

DO WE NEED A COSMOCENTRIC ETHIC?

MARK LUPISELLA

University of Maryland, College Park, 20742 USA

JOHN LOGSDON

Director, Space Policy Institute
The George Washington University, Washington, D.C. 20052 USA

Abstract—The discovery of what may be extraterrestrial fossilized remains of unique microbial life forms in a meteorite of Martian origin throws into much more concrete terms than previously the issues regarding our interaction with extraterrestrial life forms. In pursuit of these questions, we assess the need for a cosmocentric ethic which establishes the universe as the priority in a value system. As a lens through which to view the title of this paper, we consider the question of whether human space exploration and/or settlement of Mars should take priority over preserving possible indigenous extraterrestrial life. We ask many questions of a planning and policy nature and suggest that the unknown aspects of interaction with extraterrestrial life suggest the need for rigorous scientific attention as well as a cautious exploratory approach as we prepare our first human mission to a potentially life bearing planet. We explore the critical role of values and suggest that a cosmocentric ethic may be useful in exploring such issues as well as issues associated with other areas such as the search for extraterrestrial intelligence.

1. WHAT IS A COSMOCENTRIC ETHIC?

A cosmocentric ethic might be characterized as one which (1) places the universe at the center, or establishes the universe as the priority in a value system, (2) appeals to something characteristic of the universe (physical and/or metaphysical) which might then (3) provide a justification of value, presumably intrinsic value, and (4) allow for reasonably objective measurement of value.

At first glance, talk of a cosmocentric ethic might seem paradoxical. How can an ethical view be centered or focused on “all that is”? From egocentrism to geocentrism, we are able to center, focus, and prioritize value because there is some other, generally larger frame of reference which is relatively de-valued. Nevertheless, we suggest that such an ethic may be helpful in dealing with value based questions involving extraterrestrial issues such as interaction with indigenous primitive extraterrestrial life forms.

2. APPROACH

There is much to be said in a rigorous treatment of such a subject given the great body of work that exists on ethics and values. But there have been a few recent thinkers who have addressed some ethical issues associated with space exploration, and so, in the interest of merely shining a slightly different light, this paper will primarily analyze those writings and give only brief consideration to more general

ethical theories. The recent Mars meteorite announcement serves as a catalyst for considering the following question:

Should human space exploration and/or settlement of Mars take priority over preserving possible indigenous extraterrestrial life, of even a primitive nature?

3. A MARTIAN SCENARIO

...stark and silent...were the Martians—dead!—slain by the Humans against which their systems were unprepared...slain, after all the Human’s devices had worked, by the blind foreigners that had landed upon their world. Yet across the gulfs of space, minds that were to Humans as Humans were to the Martians that perished, intellects vast and cool and unsympathetic, regarded this earth with contempt, and slowly and surely drew their plans against us—we who had killed another.¹

We wish to emphasize the importance of a very real, practical policy issue facing us today regarding the exploration of our solar system—particularly with respect to the first human presence on Mars. It is possible that we could adversely affect or destroy indigenous Martian life forms, intentionally or otherwise, by landing humans and engaging in all the relevant subsequent activities such as setting up a laboratory, establishing a permanent settlement, and eventually colonizing the planet.

Questions surrounding this issue can be categorized as pre-detection and post-detection. Pre-detection issues involve those which are relevant for planning before contact is made. Post-detection issues concern how and what we will decide to do after contact is made. This kind of planning is similar to work being done within the SETI community. The pre-detection and post-detection questions can be further categorized as robotic vs. human exploration.

3.1. Pre-detection Issues

Pre-detection planning regarding robotic missions has been addressed broadly in the form of the 1967 Outer Space Treaty and more specifically in the form of contamination prevention measures implemented by space faring nations. However, the absence of rigorous international enforcement mechanisms may have allowed unacceptable contamination to occur in the past and may allow it to continue in the future. As more nations become space-faring, international mechanisms for enforcing contamination regulations might be necessary.²

Pre-detection planning regarding *in situ* human exploration, however, has not been adequately addressed as it relates to a potential life bearing planet such as Mars.³ To what extent will there be contaminant leakage?⁴ How will such contamination jeopardize or mask the existence of indigenous life forms?⁵ Will contamination due to human presence be local or global? Will it penetrate sub-surface environments?⁶ If there is concern for global contamination, what will be the criteria for determining the biological status of the entire planet—or, otherwise, the landing site? Can we adequately extrapolate, either globally or locally, from a few strategic missions? If not, how many missions of what nature will be required to obtain confidence about the status of life on Mars and any harmful affects our presence might have?

