are pointed toward Earth, not toward the stars. Mission tasks include high-resolution photography; measurement and signature intelligence; communications eavesdropping; covert communications; monitoring of nuclear test ban

compliance; and detection of missile launches. With the improvements in technology, today's spy satellites have a resolution capacity down to objects as small as ten centimeters. Surveillance satellites also provide us with efficient communications, weather reporting, Google maps, and many more public services.

Satellite spying is international, not just national. The Echelon spy network coordinates satellite snooping by the governments of the United Kingdom, the United States, Canada, Australia, and New Zealand. The Echelon network spies, sorts, decrypts, archives, and processes three million telephone calls transmitted by satellite every minute. The United States government sells pictures taken by satellites; but it keeps certain subjects from public review. Sensitive facilities such as military installations are restricted, as are remote pictures taken over Israel. Similarly, private companies use satellites for remote sensing and sell their pictures.

"Can a State gather information about the natural riches and resources of another sovereign State without having obtained the latter's prior agreement?" asks Arnould. "Is it not up to the remote sensing State to ask for the prior permission of the State [2.81] whose territory is being observed?" [2.3]. This sounds like a reasonable ethical question. Yet, it presupposes the present situation of sovereign nation states, a political system that may have made sense prior to the current thrust toward economic and technological globalization. Satellite surveillance and communication services, right along with other space activities, are playing into an emerging planetary consciousness.

Protecting national boundaries from foreign intelligence or even public transparency may soon be an artifact of history, an era we remember but no longer live in. Perhaps the way forward is to support an ethic of maximal "information without discrimination." Rather than attempt to police information gathered from remote sensing, it would be healthier and easier to prevent such information from deleterious usage.

2.3.6 Should We Weaponize Space?

Should nations weaponize space? Should militaries establish orbital beachheads from which to launch attacks? No. At least according to the 1967 United Nations Outer Space Treaty, which stresses that celestial locations could be used "exclusively for peaceful purposes." The treaty explicitly prohibits the "placing in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction."

In 2020, the United States formulated the doctrine to guide its new Space Force.

“Military space forces are the warfighters who protect, defend and project spacepower. They provide support, security, stability, and strategic effects by employing spacepower in, from, and to the space domain. This necessitates close collaboration and cooperation with the U.S. Government, Allies, and partners and in accordance with domestic and international law” [2.80] [2.70].

Because of the inability of the UN to enforce its rule, regulations of military equipment in space are today the responsibility of unilateral, bilateral and multilateral agreements, not the United Nations. No global community of moral deliberation exists. At least not yet.

“For modern warfare, space has become the ultimate high ground, with the U.S. as the undisputed king of the hill,” writes Lee Billings [2.7]. “China and Russia are both developing capabilities to sabotage crucial U.S. military satellites” [2.7]. One can only imagine a skirmish that could lead to Star Wars or, more precisely, Satellite Wars.

2.3.7 Which Should Have Priority: Scientific Research or Making a Profit?

Are we about to witness in space the equivalent of a gold rush? An economic and political frenzy for gaining dominance in space may break loose over the next decades. The telecommunications industry is already accustomed to the cost-effective use of satellites. We are on the brink of an era of space tourism, with the first trips to suborbit and low orbit vacations in the planning stages. Visits to the Moon will most likely follow. Establishing research laboratories on the Moon and Mars are being envisioned as is the mining of asteroids [2.91]. Might we be wise to ready ourselves for an El Dorado type of gold rush to the new extraterrestrial world? If so, should we try to put policies and policing mechanisms in place in advance?

Up until this point we have thought of outer space as a sandbox for Earth's scientists to play in. Governments have found the money to fund modest exploratory adventures; and scientists have organized to conduct experiments which have yielded an abundant harvest of new knowledge about our cosmos. Frequently, scientific goals have been mixed with military goals, because leaders in the military have been willing to share their budgets for scientific purposes.

Scientific experiments do very little damage, if any. Somewhere on the Moon is a golf ball left by visiting astronauts. Landing on Mars or on Titan

has not infected or contaminated anybody's ecosystem, as far as we know. NASA decontaminated its first Mars lander, but more recently NASA has saved the money spent for decontamination under the assumption that a little contamination of Mars doesn't matter. The impact on our solar system by scientific activity is benign.

