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# Colonizing mars—An opportunity for reconsidering bioethical standards and obligations to future generations

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## ABSTRACT

The exploration and settlement of Mars provides a rare opportunity to reconsider our ethical, political, philosophical, and economic relationships with non-human life (very broadly defined) relatively free of many of the constraints that have framed and limited our analyses throughout our many histories. Manned and robotic exploration throughout and beyond our solar system also fosters reconsideration of our obligations to future generations and allows for expansion of membership in the class that constitutes those generations. This paper argues that the concept of “future generations” should not be limited to *Homo sapiens*, as currently defined. Opportunities for a higher ethical standard within the context of the discovery of extraterrestrial life are discussed in terms of a thought experiment and mechanisms to allow future generations to be represented in these ethical discussions are suggested.

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## 1. Introduction

The November 2010 issue of the Journal of Cosmology comprises a series of articles addressing the development and execution of hypothetical human missions to Mars, from conceptualization to eventual colonization [1]. Included are considerations of human factors in training and adaptation, searching for life and mineral resources, economic modeling for profitability and analyses of capital development, and options and arguments for ecopoiesis, terraforming, or other premeditated and purposeful modification of the Martian environment on a grand scale. As demonstrated by that publication, both our activities and imaginations generally focus on modifying and exploiting Mars and, by extension, other extraterrestrial venues for human benefit in much the same conceptual way that we have colonized and exploited Earth [2]. However, there is relatively little discussion (at least in non-fiction) of how human culture and habit might be modified to aid the evolution of a genuinely novel relationship with the extraterrestrial environments we are experiencing for the first time and the new environments we are, in many ways, creating.

To date, engineering, economics, the limits of human physiology and other factors relevant to space travel tend to perpetuate the paradigms of human exploration and exploitation that have occurred on our own planet throughout our shared histories. For example, the referenced issue of the Journal of Cosmology included positive references to “conquer” and “conquering” in the context of our exploitation of Mars [3]. The significance of selecting these terms to modify our actions is subtle but telling in that it demonstrates a continuing conception of winners and losers and baits the question of what, then, is conquered; what loses in this context? The concept of conquering also may conflict on a philosophical level with Article IV of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon

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and Other Celestial Bodies (Outer Space Treaty) which states that “. . . celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes” [4]. Can conquest and conquering ever be peaceful? Does their use presuppose we will foster a strongly anthropocentric relationship?

### 1.1. Expanded definitions

This paper defines what may be discovered as extraterrestrial “biological entities” as opposed to using the more common terms such as extraterrestrial “life” or “organism.” First, “biological entities” is more inclusive and much broader in scope. In that such extraterrestrial entities have yet to be discovered, existing definitions of life and organisms that were written specifically for Earth and solely as a result of observation of Earth’s life may be challenged [5]. Second, biological sciences are constantly tinkering with our definition of what constitutes “life.” We are finding life in places and at environmental extremes that a few decades ago were believed impossible for life to exist, such as hot springs with temperatures to 131 °C (267 F); a mile deep in African mines; in extremely acidic and alkaline environments; and under kilometer-thick Antarctic ice [6,7]. Third, evidence of extinct and dormant forms and their products, evolving biochemical processes and ecosystems and landscapes with biological components are included. Lastly, the term “life” and “organism” are largely avoided except where specific to Earth’s life. Applying such terms to extraterrestrial biological entities fosters a process of comparison to Earth’s organisms which can be misleading and prejudicial. While true that what may be discovered could closely resemble Earth’s life, we cannot afford to make that assumption prior to discovery. We must be open to the amazing novelty of what we may find and resist the temptation to assign judgmental classifications through such statements as, “it is just a bacterium” or “it is a primitive form of life.” That comparative approach serves only to diminish the entity’s status in its own world and distort our ethical consideration of its existence [8].

### 1.2. Issues addressed

This paper will define the opportunity of discovery and describe why it is unique; discuss how a new ethical and philosophical approach to our relationship with extraterrestrial biological entities might be forged; and propose that if we can structure a new ethical relationship with extraterrestrial forms, we can apply those improved standards to all life back here on Earth, as well. And (as the title of this paper infers), by crafting a higher ethical standard toward all life, we can better frame our obligations to future generations with the knowledge that they may be very different than the present-day biological species of humans as commonly defined.