Is the proven tenacity of life on Earth evidence that if we don't find life on Mars with a few missions, that it is indeed a dead planet? Or is it the other way around—that the ability of terrestrial life to survive in extreme environments should warrant extreme caution, perhaps in the form of many precursor life-detection missions, before having confidence about the biological status of Mars? Perhaps we cannot have confidence in either extrapolation from terrestrial considerations since we essentially have only one data point—one world with one kind of life. In which case, we are dealing with an unknown of

potentially immense importance, perhaps making extreme caution prudent.

If we exercise such caution and conclude that many precursor missions are necessary before sending humans, will two missions every two years until say the second decade of the next century (when NASA Administrator Dan Goldin would like to see a human mission) be enough? If we decide on a conservative approach, twenty or so missions may not be adequate. But if it were, we would have to start planning now for those missions to address the relevant questions. And some of that is happening. Looking for water, subsurface or otherwise, is a recognized key. But, perhaps most importantly, direct life-detection experiments should be planned for now as critical components of the suite of precursor missions.

Also, guidelines should be established for activities that could jeopardize indigenous ecosystems while humans are present. Contamination measures are a part of this, but there are also issues such as establishing surveillance procedures before entering an area, guidelines for movement in an area, procedures for digging and drilling, procedures for releasing waste and dealing with rocket exhaust, etc.⁷ Such guidelines for pre-detection activities of human activity may help preserve key environments where life could exist, undetected. Emphasizing minimally intrusive procedures may be one such guideline.

As noted in the references, some of the preliminary questions raised about the effect of human contamination have been addressed in a preliminary fashion. However, we suggest that these questions should be addressed now, in an international forum and with substantial scientific rigor, so that we might better address the longer term mission planning issues. For example, the number and kind of precursor missions, and hence the timeline for a human mission, could depend heavily on the position we take regarding whether or not contamination will be local or global. If we wish to minimize the possibility of adversely affecting or destroying indigenous extraterrestrial life when we arrive with human explorers, it seems inevitable that we must address many, if not all of the questions posed previously. And certainly, there are more.

3.2. Post-detection Issues

A discovery of indigenous life by a robotic vehicle may not present any severe difficulties if we take the

proper contamination precautions, and if we are willing to take the time needed after the discovery to make policy decisions about how to proceed—which will certainly be driven largely by the circumstances. However, it may be prudent to consider some of these robotic post-detection issues now in order to prepare ourselves to whatever extent is appropriate. Will we send humans immediately to a site which has evidence of extant life? Will we opt for an immediate sample return of those life forms? Or, should we take a very conservative approach and study that life via robotic explorers so as to not disturb the immediate discovery site? If we choose robotic exploration, will it be of a remote nature, say from a low orbit or nearby moon, or will we land one or many vehicles at the immediate site as soon as possible?

Although it may be prudent to address such questions now to whatever extent we are able, we are likely to at least have time to do so after a robotic discovery is made. We may not have that luxury if humans make the first *in situ* discovery. Significant contamination leakage is likely. There will be momentum, political and otherwise, much of which is emerging now, which could be hard to curtail, especially once humans are there.⁸ Most importantly, with humans on the scene, it will be prudent to at least establish in advance some decision making mechanisms, presumably of an international nature, to deal with post-detection activities. Preferably, an international forum should establish in advance at least general, if not specific, guidelines for post-detection protocol and follow-on activities. For example, if and when such a discovery is made, should an astronaut take a sample immediately? Should the astronauts leave the immediate site and do remote analysis before disturbing the site any further? Or should we leave the planet entirely?