This situation is about to change. The private sector is now ogling space for profit. What about space tourism? Simply flying a few wealthy passengers high enough to experience weightlessness is not likely to provoke anyone's moral ire. But, what about tour busses roaming the surface of the Moon? Busses will leave tire tracks. Perhaps trash. No doubt tourists will want to visit that golf ball as well as historical sites where astronauts first landed. Will the crowds of visitors damage those sites? Are those sites sacred? Protectable? Who will decide and what will be the criteria by which they decide?

The market does not always react the way the marketers predict. Low cost and frequent flights to suborbit heights might actually encourage increased participation by scientists. These scientists will want to do research on the "ignorosphere." The ignorosphere is a level just above balloon traffic but too low for satellites. Scientific researchers might buy tickets with the tourists and then look out the windows [2.81].

2.3.8 Should We Earthlings Terraform Mars?

Should we earthlings terraform Mars? Or, any other planet or moon, for that matter? Let's ask two theologians, one Buddhist and one Christian, and then ask a NASA astrobiologist.

Francisca Cho, Associate Professor of Buddhist Studies at Georgetown University, raises the quandary: Should earthlings terraform Mars? "A Buddhist would apply neither an intrinsic nor instrumental value of life or nature to the question of terraforming Mars. The idea of an intrinsic value would go against the principle of emptiness. Instrumental value, on the other hand, would be problematic because one could not ensure that the instrumental objectives and the proper motivations.... There is no intrinsic worth to nature but neither is there intrinsic worth to human beings.... There is no option between them, so you have to transcend that framework all together" [2.12]. From a Buddhist perspective, neither an appeal to the intrinsic value of life nor an appeal to life's utilitarian value to human beings provides ethical guidance for the terraforming question.

Now, let's ask Christian theologian Cynthia Crysdale. "We need to think of ourselves as living within an ethic of risk, not an ethic of control. I say this in direct reference to the actions we take in terraforming or colonizing

or exploring other planets. My caution is to point out that the conditions of possibility that we establish in the hopes of one outcome may at the same time establish conditions under which totally unforeseen schemes of recurrence become established" [2.21]. Dr. Crysedale has wisely invoked the Precautionary Principle based upon her observations about human nature—that is, human sinfulness. No ethical justification could suffice without acknowledgement of who we are as humans, including our human proclivity to mess things up. Nevertheless, anticipating the unforeseen damage we humans are capable of is a principle one must incorporate into any such project, not merely going to Mars.

NASA's Christopher McKay provides ethical justification for his plan to terraform the red planet [2.48]. McKay hypothesizes that Mars is lifeless. At least it is lifeless today. The red planet may have been home to life in the past; but Mars must have lost its atmosphere and its ability to sustain life for reasons yet unknown. Its thin atmosphere is replete with carbon dioxide, but not oxygen. Let us speculate: Suppose we would transplant living organisms from Earth that take in carbon dioxide and expel oxygen into the atmosphere? Then, when enough oxygen suffuses the atmosphere, we could introduce oxygen inhaling organisms that expel greenhouse gases. These greenhouse gases would warm up Mars, and life would thrive. A self-regenerating ecosystem could run on its own. In less than a century, estimates McKay, we could establish a biosphere that would last ten to a hundred million years.

McKay calls this terraforming project "planetary ecosynthesis." Is such an ambitious plan ethically justifiable? Yes. McKay starts with a simple axiom: life is better than non-life. If life is better than non-life, says McKay, then it would be our moral responsibility to sponsor ecosynthesis on that planet. Transferring terrestrial life forms to Mars would be better than leaving Mars lifeless.

Curiously, McKay appeals to both intrinsic value and instrumental or utilitarian value when justifying planetary ecosynthesis. First, the intrinsic argument. Because life has intrinsic value, Mars with life would be ethically of greater worth than a lifeless Mars, even if it is transplanted life. Second, the instrumental argument. Because we on Earth would learn so much from the Mars project about sustaining a biosphere, we could apply what we learn on Mars to sustaining Earth's biosphere in the face of our imminent ecological challenges. "Both utilitarian and intrinsic worth arguments support the notion of planetary ecosynthesis" [2.46].