## 2. The ethical opportunity of discovery

Now that there is proof of water ice on Mercury, Mars, our Moon, comets and elsewhere in our solar system and that there are deep liquid water oceans beneath the ice crust of Jupiter’s moon Europa, the chances for discovery of present or pre-existing extraterrestrial biological entities in our system and in our galaxy are no longer remote [9–11]. The search for signs of life in and beyond our solar system is a National Aeronautics and Space Administration (NASA) priority, and it may be more of a matter of when rather than a question of if, and it may happen very soon, possibly within the next few decades [12]. But regardless of whether or not extinct or extant biological entities are discovered or whether of Earth origin or representative of an independent bio-chemical genesis, if our initial attempts at extraterrestrial human explorations do not also consider redefining our ethical standards, a valuable opportunity for philosophical advancement will be lost. As Mark Lupisella aptly wrote, “How we react to this kind of discovery (extraterrestrial life on a microbial scale) will define who we are as a species” [13].

Today, the potential for extraterrestrial discoveries allows such ethical reconsideration relatively free of many of the constraints that have framed and limited our analyses throughout our many histories. As expressed by Tae-Chang Kim and Allen Tough, “Fresh perspectives can lead to innovative actions,” and life on Mars or elsewhere would certainly provide such perspective [14]. It is critical, therefore, that we address the ethical issues that will rapidly evolve from such a find prior to that event, for from the moment of discovery forward there will be immense political, commercial and perhaps even theological pressures that may steer us from a more enlightened and consistent ethical policy [15,16].

Philosophies of bio-ethics have been constrained throughout much of human history by various limiting factors. These include, but are certainly not confined to, direct and indirect “worth” of various species and environments to humans, cultural significance, and taxonomic status [17].

First, utility: The degree of ethical consideration afforded non-human life is influenced by how useful such life is to humans, how much an *individual* organism is “worth” to humans and its “value” to humans [18]. Conversely, where non-human life poses an economic obstacle, ethical consideration tends to be withheld. For example, in the West we generally apply a higher ethical standard when dealing with horses than we do with rats. There are laws hundreds of years old protecting horses from cruelty, but until very recently little was said of ethical standards directed at the protection of rodents. Current U.S. laws and practices serve primarily to caution that we house, use and kill them with a minimum of pain and trauma, but only when they are in our employ, such as in scientific experimentation. Wild rats are generally not addressed; wild horses often are. An example applicable to space is provided by the potential for forward contamination (biological contamination of outer space by Earth’s microbes) due to unsterilized vehicles and equipment that may land or

crash on bodies such as Mars [19]. It has been argued that a high degree of sterilization is essential to keep Earth life inadvertently transported to Mars from confounding the ongoing search for Martian life and to decrease the chances that contamination might disrupt such alien life [20]. That conservative approach of sterilizing vehicles to a higher standard, however, has been challenged as failing cost-benefit analyses; “Such a strategy will impose additional costs on an already strained (space exploration) program” [21]. The conclusion discounts both the ethical consideration of possible alien entities in addition to the scientific and economic potentials they may offer.

Second, cultural significance: The Hawai’ian *kapu* and *‘aumakua* systems, in part, serve to protect certain species of wild animals, plants, and even inanimate objects such as rocks from human harm [22]. While such practices serve to protect and preserve them, many other cultural practices strain ethical justification, such as maiming and sacrificing animals in religious practices and a variety of blood sports, such as dog, cock, and bull fighting staged for entertainment. In contrast, no extraterrestrial biological entity (with a few exceptions) plays a significant role in human culture; none are eaten, none are used in sacrificial or other ceremonies, none are actively hunted for sport or entertainment except in Hollywood productions. The exceptions would be the cultural significance of extraterrestrial bodies, such as the Moon and Sun, in a spiritual, religious, or artistic context [23].

Third, our taxonomic classification systems are largely based on degrees of evolutionary relatedness, and that provides a valuable tool for understanding the diversity of Earth’s organisms and their phylogenetic relationships. But taxonomic status is very much a human construct. Until recently, most taxonomic treatments placed humans at the topmost “branch of the tree” or at the apex of a pyramid of all species. Relegation of other species to various sub-levels has been influenced by the organisms’ relative relatedness to humans and an assumption of the degree of exhibited sentience (evidence that the organism perceives and reacts to its environment) and sapience (that it has developed sophisticated abilities to reason and be reflective) [24]. Higher ethical standards are generally applied to organisms “higher” up the evolutionary chain. We tend to confer greater ethical consideration to a bird than we do to a clam, there is very little consideration of plants unless they have cultural significance (such as revered trees), and microbial-scale life is afforded next to no ethical consideration at all [25,26].