3.3. Peaceful Co-existence

We may also wish to consider the longer term issue of whether to establish settlements and eventually colonize Mars. “Peaceful co-existence” is one long-term option to consider as a thought experiment. Ironically, Richard Taylor’s slogan, “Move over microbe!” might apply.⁹ That is, extraterrestrial microbes might be displaced, as often happens on earth, but they need not be harmed or destroyed. Can we co-exist with Martian life?¹⁰ Would we combine into one ecosystem? Assuming we were careful, Martian life might not be destroyed. It could, however, change via the forces of its new ecosystem.

Or perhaps we will decide to preserve that life in a kind of isolated conservatory with the indigenous Martian environment intact, so that it will be allowed to evolve as it might have otherwise.¹¹ This could satisfy many people. It may even satisfy those who believe that primitive extraterrestrial life should evolve autonomously. The caveat, of course, would be to exercise extreme caution in our interaction with that environment, since most persons that might advocate such a view would be highly skeptical of our ability to avoid causing harm.

For those who would suggest that Martian life has “rights”, this compromise might not be satisfactory. Only a non-interference policy would be acceptable.¹² However, we might consider Chris McKay’s compelling view that the rights of Martian life “confer upon us the obligation to assist it in obtaining global diversity and stability.”¹³

3.4. Public Concern

There is also the issue of anticipating and addressing public concern. As there have been in the past, there will be public interest groups attempting to ensure that NASA and other space agencies are not only doing what is perceived to be environmentally correct, but perhaps morally correct, as well. Species preservation groups will have a new cause to champion, and it should be assumed that they will not hesitate to act as an obstacle if they have any reason to believe that the proper precautions are not being implemented. Environmentalists opposing the use of nuclear power sources have been able to delay launches in the past. In this light, planning now to address the above questions will help mitigate future opposition to sending humans to Mars.¹⁴

3.5. Near-term Goal for Mars Exploration

Bruce Murray has suggested three kinds of objectives that need to be decided regarding Mars exploration. (1) Open-ended exploration leading to human mission vs. accomplishing focused scientific objectives. (2) Priority for early detection of decisive evidence of life, past or present, vs. determination of key unifying global processes. (3) Technological evolution for long range exploration vs. expedient approach to near-term objectives.¹⁵ This paper can help make choices from the above by considering life-detection as the centerpiece for Mars exploration. The concerns raised in this paper would suggest we chose the following: (1) accomplishing focused scientific objectives, (2) early detection of decisive

evidence of life, and (3) expedient approach to near-term objectives.

3.6. Long-term Relevance

Addressing these questions now will not be wasted if we were to indeed find a lifeless Mars. This kind of planning can only help prepare us as we move out into the rest of the solar system in search of life.

3.6. Importance of Value

Underlying all this, of course, is the question of value. How much do we value the preservation of a primitive extraterrestrial life form and why? Certainly there is instrumental value, or more specifically, scientific value. Clearly, masking the existence of such life and/or destroying it beyond recognition would be a scientific loss of immense proportion. Biology is desperate for a second data point. And as we have tried to show, there are many important questions that need consideration if we are to ensure the benefits associated with this scientific value. However, it isn't clear that scientific value will be enough to warrant the kind of conservative approach that may be needed to ensure the preservation of possible indigenous extraterrestrial life, thereby realizing that scientific value. As history has painfully demonstrated, the momentum of doing a thing, of accomplishing a goal to satisfy certain needs or desires, often overshadows contemplation of consequences and any potential policy action that might result thereof. The exploration and exploitation of the Americas, while certainly having some positive effects, is a poignant example of the harm we are capable of when we do not take pause to consider the consequences of our actions. Also, looking further ahead, we might also wish to consider how we will guide our actions when the scientific novelty wears off.

4. APPLICABILITY OF ETHICAL VIEWS

In this section we consider some applicable versions of traditional views like homocentrism, Kantian ethics, and utilitarianism, which tend to suggest that human exploration should take priority over the preservation of possible indigenous life forms. We also examine some contemporary views of philosophers and scientists who have directly addressed the ethical challenges we face as we explore the extraterrestrial environment. These views tend to suggest that human exploration should not

take priority over the preservation of possible indigenous life forms.