Should we terraform Mars or any other celestial body within our solar neighborhood? On the one hand, McKay's argument that life is better than non-life provides a sound point of departure. On the other hand,

transplanting terrestrial life to an extraterrestrial location looks a great deal like colonizing. As we bring the history of terrestrial colonization to mind, we cannot avoid recalling the imperialism and greed that motivated colonization and the devastating impact of exploitation and genocide on the lands colonized. The Crysdales incorporation of risk based upon what we know from history about human nature gives one pause. 3

Our pause cannot last too long. The Mars Society is already making plans to colonize the red planet.

2.3.9 Should We Establish Human Settlements on Mars?

Should we earthlings become a transplanetary species? Should we begin establishing human settlements on Mars? [2.44].

Colonize Mars? Yes, says Robert Zubrin, director of the Mars Society, because it's our destiny. "Mars can and should be settled with Earth émigrés" [2.96]. No, cautions NASA consultant Linda Billings, because colonization would exacerbate terrestrial inequality. "It would be unethical to contaminate a potentially habitable planet for further scientific exploration and immoral to transport a tiny, non-representative, subset of humanity—made up of people who could afford to spend hundreds of thousands to millions of dollars on the trip—to live on Mars" [2.8]. Stealing resources from the lower classes to send the wealthier classes to Mars would violate the principles of distributive justice.

Some critics argue that, because we humans have messed up Earth, it would be immoral to do the same to Mars. Adler Planetarium astronomer Grace Wolf-Chase admonishes us to clean up Earth's mess before we mess up another planet. "Considering the possibility of extraterrestrial species motivates us to re-evaluate humanity's history as stewards of Earth, and to examine critically human behaviors before migrating to other worlds" [2.93].

Would colonization be legal? The UN Outer Space Treaty, recall, holds that Mars, like other celestial locations, cannot be subject to national appropriation by claim of sovereignty, by means of use or occupation. Might the USA or China—whichever country lands first—simply stake a claim? "I don't see how Mars could be anything but a land grab driven by homesteading rules," pines Christopher Wanjek [2.91].

Among the many quandaries that the prospect of colonization raises is this: will earthlings living on Mars still be earthlings? Or, will evolution require such a level of adaptation that humans will become posthuman? Polish scientist Konrad Szocik along with his colleagues entertains this quandary and responds by recommending CRISPR gene editing to

enhance adaptation. "It is worth keeping in mind that living in different—let's call them unnatural places, which are not a part of the environment of evolutionary adaptedness—locations is not problematic per se, if humans are prepared in an appropriate way to live there" [2.82]. Astroethicists of responsibility must engage the question: Is it our moral right if not obligation to engineer the future of human evolution so that a successor species—a posthuman species—emerges?

Here is my tentative response: if a biosphere exists on Mars, then we should treat it as having intrinsic value. But if Mars is currently lifeless then, despite the interplanetary necessity for genetic engineering, we should take advantage of the opportunity to seed the Red Planet with life for the sake of its future. This becomes the moral warrant for both terraforming and colonization.

What about the mega vision of extending the habitat of *Homo sapiens* to outer space, turning earthlings into a transplanetary species? I applaud such a grand vision. I only add two grumbles, one scientific and the other theological. Scientifically, once Earth's colonists have adapted to a significantly new off-Earth environment, their descendants may no longer be human. We will not be able to say confidently that a single transplanetary species has come into existence. Theologically, we ought not to expect a utopian life to commence on a new planet. We ought not to expect we will create El Dorado or a heaven in the heavens. Earth's colonists to new worlds will bring with them a very ancient yet perduring pattern of living: sin.

2.3.10 How Do We Protect Earth from the Sky?

Even with colonists migrating from the third to the fourth planet, the vast majority of earthlings will remain living on Earth. Earth will continue to be our home for the foreseeable future. The ecological-ethical mandate is clear: if we *Homo sapiens* do not get our act together we'll go extinct before Martian microbes will.