Consideration is also often tempered by our assessment of the degree of physical pain and emotional trauma that an organism experiences. As our ability to detect such sensation in other organisms has increased, so has our ethical consideration. For example, vivisection of dogs is no longer considered the ethical procedure it was in much of Europe through the first half of the 17th Century. As stated by Jeremy Bentham in 1789, “The question is not, can they reason? Nor, can they talk? But, can they suffer?” [27]. That argues well for our history of ethical advancement, but also demonstrates that such behavior in the past was guided predominantly by our ability to detect and then acknowledge suffering. Without acknowledgement we were free to inflict our will with reduced ethical restraint. When in the realm of extraterrestrial entities, can we presume to make such judgments?

The opportunity we now have is that extraterrestrial biological entities have yet to be discovered and, as such, they have no utility or utilitarian value or worth. We share no history with them; they are neither heroes nor villains in our cultures, so their place within the context of our cultures has not been established. They have no taxonomic status and have not, therefore, fallen into a possibly prejudicial preconception of “place” or ranking. And we have no measure of if they suffer physically or emotionally or if those terms are even appropriate or applicable. They are free in that they are unknown.

However, the moment that extraterrestrial biological entities are discovered, opportunities to craft protocols and policies that foster enlightened relationships less biased and confined by predominantly utilitarian and exploitive motives and other influences will decrease. Compounding this immediacy, human–extraterrestrial relationships established at our first encounter have the incredible power of legal, political and cultural precedent; after discovery, it will become increasingly difficult to alter the aforementioned relationships as special interests become entrenched, bureaucracies calcify to match Earth-oriented protocols and priorities, procedures grow routine, and opportunities to critique motives diminish. It is not difficult to imagine the immense commercial pressure to afford less ethical consideration to an entity discovered at a prime mining site on Mars, for example, as opposed to one found in a far less valuable location, or a microbe-like form possessing enzymes that promise the potential of tremendous financial gains through patenting and industrial use contrasted with one of little obvious biochemical potential. We must, therefore, resolve our policies regarding extraterrestrial ethical issues prior to their discovery, before we know whether or not they exist; prior to learning of their possible commercial value and before we can assess their capacity for suffering.

In the context of space exploration we are provided a rare moment to craft policies that reconsider what is ethical and what is not. Once extraterrestrials are discovered, such entities will rapidly be relegated to terrestrial ranking and an opportunity for creative and liberating new approaches to humans’ relationship with the greater biological universe will be lost until the next new world is “conquered.”

### 3. Crafting new ethical relationships with extraterrestrial biological entities

How, then, might our exploration of another world such as Mars, Europa, Ganymede, or even our own Moon provide an opportunity to consider a new relationship with non-human biological entities? How might this work in that we do not know if such entities even exist?

One of the most difficult aspects of defining an ethical standard applied to non-humans is that while we intimately share our lives there is very limited dialog among species, and certainly none at a philosophical level that I am aware of [28].

Humans do the analysis and derive ethical standards focused through the lens of human perception; other species have little say in the process. This makes it extremely difficult for humans to not be biased and anthropocentric, to not depend on the relative utility of other species and our long history of viewing most other life as a means to further our own survival and pleasure. Compounding this difficulty is the validity of our assumptions about their degree of sentience and, perhaps, sapience that are largely based on our technological ability to detect and measure those abilities. How, then, might we develop a just bioethical standard that would guide our actions affecting biological entities that have no voice, much less extraterrestrial entities that have yet to be discovered?

### 3.1. Giving voice to the voiceless

A prominent guiding theory was provided by Harvard moral and political philosophy professor John Rawls (1921–2002) in the context of fairness and justice among humans. How can you be fair and, by extension, how can you be ethical? In contemplating this issue, he devised a thought experiment, a hypothetical situation he calls the “original position” [29].

In briefest terms: the best way to have two children divide a cookie between them fairly is to have one cut and the other choose. If the party doing the cutting (those who do the defining and distribution of ethical standards) is ignorant of which half she or he will receive (i.e., whether or not those standards will be applied to her or him), it is likely they will divide (define and distribute those ethical standards) as fairly as possible. That becomes a foundation for justice, the balance between morality and law, fairness, and, by extension, ethical social institutions.