4.1. Homocentrism

Homocentrists would not have much reservation about displacing or possibly destroying indigenous extraterrestrial life if it was required for human exploration and colonization of an extraterrestrial environment. Homocentric ethical views make humans needs and desires the priority, generally at the expense of all else.

As Robert Zubrin points out, the obvious problem for those who would answer no to whether human settlement of Mars should take priority over the continued existence of extraterrestrial microbes is to provide some explanation of why such an answer wouldn't apply to terrestrial microbes which we wouldn't hesitate to kill with an antibiotic pill.¹⁶ This is a reasonable challenge. However, at the same time, it also seems reasonable to suppose that extraterrestrial microbes should not be treated the same as terrestrial microbes. Zubrin himself acknowledges their unique value.¹⁷ An answer to Zubrin's challenge might be to point out that extraterrestrial microbes are not pro-actively destructive to our well-being, as are many terrestrial microbes. Perhaps extraterrestrial microbes should be assumed innocent until proven otherwise. Also, assuming Martian microbes are not of the same phylogenetic tree as life on earth, as a species, they would be unique in a way that terrestrial microbes are not. This significant uniqueness seems to imply some kind or degree of value, instrumental or otherwise, that might not necessarily be attributed to terrestrial microbes.¹⁸

Criticisms of homocentrism that it fails to consider ecological concerns and long-term effects are not so obvious since one can be concerned about the long-term ecological impacts on humans.¹⁹ However, it has generally been the case that homocentrism has been more short-sighted than far-sighted. These complaints reflect a deeper instinct articulated by the philosopher Don MacNiven that theories biased towards humans are suspect.²⁰ This concern is supported by thousands of years of seeing our knowledge expand, constantly de-centralizing human beings—"The Great Demotions," as Ann Druyan has poignantly observed. It may ultimately be true, if we can even know such a thing, that homocentric value theories are valid, but we would be wise to heed the lessons of history and consider broader views.

Perhaps, however, we might be enticed by views that tend to be homocentric since they seem so well rooted in common experience. Besides having to contend with additional lessons of history which have shown that experience can often be misleading, we have also to consider whether the conflicts that arise from such an ethical framework when tough decisions face us could be ameliorated by a better theory of value. Indeed, the philosophical foundations for claiming humans are ends in themselves, and that, as a result, are intrinsically valuable, to the exclusion of all else, has been reasonably challenged, resulting often times in much conflict.

4.2. Kantian

A Kantian view, generally considered to be a brand of homocentrism, appeals to the rational basis of ethics and might be considered a kind of cosmocentric ethic by suggesting that the universe itself is rational. If the universe is rational, why wouldn't nonhumans, and all things that make up the universe, be rational, as well—and as a result, worthy of direct moral consideration as ends in themselves—as things that possess intrinsic value? In making this move, it seems the Kantian must either re-consider the claim that the universe is rational, or consider that all of existence is worthy of moral consideration as ends, not merely means, which would radically change the traditional understanding of Kantian ethics.

4.3. Utilitarianism

A traditional utilitarian view has at its heart the concept of intrinsic value in the form of pleasure. Such a view, while used to justify respectful treatment of animals because they experience pleasure and pain, does not seem applicable to extraterrestrial microbes. We might consider, then, that the homocentric bias noted by MacNiven, although diluted by an expanded set of moral considerability in some utilitarian views, could still hold against a view that excludes primitive life forms that do not feel pain. Indeed, objective justification for the intrinsic value of pleasure requires much elucidation. In addition, appealing to happiness or pleasure as a variable for measuring value seems ultimately to involve much subjectivity, retaining the fundamental dilemma of assessing and/or measuring value.

