

ASTROBIOLOGY PERSPECTIVE ON LIFE OF THE UNIVERSE



ASTROBIOLOGY SCIENCE, ETHICS, AND PUBLIC POLICY



EDITED BY

Octavio A. Chon Torres

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Publishing

WILEY

Astrobiology

Scrivener Publishing
100 Cummings Center, Suite 541J
Beverly, MA 01915-6106

Astrobiology Perspectives on Life of the Universe

Series Editors: Richard Gordon and Joseph Seckbach

In his 1687 book *Principia*, Isaac Newton showed how a body launched atop a tall mountain parallel to the ground would circle the Earth. Many of us are old enough to have witnessed the realization of this dream in the launch of Sputnik in 1957. Since then our ability to enter, view and understand the Universe has increased dramatically. A great race is on to discover real extraterrestrial life, and to understand our origins, whether on Earth or elsewhere. We take part of the title for this new series of books from the pioneering thoughts of Svante Arrhenius, who reviewed this quest in his 1909 book *The Life of the Universe as Conceived by Man from the Earliest Ages to the Present Time*. The volumes in ***Astrobiology Perspectives on Life of the Universe*** will each delve into an aspect of this adventure, with chapters by those who are involved in it, as well as careful observers and assessors of our progress. Guest editors are invited from time to time, and all chapters are peer-reviewed.

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Astrobiology

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WILEY

This edition first published 2021 by John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA and Scrivener Publishing LLC, 100 Cummings Center, Suite 541J, Beverly, MA 01915, USA

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Library of Congress Cataloging-in-Publication Data

ISBN 978-1-119-71116-2

Cover image: The editors

Cover design by Russell Richardson

Set in size of 11pt and Minion Pro by Manila Typesetting Company, Makati, Philippines

Printed in the USA

10 9 8 7 6 5 4 3 2 1

Contents

Foreword	xv
Preface	xix
1 Astrobioethics: Epistemological, Astrotheological, and Interplanetary Issues	1
<i>Octavio A. Chon Torres</i>	
1.1 Introduction	1
1.2 Epistemological Issue	3
1.3 Astrotheological Issue	6
1.4 Interplanetary Issue	9
1.5 Conclusions	12
References	13
2 Astroethics for Earthlings: Our Responsibility to the Galactic Commons	17
<i>Ted Peters</i>	
2.1 Introduction	17
2.2 Laying the Foundation for an Astroethics of Responsibility	20
2.2.1 First Foundational Question: Who Are We?	21
2.2.2 Second Foundational Question: What Do We Value?	22
2.2.2.1 Science and Value	24
2.2.2.2 Religious Reliance on the Common Good	25
2.2.2.3 A Secular Grounding for Astroethics?	27
2.2.3 Third Foundational Question: What Should We Do?	29
2.2.3.1 From Quandary to Responsibility	29
2.2.3.2 From Space Sanctuary to Galactic Commons	30
2.3 Astroethical Quandaries Arising Within the Solar Neighborhood	32
2.3.1 Does Planetary Protection Apply Equally to Both Earth and Off-Earth Locations?	32

2.3.2	Does Off-Earth Life Have Intrinsic Value?	33
2.3.3	Should Astroethicists Adopt the Precautionary Principle?	36
2.3.4	Who's Responsible for Space Debris?	36
2.3.5	How Should We Govern Satellite Surveillance?	37
2.3.6	Should We Weaponize Space?	38
2.3.7	Which Should Have Priority: Scientific Research or Making a Profit?	39
2.3.8	Should We Earthlings Terraform Mars?	40
2.3.9	Should We Establish Human Settlements on Mars?	42
2.3.10	How Do We Protect Earth from the Sky?	43
2.4	Levels of Intelligence in the Milky Way Metropolis	44
2.4.1	What is Our Responsibility Toward Intellectually Inferior ETI?	46
2.4.2	What is Our Responsibility Toward Peer ETI?	46
2.4.3	What is Our Responsibility Toward Superior ETI or Even Post-Biological Intelligence?	48
2.5	Conclusion	50
	References	51
3	Moral Philosophy for a Second Genesis	57
	<i>Julian Chela-Flores</i>	
3.1	Moral Philosophy on Earth and Elsewhere	58
3.1.1	The Origin of Ethics and Its Universal Relevance	58
3.1.2	Why Should We Act Morally?	59
3.1.3	Is a New Morality Needed for Astrobiological Explorations?	60
3.2	Identifying the Lack of Ethical Substance in Science Communication	61
3.2.1	Understanding the Boundaries of Knowledge	61
3.2.2	Implications of the Limits and Horizons of Science	63
3.3	Going from Astrobiology to Astrobioethics: A Big Step for Science and Humanism	64
3.3.1	The Pathway from Ethics to Bioethics and to Astrobioethics	64
3.3.2	The Question of the Role of Ethics in Astrobiology	64
3.4	Would There Be New Ethical Principles if There Were a Second Genesis?	65
3.4.1	Inevitability of the Emergence of a Particular Biosignature	65
3.4.2	Universalizable Ethical Criteria	66