Rawls asks that we consider that a hypothetical group of humans are sequestered in something like a jury deliberation room and asked to draft a set of principles of justice for the basic structure of society, principles that “free and rational persons concerned to further their own interests would accept in an initial position of equality” [29]. The constitution they produce would function to design and guide a society, its governance, its laws, and other similar categories in a just and fair manner. The participants are instructed to assign basic rights and duties and determine the division of social benefits. They are to debate and negotiate to determine how to regulate their claims against one another. That is not a new approach; it was attempted, in part, in Philadelphia in the late 18th Century with some practical success but without enduring and perfect justice or fairness. However, Rawls adds some rather serious caveats that are very novel, for the hypothetical group inhabits this “original position” behind what he terms a “veil of ignorance.” The participants who are drafting this list of ethical standards are unaware of their personal present or future status within the society. They do not know their personal abilities, psychological state, physical stature, race, culture, beliefs, gender or other factors that would bias them in their self interest and detract from equal application of justice. But they are fully aware of the conditions of the world, societies, and governments. They are “unformed but fully sapient,” yet have no concepts of their individual future condition. As they are rational, their product would not be the cookie, very evenly divided, but a set of rules and criteria for ensuring just division and distribution. Because of the ignorance afforded by the veil they would be free of favoritism or other personal or group biases. As such, they would strive to ensure that their list is just and fair.

Rawls limited membership of the group in the “original position” to humans, but what if that group were expanded to include, say, whales or bonobos and that none of the members of that group knew whether, in their future life, they would be human, whale, or bonobo? How might the rules governing ethics and fairness change in response? What is proposed here as a thought experiment is this question: What if the group in the original position was expanded to include representatives of *extraterrestrial biological entities* and the task given the group was to draft a constitution that would establish fair and ethical standards and practices regarding space exploration, colonization, and exploitation? This, of course, is highly hypothetical and is not a proposal to actually assemble the group anymore than Rawls was proposing that his group of “unformed yet fully sapient” humans be convened. But the unique perspective provided by not knowing whether you would live your life as a human or a Martian microbe would generate some innovative and interesting results. Would there be a call to guarantee the continued existence of every microbe, that they would not be disturbed or killed? Likely not. More likely, there may be stipulations that all be allowed to exist as a species and continue to evolve, as suggested by NASA’s McKay [30]. Conclusions are not provided here; it is suggested to open a discussion of new ways to address bioethical issues.

### 3.2. Models of representation

How, then, might formal representation of extraterrestrial biological entities be constructed apart from Rawls’ hypothetical conditions? *Ad litem* representation by a panel of humans would be a practical starting point. It is widely provided today for humans who have no voice, such as those with severe mental or physical handicaps, infants, and the unborn. Similarly, appointed ethics committees and religious counselors provide voice for many in homes, hospices and hospitals [31]. Corporations freely participate within our societies and have voice via legal charter and other recognized frameworks; humans represent their interests.

Alan Tough and others have created an open Invitation to Extra Terrestrial Intelligence (IETI; [www.ieti.org](http://www.ieti.org)) to facilitate their communication with humans should they detect the offer and wish to do so. While the focus is firmly on intelligent extraterrestrial life, the website describes itself as “an informal group of approximately 100 scientists, artists and futurists . . . (with interests in) establishing a constructive dialog between humanity and our cosmic companions.” Here, the sapient extraterrestrials would clearly represent themselves.

Regardless of the specific model of representation, in that extraterrestrial sites that may be home to the entities here addressed lie outside any national jurisdiction, the “Outer Space Treaty” and similar United Nations instruments would apply [32]. As such, representation, whether *ad litem* or other, would best be international in membership and most productive if inclusive of a diversity of human cultures and value systems. It is significant that IETI includes futurists and artists in addition to scientists, recognizing both the legitimacy and need for their participation and vision in addition to scientific and political perspectives. The framework of the United Nations would provide a likely home for such a function, especially in consideration of the UN’s established legal status among nations and its existing Office for Outer Space Affairs.

### 3.3. Extending ethical consideration to all entities

A significant stumbling block in the progression of ethical thought has been a general preconception that a perfect ethical standard is both definable and attainable while simultaneously limiting membership to those entities deemed worthy of ethical treatment. Such relativism produces standards later found contradictory and ethically unacceptable, triggering the need for redrafting ethical criteria. For example, centuries ago a man might have been considered an ethical person within his culture and community yet still own slaves, abuse children as directed by family custom and hold wives as chattel. As the conditions of all manners of such subjugation were socially challenged and determined to be unethical (i.e., could not be ethically justified by newly evolving ethical standards), the circle of consideration was widened to include the formerly excluded. Similarly, mistreatment of select animals (e.g., cruelty to horses and bear baiting) was challenged as being unethical, and again many species have been subsequently protected from those forms of harm (e.g., dogs, a range of vertebrate farm and research animals, and even fish and invertebrates) [33]. Through time, we generally widen the circle of ethical consideration; it is seldom constricted except, for example, during times of war, catastrophe or periods of “social readjustments.”