4.4. A Geocentric Bias?

Robert Haynes, Chris McKay, and Don MacNiven have been prompted by considering extraterrestrial activities to suggest the need for a cosmocentric ethic by name.²¹ They conclude that existing ethical theories exclude the extraterrestrial environment because they are geocentric and cannot be applied to extraterrestrial environments, hence leaving a vacuum for a cosmocentric ethic.²² These claims do not appear to be well-founded. Haynes says that homocentrism implies geocentrism because we know of no other sentient beings in the universe.²³ This doesn't necessarily follow. Perhaps in the strictest sense, this is true for now because we only inhabit the earth, but can't we take our homocentrism with us anywhere we go? And can't we still be homocentrists if we were to discover extraterrestrial intelligence? Haynes' claim doesn't seem to apply in a general sense. McKay notes that ecological ethics has been "inextricably intertwined" with life on earth and so he comes to the same conclusion.²⁴ But this observation does not necessarily rule out the application of existing ethical theories to the question at hand. MacNiven, while offering no additional reasons, agrees with Haynes and McKay, and further suggests that homocentrism, zoocentrism, and biocentrism would present no moral objection to activities such as terraforming.²⁵ Nevertheless, some traditional ethical ideas have been applied to the question at hand.

4.5. Rights

Carl Sagan has written: "If there is life on Mars, I believe we should do nothing with Mars. Mars then belongs to the Martians, even if they are only microbes."²⁶ Although the notion of rights is not directly invoked, this kind of view can be identified with such an ideology.

Haynes claims that Tom Regan's "animal rights" view would ascribe rights to indigenous microbes.²⁷ This is consistent with Chris McKay's view which is based on the intrinsic value of life principle and hence suggests that Martian microbes have a right to life—"to continue their existence even if their extinction would benefit the biota of Earth."²⁸ Presumably this would involve minimal human presence.²⁹ There also exists animal rights literature making "interests" of organisms to be of critical importance, which might include microbes, although such a view has not been definitively articulated.³⁰

Such “rights” based views need to demonstrate why life should be intrinsically valuable and why microbes would have an absolute right to it. Rights are problematic because they are often seen as matters of degrees when difficult decisions have to be made. Degrees of rights, in the final analysis, ultimately seem no different than degrees of value.³¹ If one claims that other animals have rights and that there are no degrees of rights, how are we to assess those situations that involve conflict of rights and/or interests between humans and other life forms?

4.6. A Hybrid View

Steve Gillett has suggested a hybrid view combining homocentrism as applied to terrestrial activity combined with biocentrism towards worlds with indigenous life.³² Invoking such a patchwork of theories to help deal with different domains and circumstances could be considered acceptable and perhaps even desirable especially when dealing with something as varied and complex as ethics. Indeed, it has a certain common sense appeal. However, instead of digging deeply into what is certainly a legitimate epistemological issue, let us consider the words of J. Baird Callicott: “But there is both a rational philosophical demand and a human psychological need for a self-consistent and all-embracing moral theory. We are neither good philosophers nor whole persons if for one purpose we adopt utilitarianism, another deontology, a third animal liberation, a fourth the land ethic, and so on. Such ethical eclecticism is not only rationally intolerable, it is morally suspect as it invites the suspicion of ad hoc rationalizations for merely expedient or self-serving actions.”³³

4.7. Weak Anthropocentrism

Callicott’s application of weak anthropocentrism suggests that the value of primitive extraterrestrial life can be justified by appealing to its transforming and ennobling effect on human nature. He says, “I can think of nothing so positively transforming of human consciousness as the discovery, study, and conservation of life somewhere off the earth.”³⁴ In addition, for Callicott, species possess a “truncated” version of the traditional definition of intrinsic value in that they have value “for” themselves, for their own sake, but not “in” themselves, independent of a valuing consciousness.³⁵ The basis for Callicott’s perspective on intrinsic value is a Humean/Darwinian emotive/bioempathic view which suggests that emotionally based value identification with other

living things results from natural selection. Furthermore, relativism can be avoided by appealing to Hume’s “consensus of feeling” which standardizes or fixes the human psychological profile and values that result thereof. Although value may not be focused solely on humans in this view, humans are indeed the source of value in that they recognize intrinsic value of other living things as their “standard” genetic make-up dictates. But are values such as those recognizing the intrinsic value of nonhumans so standard or fixed? It appears not since there exists much intense, often violent, controversy over the value of nonhumans. Hence, there still appears to be an inherent subjectivity on an individual as well as a collective basis, since the feelings of humans are what dictate the recognition of intrinsic value. This view, then, seems not to objectively justify intrinsic value or provide a way for measuring such value when difficult decisions have to be made.