Earth is a dangerous place to live. The heavens threaten. The Sun occasionally launches solar flares, which fry electricity grids by generating intense currents in wires. More rare than solar flares but equally potent are blasts of radiation from a nearby γ -ray (gamma ray) burst. A short-hard γ -ray burst, caused by the violent merger of two black holes or two neutron stars or a combination, provides the most frightening scenario. If one such blast would be directed at Earth from within 200 parsecs away (less than 1% of the distance across the Milky Way), it would zap Earth with enough high-energy photons to wipe out 30% of the atmosphere's protective ozone layer for nearly a decade.

There are more threats coming from Earth's heavens. Comets and asteroids, when large in size, can explode on Earth's surface with the impact of a nuclear bomb. It is widely believed among scientists that sixty-five million years ago an asteroid ten kilometers in diameter hit Earth and triggered the mass extinction of dinosaurs. Can we protect Earth from future asteroid catastrophes? The UN's Science and Technical Subcommittee's Near-Earth Object Working Group and its internal panel, Action Team 14, have been working on the details of an international approach since 2001.

The astroethical response to possible and probable futures is to prepare. These damage scenarios lead us to think ahead. We need to plan for our planet's future, and we need to incorporate such possibilities into our planning. With regard to solar flares, fortunately, there are ways to mitigate the damage should it occur: engineers can protect the grid with fail-safes or by turning off the power in the face of an incoming blast. With regard to a comet or asteroid strike, we will be given advanced notice. A diversion strategy could be effective, perhaps by hitting the object while it is yet far away with a nuclear bomb. We have no way to prevent gamma ray bursts from striking our Earth, but we could provide protective shields in sanctuaries for life forms we wish to restart following the event. These matters belong to our quandary. Just how will we respond?

2.4 Levels of Intelligence in the Milky Way Metropolis

Is it likely that yet-to-become neighbors are already living in our Milky Way metropolis? Yes, indeed. "A conservative estimate," speculates University of Arizona astrobiologist Chris Impey, "might be a billion habitable 'spots'—terrestrial planets in conventionally defined habitable zones, plus moons of giant planet harboring liquid water—in the Milky Way alone. That number must be multiplied by 10^{11} for the number of 'petri dishes' in the observable cosmos" [2.34].

When we meet them, will they be like us? No, says philosopher of biology Michael Ruse. Something like us, perhaps; but not us. "It seems that natural selection can and does produce intelligent beings all the way up to humans. I confess that even if this can happen, I would think selection would more likely produce humanoids—beings like humans but not necessarily identical to us. There might be at least as many Wookies in the universe as there are humans" [2.75].

The first question the ratiocentric astrobiologist will ask about our extraterrestrial contacts will be this: Are they intelligent? If so, just how

intelligent? We mean it when we employ a term such as ETI, extraterrestrial intelligence.

In anticipation of contact with alien intelligence in a form that reasonably resembles *Homo sapiens* on Earth, perhaps we should consider engagement with three possibilities: extraterrestrial biotic individuals who are inferior to us (intellectually less intelligent), our peers (equal in intelligence), and superior to us (more highly intelligent) [2.58]. Each of these three categories implies a different set of moral responsibilities [2.58].

Curiously, for decades prior to the advent of the field of astrobiology, astronomers and science fiction writers measured the variety of extraterrestrial beings according to scales of intelligence. The mere existence of astro-cognitionists among astrobiologists demonstrates the preoccupation we have with intelligence. "The multidisciplinary field of astro-cognition," according to David Dunér, "could be generally defined as "the study of the origin, evolution and distribution of cognition in the Universe," or simply "the study of the thinking Universe" [2.28]. Until recently, coffee conversation among astrobiologists distinguished between stupid microbial life, on the one hand, and intelligent or even super-intelligent aliens, on the other. Elsewhere I have argued that *all life is intelligent, even microbial life; and what we are dealing with are relative levels of intelligence* [2.61].⁷

Regardless of my position on continuity of intelligence, the astro-ethicist must speculate about possible and probable ETI scenarios. We may make new galactic friends with beings inferior to us in intelligence, equal to us in intelligence, and even superior to us in intelligence. Some might be hostile. Some might be friendly. Others might even be benevolent. Each possible extraterrestrial scenario would shape our terrestrial response and our responsibility. In what follows we will get specific about each scenario.