The generally accepted standard in many countries is that all humans have a right to ethical consideration. In addition to our species, a limited subset of animals has been added in some countries (e.g., horses and great apes). A significant factor for such inclusion is our parallel growth of empathy toward them fostered by increased knowledge about them. Where we can ascertain that they experience pain, that they may be self aware, that they are more intelligent than expected or that they possess a sense of purpose we are more likely to extend ethical consideration. Accordingly, as our tools and technology improve our ability to ascertain the presence of their pain or measure their intelligence we may be unable to avoid being in an ethical bind if we do not also extend consideration where we have not before. For example, recent development of acoustical detection technologies, the computers and software to analyze complex data sets to discern meaningful patterns, and satellite imagery allowing accurate observation and mapping of humpback whales allow a greater appreciation of their complex communication, social structure and other factors than was possible before [34]. They are far more intelligent than previously believed, and many people have elevated their ethical consideration of that species as a result. Another example is provided by technologies that now allow us to consider the creativity of social insects at solving structural and logistical problems [35,36]. Research on the possible function of “swarm intelligence” (as opposed to an individual’s solitary capacities) in some invertebrate species is ongoing, challenging our common definitions of intelligence [37]. Even plants have been found to communicate when attacked by herbaceous insects [38] and hints of altruism are being studied [39]. Can we assume they do not sense and respond to pain in ways we cannot yet detect, much less measure? Will the circle of ethical consideration be broadened to include them should our technology evolve to detect their pain or the other factors we use to screen where ethical consideration is allowed and where it is not?

In sum, we should not be too quick to ethically categorized non-human species when the criteria for such determinations are possibly limited by our technology. This becomes especially critical when we are assessing extraterrestrial biological entities. I pose that it is justifiable to extend ethical consideration to them, even those of microbial size and bio-complexity, because of our present ignorance.

By extending ethical consideration from its ancient core of just a select subset of humans, to all humans, to other sapient species, to sentient species, to all life and eventually to ecosystems and landscapes both on Earth and elsewhere we will end the cycle of exclusion followed by apology that has been a product of our ethical thinking for millennia. Rather than parse where we will provide ethical consideration and where we will not based on our Earthly experience we can start fresh with a new purpose and understanding. Degrees of sentience and sapience may become irrelevant on extraterrestrial venues and, following, may become irrelevant back here on Earth, as well.

## 4. Expanding the definition of future generations and our obligations to them

Rawls and many others have addressed “justice between generations.” It is an ancient concept, and many cultures and traditions maintain that we, those living in the present, have a moral obligation and general duty to those yet unborn to leave the Earth in as good a condition as we find it [40–43]. The obligation is founded on many of the same criteria justifying our moral obligation to the present: that we are stewards of the Earth in that it is within our power to radically change it, for better or worse; that we maintain a concern for future peoples by the same motive that we care for our own children, as an extension and continuation of our humanity and identity; that a disregard for our futures negates our attempts for any physical, social or philosophical action that strives to survive into the future; and that caring about future generations is the best way to care for our own.

Ethical concern for future generations is clearly a “futures” project. As succinctly stated by E.O. Wilson, “Any ethic worthy of the name has to encompass the distant future” [44]. In the spirit of the long view, Allen Tough adds to the list of obligations that we do not set in motion catastrophic events that will diminish future prospects (to which Tonn adds, including human extinction [45]); that environments supportive of healthful living are, at a minimum, maintained; that general conditions of peace and political stability are provided [46]; and that options for future choice are maintained [40]. Bell advises, however, we must recognize our ignorance of the ultimate impacts of our actions and, in the spirit of humility, proceed with extreme caution [47].

The qualifications for membership in future generations are changing, and changing rapidly. Our descendents may no longer necessarily be limited to traditionally defined *Homo sapiens*. Rather, our species is becoming less distinct and singular as evidence of close natural interrelatedness and blending with other species at the cellular and molecular level grows and as techniques and processes allowing artificial sharing of genomes among species, xenotransplantation (using non-human biological materials in humans, such as pig valves to correct malfunctioning human hearts), mechanical and cybernetic augmentation and other modifications shatter the singular definition of human [48]. In Buddhist thought, the concept of future generations decidedly embraces a multitude of species and recognizes life as a shared process among species. As described by the current Dalai Lama (Tenzin Gyatso), “Even though there is a chance you may be reborn as a creature, perhaps even on a different planet, the idea of reincarnation gives you reason to have direct concern about this planet and future generations” [43]. If we were to encounter our descendents six generations from now, we may not recognize them as human, and it may not matter that they are not in a current taxonomic or physiological sense. How might Rawls’ and others’ theories be adapted to provide guidance on our obligation to future generations that include a diversity of post-humans he did not likely imagine, extraterrestrial species and even systems, such as landscapes?