4.8. The Sanctity of Existence

MacNiven has suggested that a central tenet of a cosmocentric ethic would be the principle of the sanctity of existence, which, he notes, would make it difficult to justify the significant modification or destruction of indigenous life forms.³⁶ In a minimal sense, the principle of the sanctity of existence seems to satisfy criterion one and two for our idea of a cosmocentric ethic because the universe, and all therein, exists. However, we do not see a compelling articulation of why, specifically, all things have intrinsic value because they exist. We should prefer some justification of the principle itself as well as its invocation. MacNiven additionally suggests appealing to a “selective concept of uniqueness” as we sometimes do in considering terrestrial matters such as preserving the Grand Canyon.³⁷ Here, again, we might ask why uniqueness should have intrinsic value. Also, in addition to not directly satisfying criterion three of our conception of a cosmocentric ethic, we see still, even in light of the notion of uniqueness, the problem of measuring value—or more specifically, of weighing the value of human activity against other forms of value such as the preservation of an extraterrestrial life form.

4.9. Formed Integrity

Holmes Rolston proffers a compelling view which appeals to the “formed integrity” of a “projective universe.” This view suggests that the universe creates objects of formed integrity (e.g. objects

worthy of a proper name) which have intrinsic value and which should be respected.³⁸ However, Haynes points out that Rolston's view appears to conflict with modifying the earth, even to the benefit of humans.³⁹ This view would certainly call for the preservation of primitive extraterrestrial life.

Rolston's view is close to our conception of a cosmocentric ethic in that it seems to satisfy criterion one, two, and possibly three and four. In Rolston's view, justification of intrinsic value might come from the creative processes of the universe itself—that is, the creative process, and all that results from it, is intrinsic to the universe.⁴⁰ The possibility of satisfying criterion three, however, with this compelling possibility, requires much more explanation, since in assigning value to the universe's creative processes, we might be guilty of anthropomorphizing the universe.⁴¹ Indeed, we could ask why the universe is a creative entity—which might shed light on the general requirement for more rigorous elucidation of how the universe's creative process can give rise to a justification for intrinsic value.

Rolston's view also attempts to address the problem of assessing or measuring value (which is at the heart of criterion four of our conception of a cosmocentric ethic) by suggesting that if a thing has formed integrity, or is worthy of a proper name, it should be respected, which presumably means left alone. But how do we decide what has formed integrity so that it will be named? This is the value measurement problem in a different form. The conflict ultimately remains, since personal subjective value judgments seem unavoidable in assessing what has formed integrity.

4.10. Complexity

Lastly, we may want to consider the emerging science of complexity as a basis for a cosmocentric ethic. It has been claimed by some thinkers that the evolution of complexity and even consciousness is an inevitable manifestation of the laws of physics.⁴² If this is so, we might not only satisfy the first two criteria for a cosmocentric ethic, but the third and fourth as well. Intrinsic value would be justified as a fundamental characteristic and evolutionary trend of the universe, and degrees of value could be associated with degrees of complexity. The use of complexity in a cosmocentric ethic has promise, (indeed, there are scientists today trying to measure complexity) but, obviously, it could also have

undesirable consequences or side-effects. In order to deal with something as subtle as weighing the value of primitive indigenous extraterrestrial life forms against human activity, such a view would have to be developed extensively—including supplementing complexity with other complimentary concepts, or perhaps in search of such concepts, pursuing a deeper understanding of universal laws and their source.

5. IMPLICATIONS FOR A COSMOCENTRIC ETHIC

5.1. Instrumental Value and the SETI Connection

A cosmocentric ethic should provide a framework in which we can explain and capitalize on the instrumental value associated with something like primitive extraterrestrial life forms. More specifically, an appropriately conservative exploration approach seems to be a reasonable implication for a cosmocentric ethic, especially given the unknown aspects of interacting with extraterrestrial life. This would ensure that the instrumental value of such a discovery would be realized.

A further extension of this instrumental value, as the Drake equation indicates, is the connection between the existence of primitive life and the probability of intelligent life in the universe. Shedding light on the existence of intelligent life in the universe clearly goes far beyond the bounds of biology and transcends science.