3.5	Astrobioethics is Subject to Constraints on Chance	67
3.5.1	Not All Genes Are Equally Significant Targets for Evolution	67
3.5.2	Evolutionary Changes Are Constrained	67
3.6	How Are We Going to Treat Non-Human Life Away from the Earth?	68
3.6.1	Can Ethical Behavior Be Extended into a Cosmic Context	68
3.6.2	Instrumentation for the Search of Life	69
3.7	Ethical Principles in Early Proposals for the Search for Non-Human Life in the Solar System	69
3.7.1	Ethical Considerations in Previous Research in the Solar System	69
3.7.2	Instrumentation That Might Harm Exo-Microorganisms	70
3.8	Conclusion	71
	Glossary	72
	References	73
4	Who Goes There? When Astrobiology Challenges Humans	79
	<i>Jacques Arnould</i>	
4.1	Introduction	79
4.2	The Copernican Revolution	80
4.3	Religious Reactions to the Copernican Revolution	81
4.4	Astrobiology and Speculation	83
4.5	Heretics	84
4.6	The Many Worlds Hypothesis	86
4.7	Desecration of Planets Beyond Earth	86
4.8	The Precautionary Principle	87
4.9	The Sacred Beyond Earth	91
4.10	Who Goes There?	91
4.11	Conclusion: The Astrobiological Apocalypse	92
	Further Readings	93
5	Social and Ethical Currents in Astrobiological Debates	95
	<i>Kelly C. Smith</i>	
5.1	Introductory Musings	95
5.2	Uncertainty Opens the Door	97
5.3	Time Frames	100
5.4	Conceptual Frames	103
5.4.1	Error Avoiders vs. Optimizers	104
5.4.2	Ecologicals vs. Anthropocentrists	105

5.4.3	Communalists vs. Commercialists	106
5.5	Complications, Connections, and CYA	107
5.6	A Concluding Thought	109
	References	110
6	The Ethics of Biocontamination	113
	<i>Tony Milligan</i>	
6.1	The Beresheet Tardigrades	114
6.2	Our Conflicting Intuitions	117
6.3	The Intelligibility of Microbial Value	123
6.4	Contamination and Discovery	128
6.5	Conclusion	131
	References	132
7	Astrobiology Education: Inspiring Diverse Audiences with the Search for Life in the Universe	135
	<i>Chris Impey</i>	
7.1	The State of Astrobiology	136
7.2	Astrobiology as a Profession	138
7.3	Graduate Programs	141
7.4	Undergraduate Programs	142
7.5	Conferences and Schools	143
7.6	Courses for Non-Science Majors	144
7.7	Massive Open Online Classes	149
7.8	Teaching Materials and Books	149
	References	152
8	Genetics, Ethics, and Mars Colonization: A Special Case of Gene Editing and Population Forces in Space Settlement	157
	<i>Konrad Szocik, Margaret Boone Rappaport and Christopher Corbally</i>	
8.1	Introduction	158
8.1.1	The Complex Relationship Between Population Forces and Ethics	158
8.1.2	Humans Evolving on Earth and Mars	159
8.1.3	Bioenhancements: Science, Technology, and Ethics	160
8.1.4	A Set of Astrobioethical Guidelines for Off-World Exploration	161
8.2	Population Forces and the Ethical Issues They Raise	163
8.2.1	Natural Selection and Genetic Drift on Mars	163
8.2.2	Contrasting and Convergent Population Forces on Earth and Mars	164