Two significant volumes published in 1994 by the Institute for the Integrated Study of Future Generations comprise a series of papers presented in Kyoto that year addressing alternative futures with a focus on future generations [14,49]. Many of the contributors spoke directly to expanding definitions and liberating past analyses of our obligations by articulating a futures perspective. An underlying message was that yes, we have obligations to future generations, but those generations may not mirror those of the present, ideologically, politically, socially, culturally, or even biologically. But that hardly concludes that we do not share their worlds or have obligations to them. As expressed by Richard Slaughter, we can best recognize and fulfill our obligations if we accept that we in the present and those in our futures are linked in much the same way as we are to past generations. Our actions in the present have consequence, and as such we have the moral obligation to consider their impact on future generations and whatever they comprise. He concludes that establishing a culture of foresight is “arguably the greatest gift the present generation could give to futures ones” [50].

## 5. A proposal for ethics as applied to extraterrestrial biological entities

At a minimum, generally accepted existing ethical standards should not cease once we are outside of Earth’s atmosphere; space is our environment and extends to as far as we can undertake any action that has any effect. Both classic and more futures-oriented thought agree that ethical consideration should also be given beyond the immediate human family, to sapient species at a minimum, if for no other reason than our actions are a reflection of our self perception. In that extraterrestrial entities are yet to be discovered and, if existing, likely evolved under conditions significantly different than terrestrial life, we cannot pre-conclude that they exist below some hypothetical threshold of sapience or sentience referenced on Earth. We cannot, therefore, exclude them from ethical consideration. Accordingly, we should proceed with exploration with extreme caution and opt for passive observation and remote sensing for signs of possible life, not harming such life in an effort to demonstrate its existence. If life is detected by such means, we should continue close and extended observation coupled with ethical analysis and open public dialog. If ethical consideration is to be withheld or limited, such a decision should be made only after such a process and should require documented justification.

## 6. Conclusion

The ongoing search for extraterrestrial life on Mars and elsewhere in our solar system provides an ideal opportunity to explore ethical obligations in a fresh context, and using the products of such discussions we can better reconsider definitions of what it means to be human and our concepts of participation as part of universal life itself. But we must ask these questions and work toward their resolution *prior* to their discovery. Should we leave the questions unanswered, Earth’s conflicting and often indefensible ethical standards will be exported and may become truly universal, representing a forward contamination of a philosophical sort.

The purpose of this article is not to argue or campaign for or against equal rights among all biological entities, both Earthly and extraterrestrial, or to pray for extending rights to the rocks they might live on. The current age of space exploration allows us to imagine and plan for fantastic physical structures and architectures, engineering projects on other planets that dwarf anything attempted on Earth, innovation and amazing new knowledge in physics, chemistry, and engineering. But we tend to see ourselves, as a species, as *Homo sapiens*, as the primary actors. We have entered radically foreign environments, yet we continue largely unchanged in our ways of thinking and our ways of acting. If we initiate exploration, colonization, and exploitation of other worlds without also rethinking our relationship with the environments we will share and all they offer, biological as well as physical, we will have missed a prospect for advancement.

To many, providing representation for extraterrestrial biological entities seems a stretch of reason, but it is humbling to recall that in the nineteenth century, “the highest court in California explained that Chinese had not the right to testify against white men in criminal matters because they were a race of people whom nature has marked as inferior, and who are incapable of progress or intellectual development beyond a certain point . . . between whom and ourselves nature has placed an impassable difference” [26]. Ethics has progressed to be more inclusive and there is little to argue that it would not continue to evolve to be even more comprehensive. As the current Dalai Lama has suggested, “we have to check our motivation and ensure that (our ethical) foundation is compassion, . . . (that we take) the widest possible perspective, . . . (and that) in the face of any real ethical challenge, we must respond in a spirit of humility, recognizing not only the limits of our knowledge (both collective and personal) but also our vulnerability to being misguided in the context of such a rapidly changing reality” [51].

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