⁷David Dunér expands on my work, adding *intersubjectivity* to my list of traits of intelligence. "A recent attempt to define intelligence in connection to extraterrestrial life and evolution of intelligence is more elaborated. Ted Peters defines intelligence in terms of seven traits: interiority, intentionality, communication, adaptation, problem solving, self-reflection, and judgment [2.61]. Even microbes exhibit the first four traits; humans, along with some other animals, exhibit all of them. Where there's life, there's intelligence, so to speak, according to Peters. Intelligence seems to be a matter of degree rather than of kind. However, to this list of traits, I would add a most critical one: intersubjectivity, which I will explain in more detail in the following. Intersubjectivity, the ability to understand other minds, is an important trait in order to explain intelligence and how an intelligent creature can evolve complex communication, civilization, and technology" [2.28].

2.4.1 What is Our Responsibility Toward Intellectually Inferior ETI?

If intelligence can be measured in terms of higher and lower, what if the extraterrestrials we engage exhibit lower intelligence than Earth's *Homo sapiens*? Might the ethical framework for discerning our responsibility toward intellectually inferior ETI be analogous to our responsibility toward Earth's animals? [2.66].

If we answer affirmatively, then we would find ourselves in a classic dialectic. On the one hand, instrumentalist values are obtained. The human race exploits all other life forms—both plants and animals—for human welfare. Animals provide food, work, clothing, and even company. Animals can be sacrificed in medical research to develop therapies that will benefit only human persons. On the other hand, intrinsic values are obtained. We human beings have a sense of responsibility toward the welfare of animals. We respect them as intelligent beings; and we are concerned about preventing suffering to animals. In some instances, we exert considerable energy and effort to preserve their species from extinction and to insure the health of individual animals. In the case of pets, we love them to a degree that rivals loving our own family. We treat our pets as if they possess intrinsic value. In sum, we have inherited this double relationship to our inferiors already here on Earth.

What about ETI whose intelligence level is similar to that of the animals we have come to know? In terms of our responsibility, I believe we should take the initiative to extend concern for the welfare of such ETI on the model of our current concern for the subjective quality of animal experience. We should do what we are able to protect ETI from suffering and enhance their experience of wellbeing. In short, an astroethics of responsibility suggests that we respect ETI and show them care.

2.4.2 What is Our Responsibility Toward Peer ETI?

In the event that the aliens with whom we make contact and engage in transplanetary community approximate the intelligence level of *Homo sapiens* on Earth, an astroethics of responsibility strongly suggests that we earthlings would treat them as possessing dignity. That is, we would treat our extraterrestrial equals as possessing intrinsic value; and imputing dignity is the principal form in which response and care would become manifest [2.52] [2.57] [2.66].

Might the Golden Rule provide an ethical superstructure? Jesus' version of the Golden Rule is familiar to us all: ^{NRS} Matthew 7:12 "In everything do

to others as you would have them do to you." Even though philosopher Immanuel Kant found weaknesses in the classical Golden Rule, his categorical imperative universalized it. The formal principle from which all moral duties are derived is this: "I ought never to act except in such a way that I also will that my maxim should become a universal one" [2.38]. In short, we should treat peers as equal to ourselves; and we should care for their welfare just as we would care for our own.

Is there any reason to expect that our new friends living on a hypothetical exoplanet will have developed moral standards that correspond to ours? Yes, answers Michael Ruse. After all, extraterrestrial creatures must have evolved and adapted to the same laws of physics operative everywhere in the universe. Their logic and mathematics would be the same. Morality also? Yes, perhaps.

"Two of the greatest and most widely accepted enunciations of the supreme principle of morality are the Greatest Happiness Principle and the Categorical Imperative. The former specifies that one's actions ought to be such as will maximize happiness [John Stuart Mill]. The latter...entreats one to regard one's fellow humans as ends, and not simply as means to one's own gratification [Kant]. Either or both of these could find their equivalent on our hypothetical planet elsewhere in the universe" [2.74].

Our takeaway is this: if we earthlings ascribe intrinsic value and treat intelligent aliens with dignity, it is reasonable to expect the aliens will understand us and perhaps even respond in kind. Earthling care for ETI might be accepted and, hopefully, reciprocated.