8.2.3	Population Forces When Humans Colonize Mars, the Asteroids, and Outer Planets	165
8.3	Ethical Issues Implied by Population Forces and Genome Modification	166
8.3.1	Selection of Interplanetary Migrants Based on Invasive Genetic Procedures	166
8.3.2	Required Pre-Settlement Genetic Remediation	167
8.3.3	Moral Context for Genetic Engineering for Space	168
8.4	Case Types for Off-World Population Change and Their Ethical Implications	168
8.4.1	The Case of the Isolated Space Colony	168
8.4.2	The Case of an Inclusivist or Exclusivist Space Colony: Science, Research, Intelligence	169
8.4.3	The Case of the Space Refuge as an Ethically Expensive Option	170
8.4.4	The Case of the Formation of a New Species of Human	171
8.5	Religious Ethics and Population Forces	172
8.6	Conclusions	174
	Acknowledgement	175
	References	175
9	Constructing a Space Ethics Upon Natural Law Ethics	177
	<i>Brian Patrick Green</i>	
9.1	Introduction	178
9.2	Space Ethics and Natural Law Ethics	179
9.3	A Natural Law Ethics Including Space	182
9.4	The Disadvantages, Ambiguities, and Advantages of a Natural Law Space Ethics	185
9.5	Conclusion	188
	References	189
10	Two Elephants in the Room of Astrobiology	193
	<i>Jensine Andresen</i>	
	Abbreviations	194
10.1	Identifying the Two Elephants	195
10.2	The Phenomenon Elephant	197
10.3	The Weaponization Elephant	204
10.4	U.S. Government Spending on Weapons for Space	206
10.5	The Military-Industrial Complex Operates Under Euphemisms Citing “Government-Industry” Linkages	211
10.6	How the Two Elephants Are Connected	215

10.7	The Astroethics Public Policy Path Forward	216
	References	219
11	Microbial Life, Ethics and the Exploration of Space Revisited	233
	<i>Charles S. Cockell</i>	
11.1	Introduction	233
11.2	Critiques of Intrinsic Value	235
11.2.1	The Argument from Existing Destruction	235
11.2.2	The Argument from Sheer Numbers	237
11.2.3	The Argument from Impracticality	238
11.2.4	The Argument from Prevailing View	241
11.2.5	The Argument from Respect	243
11.3	What of Intrinsic Value?	244
11.4	Adjudicating Other Interests	247
11.5	Do We Need a Cosmocentric Ethic for Microbial-Type Life?	249
11.6	Conclusions	251
	References	251
12	Astrobiology, the United Nations, and Geopolitics	255
	<i>Linda Billings</i>	
12.1	Introduction	255
12.2	What is Astrobiology?	258
12.3	Ethical Issues in Astrobiology	258
12.4	Astrobiology and Planetary Protection	259
12.5	Conflicting Ideologies	262
12.6	International Cooperation—or Not?	266
12.7	Conclusions	267
	References	269
13	An Ethical Assessment of SETI, METI, and the Value of Our Planetary Home	271
	<i>Chelsea Haramia and Julia DeMarines</i>	
13.1	A Brief History of SETI and METI	271
13.2	Ethical Analyses of SETI and METI	273
13.3	Ethical Proposals for the Road Ahead	282
	References	289
14	The Axiological Dimension of Planetary Protection	293
	<i>Erik Persson</i>	
14.1	Introduction	293

14.2	The Relation Between the Epistemic and the Axiological Dimensions of Planetary Protection	294
14.3	The Axiological Dimension of Planetary Protection Today	296
14.4	The Nature of Epistemic Values	298
14.5	The Outer Space Treaty and the Axiological Dimension of Planetary Protection	299
14.6	The Axiological Dimension of Planetary Protection – Historical Background	302
14.7	Ethics and Planetary Protection	305
14.8	Competing Values – Planetary Protection and the Commercial Use of Space	307
14.9	Conclusions	308
	References	309
15	Who Speaks for Humanity? The Need for a Single Political Voice	313
	<i>Ian A. Crawford</i>	
15.1	Introduction	313
15.2	The Need for Global Decision-Making in an Astrobiological Context	315
15.3	Some Socio-Political Implications of Astrobiological Perspectives	319
15.4	Who Speaks for Humanity? Building Appropriate Political Institutions for Space Activities	324
15.4.1	A World Space Agency	325
15.4.2	Strengthening the United Nations for the Governance of Space Activities	327
15.4.3	Space Activities in the Context of a Future World Government	328
15.5	Conclusions	331
	References	332
16	Interstellar Ethics and the Goldilocks Evolutionary Sequence: Can We Expect ETI to Be Moral?	339
	<i>Margaret Boone Rappaport, Christopher Corbally and Konrad Szocik</i>	
16.1	Introduction	339
16.1.1	The Little Broached Question of Ethics	340
16.2	Astronomical Detection of Possible Life	341