We might also note the possible importance of understanding value as it relates to extraterrestrial intelligence. An examination of value theory in this light may be immensely useful by acting as a different lens through which we see our own values. Such an endeavor may also ultimately help us in dealing with questions of interaction with extraterrestrial intelligence. Are there such things as truly universal values, and would we need an understanding of them in order to interact optimally with extraterrestrial intelligence? Should we proactively send out signals in an attempt to make contact? What, if anything, should we assume about them and/or say to them? A cosmocentric ethic could be helpful in such matters since it assumes the importance of that which we are certain to have in common with extraterrestrial intelligence—the universe itself.

5.2. Intrinsic Value and Its Measurement

The philosopher Alan Marshall stresses that intrinsic value is not imposed by humans, but is merely recognized by humans.⁴³ However, we cannot emphasize enough the problem of justifying intrinsic value as objectively as possible if that is to be a critical element of an ethical framework such as a cosmocentric ethic. Indeed, the significance of appealing to the universe as a basis for an ethical view is that justification of intrinsic value may be realized to the greatest extent possible by basing it on the most compelling objective absolute we know—the universe. In a pantheistic world-view, this is functionally equivalent to knowing the nature of God. In this light, if the nature of the Universe itself can't be an objective source of justification for value, what else could be? In addition, we should like to have some way of objectively assessing, preferably measuring, value so as to avoid unduly compromising human needs and desires.

5.3. The Fact/Value Problem

We must acknowledge at this juncture the importance of the fact/value dilemma which suggests, among other things, that knowing something about the way the universe is cannot lead to a justification of value. Thankfully, this complex philosophical problem, although ultimately relevant, is beyond the scope of this paper. But we submit for consideration that this problem can also be understood as the idea that values do not *necessarily* follow from facts—not that values *absolutely cannot* follow from facts. That is, if we find a fact-based value theory compelling enough, we have the choice to associate and/or derive value (an “ought”) from what “is”. Our value theories can be models just like physical theories. What matters most is that they have broad explanatory and problem-solving power.

5.4. General Need

Finally, some may argue that the rational pursuit of ethics is futile—that economics is the primary motivation for human activity. To this we say that any effort, ethical or otherwise, whether by reflection, learning, or doing, which attempts to improve our existence in the universe, is important. We don't really understand human nature, or perhaps more importantly, our potential, and so actively searching out, participating in, and creating our destiny, whether it be through space exploration, or value exploration, is worthwhile and noble.

...silent...were the Martians—silent, yet alive!—preserved by the Humans against which their systems were otherwise unprepared...alive, after all the Human's devices had worked, alive from the care shown by those who had landed upon their world. And so, across the gulfs of space, minds that were to Humans as Humans were to the Martians, intellects vast and cool and sympathetic, regarded this earth with admiration, and slowly and surely drew their plans to welcome us to the cosmic neighborhood—we who had evolved beyond our selfish genes—we who had chosen respect.

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2. For a historical legal analysis see: Darlene A. Cypser, International Law & Policy of Extraterrestrial Planetary Protection, *Jurimetrics* Vol 33, p. 315 (1993).
3. The Moon was widely regarded to be a dead body.
4. McKay and Davis note that a human presence on Mars will result in contamination. They write: “It may be assumed, *a priori*, that all space suits and habitats will leak.” Chris McKay and Wanda Davis, Planetary Protection Issues in Advance of Human Exploration of Mars, *Advanced Space Research* Vol. 9, No. 6, p. 197 (1989).
5. For a discussion on pathogen/host co-evolutionary dependency and other factors suggesting that contamination issues are unimportant, see Robert Zubrin's and Richard Wagner's, *The Case For Mars*. The Free Press, New York, pp. 134-135 (1996). For a brief response, see Mark Lupisella, The Rights of Martians, *Space Policy* Vol. 13, No. 2, p. 93 (May 1997).
6. McKay and Davis, p. 198, suggest that contamination will probably not be global due to oxidation and ultraviolet radiation. They also write: “niches at considerable depths below the permafrost are probably safe and would not be affected by a human base.” We suggest that these questions may need additional scientific rigor—especially considering that drilling will be an important activity. Computer simulations are one possible avenue of research.
7. McKay and Davis, p. 198, note several sources of environmental impacts due to a human base