Messaging Extraterrestrial Intelligence International (METI) founder and director, Douglas Vakoch, gives voice to such an astroethical responsibility at the moment of contact. "Relevant responsibilities to address include (1) looking out for the interests of humankind as a whole, (2) being truthful in interstellar messages, and (3) benefiting extraterrestrial civilizations" [2.87] [2.88].

With METI in mind, let's refine the peer ETI category into two subcategories: hostile and peaceful. If hostile, ETI could become a threat to us. Should we hide in hopes that we can avoid detection? Should we mount a defense? A preemptive offense?

Fearing such a threat, Stephen Hawking along with some of METI's own advisors argue that Active SETI should be stopped. We should hide Earth electronically so that hostile aliens cannot find us. Such a rejoinder arises from the fear that aliens will turn out to be just like earthlings: beset with the desire to conquer, subjugate, and pillage.

What about a preemptive offense? One of the problems we have learned from history is that we earthlings can become unnecessarily hostile and pose a threat to our fabricated enemies. We are subject to demagoguery. Even if the ETI civilization in question is peaceful, a terrestrial demagogue could persuade us earthlings that the aliens are hostile; and we earthlings, like a mob, would support military action against them. Theologians are particularly worried about human hostility, regardless of how pacific ETI might be.

Whether hostile or peaceful, peer ETI should be afforded respect in the form of dignity. In the event that peer ETI prove to be neutrally peaceful or even benevolent, then the principles giving expression to Enlightenment values should prevail without challenge: equality, liberty, dignity, and mutuality. And, yes, we should care about their well-being if not flourishing.

2.4.3 What is Our Responsibility Toward Superior ETI or Even Post-Biological Intelligence?

Among the array of possible futures, intellectually superior ETI we encounter could be hostile, peaceful, or even benevolent. In all cases, our inherited Enlightenment values would require that we treat them with dignity. If hostile, we earthlings might find ourselves enslaved to the superior extraterrestrials. We *Homo sapiens* are certainly not ready to develop a slave morality; yet a ratiocentric ethic would mandate protocols for slavlike behavior on our part. We might find ourselves relating to superior ETI just as our pets on Earth relate to us.

What would be our responsibility should intellectually superior aliens turn out to be altruistic, even salvific? This scenario of salvation coming to Earth from another planet has already risen to mythical status in our culture [2.56]. Here's the logic of the ETI myth. Because we on Earth have not yet achieved the level of rationality necessary to see that international war and ecological degradation are inescapably self-destructive, we could learn from ETI more advanced than we. "All technological civilizations that already have passed through their technological adolescence and have avoided their self-destruction...must have developed ethical rules to extend their societal life expectancy," says Guillermo Lemarchand [2.40]. Because they are beyond war, spacelings can help earthlings get beyond war [2.57] [2.66]. If ETI saves Earth from self-destructive habits such as war or even ecocide, might gratitude be a fitting response?

In short, we should treat superior ETIs with dignity, respecting and even caring for their welfare. If they are hostile and enslave us, we should invoke an appropriate slave morality that respects their superior minds

and maintains their dignity. If ETI are peaceful toward us and open up avenues of conversation and commerce, then the principles of justice and the striving to maintain peace should be obtained. If out of their superior wisdom and altruistic motives ETI seek to better our life here on Earth, we should accept the gifts they bring and respond with an attitude of gratitude.

Now, what would be our responsibility if superior ETI turn out to be postbiological? This is a reasonable speculation, given how here on Earth we are already imagining a posthuman scenario that leads to merging humanity with technology as the next stage of our human evolution. Transhumanism, also known as Humanity Plus (H+), is calling us forward. Our mental lives in the future may take place within a computer or on the internet. What we have previously known as *Homo sapiens* will be replaced by *Homo cyberneticus*. "As humanism freed us from the chains of superstition, let transhumanism free us from our biological chains" [2.95]. The terms "posthuman" and "postbiological" refer to who we might become if the transhumanists among us achieve their goals.