16.2.1	The Complex Relationship Between Signals and Ethics	341
16.2.2	Astronomical Signal Detection, the Goldilocks Zone, Habitation, and Ethics	342
16.2.2.1	Exoplanets	342
16.2.2.2	Exoplanets in the Goldilocks Zone	342
16.2.2.3	Exoplanets, Oxygen, and the 'Red Edge'	343
16.2.2.4	The Great Leap from Plant Cover to Ethics	344
16.3	Operationalizing Human Neurological Features for an ETI Vetting Protocol	344
16.3.1	Parallel Moral Assessments by Host and Visitor	344
16.3.2	Anthropocene or 'Adolescence'?	345
16.3.3	Vetting ETIs: Friend or Foe? Right vs. Wrong	346
16.3.4	Rationale and Approach: Operationalizing Human Neurology to Assess ETIs	347
16.3.4.1	Theory of Mind	349
16.3.4.2	Sequence of Evolutionary Innovations: Logical, Determinate, Systemic	350
16.3.4.3	Cultural, Moral, and Religious Capacities – How Important and in What Order?	351
16.3.4.4	Assessing ETIs for Culture	352
16.3.5	A Test for Neuroplasticity: The Clincher if We Have Time	353
16.4	Fictional Case Studies of Vetting ETIs	354
16.4.1	Examples from Film and Television	354
16.4.2	Case Study of the Film <i>Arrival</i>	355
16.5	Conclusion	356
	References	357
17	Intrinsic Value, American Buddhism, and Potential Life on Saturn's Moon Titan	361
	<i>Daniel Capper</i>	
17.1	Introduction	361
17.2	Titan and Possible Weird Life	363
17.3	Some Strengths and Limitations of the Intrinsic Value Concept	365

17.4	Buddhist Scriptures and the Search for Extraterrestrial Life	368
17.5	American Buddhists and Life on Titan	369
17.6	Discussion	372
17.7	Conclusion	374
	References	375
18	A Space Settler's Bill of Rights	377
	<i>Russell Greenall-Sharp, David Kobza, Courtney Houston, Mohammad Allabbad, Jamie Staggs and James S.J. Schwartz</i>	
18.1	Introduction	377
18.2	Basic Physiological Needs	380
18.3	Physical and Psychological Well-Being	381
18.4	Freedom of Expression	383
18.5	Privacy	383
18.6	Reproductive Autonomy	384
18.7	Vocational and Educational Liberty	385
18.8	Communication	385
18.9	Constrained Dissent	386
18.10	Self-Governance and Revisability	386
18.11	Conclusion	386
	References	387
	Index	389

Foreword

The science of astrobiology may be understood as a book with four chapters: the origin, evolution, distribution and destiny of life in the universe. Astrobiology's still unfinished first chapter emerged mainly from the work of Alexander Oparin (1894–1980) and other organic chemists. They gave rise to the subdiscipline of astrobiology that was called chemical evolution, a scientific approach to the origin of life on Earth. NASA was established in 1958. Since then, the young space agency encouraged space exploration of the Solar System: their efforts, together with the space agencies that came after them, could lead to at least a single additional example of life in our cosmic neighborhood. This would be the beginning of a second chapter of astrobiology—the evolution of life in the universe. A preliminary development, a third chapter of astrobiology, was due to the molecular biologist and Nobel Laureate Joshua Lederberg (1925–2008). He raised the question of the origin of life, not as a terrestrial phenomenon, but rather as a cosmic distribution of life. A fourth chapter, the destiny of life in the universe, is a different inspiring topic. For getting off the ground, it will need interdisciplinary interactions at the frontier of astrobiology and humanism.

The eighteen chapters of *Astrobiology: Science, Ethics and Public Policy* attempt to fill a gap in the current literature on the continuing growth of this new science of life in the cosmos. Even though astrobiology has made remarkable progress, the humanistic neighbors across its cultural frontiers are only at the beginning of confronting the problem of other life. A specific neighboring humanistic area is a main concern of the present book. It has been called alternatively *astroethics*, or *astrobioethics*. We will adopt the latter denomination, following the suggestion of the 2016 International Working Group on Astrobioethics.