- that should be considered, including mechanical disturbances, life support system leakage, airborne pollution, and “seemingly innocuous perturbations” like water, heat, light, etc.
8. McKay and Davis, p. 197, write: “It is arguable that once humans land on Mars, attempts to maintain a strict policy of preventing the introduction of Earth life into the martian environment will become moot.”
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 18. Indeed, we will see that Don MacNiven cites the importance of uniqueness in determining value.
 19. Witness the poignant poster of the Earth under which reads, “Save The Humans.”
 20. Donald MacNiven, *Creative Morality*. Routledge, New York, pp. 202-203 (1993).
 21. In addition, Martyn Fogg writes: “the concept of terraforming is inspiring enough to perhaps generate a formal effort toward extending environmental ethics to the cosmic stage. Martyn Fogg, *Terraforming: Engineering Planetary Environments*, p. 490.
 22. Robert Haynes, Ecopoiesis: Playing God On Mars. *Moral Expertise*, p. 177. See also Haynes and McKay, Should We Implant Life On Mars? *Scientific American*, p. 144 (December 1990) and MacNiven’s, *Creative Morality*, p. 204.
 23. Haynes, Playing God On Mars, p. 176.
 24. McKay, Does Mars Have Rights? p. 196.
 25. Donald MacNiven, Environmental Ethics and Planetary Engineering. *Journal of the British Interplanetary Society* Vol. 48, pp. 442-443 (1995).
 26. Carl Sagan, *Cosmos*. Random House, New York, p. 130 (1980).
 27. Haynes, Playing God On Mars, p. 177.
 28. McKay, Does Mars Have Rights? p. 194.
 29. McKay, p. 194.
 30. Bernard Rollin draws a line between protozoa which exhibit behavior that might indicate consciousness (albeit broadly defined) and bacteria and plants for which there is no such evidence. *Animal Rights and Human Morality*. Prometheus Books, Buffalo, pp. 39-42 (1981).
 31. Indeed, Callicott writes: “The assertion of ‘species rights’ upon analysis appears to be the modern way to express what philosophers call ‘intrinsic value’ on behalf of nonhuman species. Thus the question, ‘Do nonhumans species have a right to exist?’ transposes to the question, ‘Do nonhuman species have intrinsic value?’” J. Baird Callicott, On The Intrinsic Value of Nonhuman Species. Bryan Norton (Ed.), *The Preservation of Species*. Princeton University Press, Princeton, p. 163.
 32. Steve Gillett, The Ethics of Terraforming, *Amazing*, pp. 72-74 (August 1992).
 33. Callicott, Moral Considerability and Extraterrestrial Life, p. 251.
 34. Callicott, p. 252.
 35. Callicott, On the Intrinsic Value of Nonhuman Species, p. 143.
 36. MacNiven, Environmental Ethics and Planetary Engineering, pp. 442-443 (1995).
 37. MacNiven, pp. 442-443.

38. Holmes Rolston III, The Preservation of Natural Value in the Solar System, E. C. Hargrove (Ed.), *Beyond Spaceship Earth: Environmental Ethics and the Solar System.*, Sierra Club Books, San Francisco, (1990).
39. Haynes, Playing God on Mars, p. 177.
40. Similar to MacNiven's view, this perspective, has been referred to as "object-centered" by Richard Miller, in an independent study entitled, "The Greening of Mars: Ethics, Environment, and Society, Terraforming: An Ethical Perspective." University of Waterloo, Canada, (1996).
41. Generally, this anthropomorphizing tendency causes suspicion regarding a view's validity. However it could, ironically, be interpreted as evidence to support or justify intrinsic value—perhaps via some version or derivation of the Anthropic Principle, for example.
42. See Paul Davies', *Are We Alone*. Harper Collins, New York, p. 102 (1995) and Stuart Kauffman's, *At Home In the Universe*. Oxford University Press, New York, p. 19 (1995).
43. Alan Marshall, Ethics and the Extraterrestrial Environment. *Journal of Applied Philosophy*, Vol. 10, No. 2, p. 233 (1993).