Might a race of extraterrestrials have already arrived at the posthuman and postbiological stage [2.60]? Templeton Prize winning astrophysicist Martin Rees engages this scenario. "The most likely and durable form of life may be machines whose creators had long ago been usurped or become extinct" [2.72]. In outer space we earthlings may meet our own posthuman future.

To make it more complicated, we can speculate that extraterrestrial postbiological intelligence might not even take an individual form. It might be communal, at least according to Eric Korpela. "I will attempt to dispense with terms such as civilization and species, as such terms presume, to some extent, that ETI will be like us: organized groups of independent biological organisms.... the universe may surprise us. The most common type of 'civilization' might consist of a single electronic intelligence" [2.39].

At this point, a subtle shift away from intelligence toward consciousness requires our attention. Philosopher Susan Schneider, a recent holder of the Baruch S. Blumberg NASA/Library of Congress Chair in Astrobiology, acknowledges that "the most advanced alien civilizations will likely be populated by forms of SAI (Super Artificial Intelligence)" [2.76]. What might this imply for the astroethicist? We observe that we have no moral compunction to allow our laptop computer battery to run down and render it nonfunctional. Our electronic computers may appear intelligent; yet they possess no intrinsic value, no dignity. We earthlings would be justified in treating extraterrestrial intelligence without conscious selfhood within a framework of instrumental value.

Table 2.1 Ethics for inferior, peer, and superior ETI.

	Inferior ETI	Peer ETI hostile	Peer ETI peaceful	Sup ETI hostile	Sup ETI peaceful	Sup ETI salvific
Astro-ethics?	Respect/Care	Dignity	Dignity	Dignity	Dignity	Dignity

Conscious selfhood adds something well beyond intelligence alone, observes Schneider. "Whether SAI is conscious is key to how we should value postbiological existence.... Consciousness is the philosophical cornerstone here, being a necessary condition on being a self or person, in my view" [2.76]. Unless extraterrestrial intelligence is packaged in a self or a person, we earthlings need not ascribe intrinsic value or treat it with dignity. Before we can determine our astroethical responsibility to an intelligent machine on an exoplanet, we will have to ask it whether it is a self or a person.

A transplanetary community of intelligent persons would warrant an astroethic of responsibility that works out of a vision of a galactic common good (Table 2.1).

2.5 Conclusion

Where have we been? I have proposed an "astroethics of responsibility" founded on a substructure of quandary-responsibility ethics. Atop this foundation, the load-bearing vertical supports included: (1) the moral agent: earthlings as a single planetary community of moral deliberation; (2) the moral norm: the galactic common good; (3) the moral spheres: the solar neighborhood and the Milky Way metropolis; (4) the moral justification: a theological grasp of the common good plus a naturalistic grasp of the Golden Rule. The floor plan designated a conference room for each of thirteen previously formulated ethical issues.

I distinguished two spheres of astrobiological application: the solar neighborhood and the Milky Way metropolis. Within the sphere of the solar neighborhood, ten already articulated quandaries were addressed: (1) planetary protection; (2) intrinsic value of off-Earth biospheres; (3) application of the Precautionary Principle; (4) space debris; (5) satellite surveillance; (6) weaponization of space; (7) scientific versus commercial space exploration; (8) terraforming Mars; (9) colonizing Mars; and (10) anticipating natural space threats [2.66]. Within the sphere of the Milky Way metropolis in which the "galactic commons" becomes the astroethical

norm, engagement with intelligent extraterrestrials was analyzed within three categories: (1) ETI less intelligent than Earth's *Homo sapiens*; (2) ETI equal in intelligence; and (3) ETI superior in intelligence in both biological and postbiological forms [2.66].

I have argued that we should nominate earthlings in the form of a "single planetary community of moral deliberation" to the office of moral agent. This earth-born community should then look to the sky and allow our planet's place in the immense and unfathomable universe to affect our shared consciousness. I support the mandate of naturalist Steven Dick regarding the decisive role that cosmic consciousness needs to play in developing an astroethics of responsibility. "A cosmic perspective is surely in order as we expand our views of the space environment, including (and especially) life. Such a view will not happen overnight, but perhaps, humanity will increase its awareness in stages, as we encounter the universe in increasingly intimate ways that will become a basic part of what it means to be human, or post-human" [2.27].

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