As suggested by the present book, there are two time-honored philosophical subdisciplines that will be relevant for progress in astrobiology. Firstly, ethics, which goes back to Aristotle's *Nicomachean Ethics* (c. 340 BC). The other one, political philosophy, has its roots in the best known of Plato's dialogues, *Republic* (c. 375 BC). Ethics covers questions such as

culture, religion and human-nonhuman relations. But our main interest regards especially human-nonhuman relations, since they concern not only public policy, but the future of astrobiology itself. To be fair to the society we live in, we need the assistance of government to ensure that justice is implemented, so that our rights, and those of others, are respected. Then, we should return to political philosophy to guide us in enquiries on public policy:

What are the right policies for implementing public power in order to respect, preserve, and improve the quality of life on Earth, and elsewhere?

Governments have the vocation to face difficult decisions concerning the distribution of limited public funds that are available to the State. One aspect of this obligation is the support of big science. The main example goes back to the middle of the last century. It involves physics of high energies with their large accelerators. More recently, astrobiology has been inserted into this restricted group, whose most urgent expenses are due to Solar System exploration. Once again, political philosophy comes to our aid regarding the enormous long-term decisions that our expenses force upon public offices. For instance, if we commit ourselves to terraforming in the Red Planet, this activity presents us with a clear-cut question that begs for a political answer. Even closer to the present, though, governments will face the economic exploitation of the Moon, Mars and the asteroids. For these activities we may profit from an earlier analogous multinational experience that has already been addressed with the exploitation of the Antarctic.

Similarly, we are becoming aware that spacefaring nations, with their corresponding space agencies, will need to take possession of new resources pacifically, according to the UN's Outer Space Treaty. Consequently, political agreement is necessary within the United Nations Organization. All space agencies, which are capable of space exploration, should respect UN agreements: the European Union, the United States of America, Russia, Japan, China and India. More recently, other national agencies have come to the foreground, including Israel and the United Arab Emirates. Clearly, political philosophy may come again to our aid.

In a different line of thinking, philosophical studies of morality serve as a basis for extending ethics into considerations that are forced upon us by the eventual understanding of the distribution of life in the universe. In this case the term "neighbor" takes a new, deeper, inspiring, unexpected and unprecedented philosophical significance. We generally accept the principle of equality as a proper ethical basis for relations with other human beings. But with Peter Singer in *Practical Ethics* (1979), we are aware that

the principle of equality is also a proper ethical basis for the more restricted question of human-nonhuman relations on Earth. A very remarkable example of an animal that we should keep in mind—the dolphin—was singled out by the neuroscientist Lori Marino: she found that the rate of encephalization (variation in relative brain size) in the hominid line may have been matched by this marine mammal's encephalization as recently as only one million years ago. But independent of this special evolutionary factor, all nonhuman animals should be encompassed, without exception, in our ethical codes. But our search for other manifestations of the phenomenon of life ranges from microbial evolution in the Solar System to the evolution of intelligence in worlds elsewhere in our galaxy. Thus, a bigger, inevitable and evident question in morality cannot be avoided:

*With nonhuman species, on Earth and elsewhere,
how far should we extend our ethical codes?*

In agreement with Edward Osborne Wilson in *Consilience* (1998), the origin of ethics is not a religious debate between believers and non-believers, but rather between “transcendentalists,” those of us who believe that ethical precepts (such as justice and human rights) are independent of human experience, and “empiricists,” who believe that ethical principles are human inventions. In what follows we shall understand how, for astro-bioethics, both sides of this debate are fruitfully complementary.

Even though we have already underlined that independent of any theological consideration, the main debate on ethics is between transcendentalists and empiricists, nevertheless we must not exclude, but instead we should pay special attention to some religious aspects both of morality and public policy. Independent of any ethical system, our Judeo-Christian traditions contain writings that are remarkable from an ethical point of view, as they address fundamental questions. An outstanding example is Jesus' *The Sermon on the Mount* (Mathew, 5,1-14, written c. 85 AD), which is inserted in a long biblical tradition (Psalm 1 and Jeremiah 17,7).

On the other hand, as astrobiologists we are mainly concerned with an empirical approach to ethics. Its insertion in science goes back to Charles Darwin in *The Descent of Man* (1875). This work offers a rationalization of the origin of ethics. Since the second half of the last century, the application of Darwinian theory to social behavior—sociobiology—has taught us how ethical behavior, as well as astrobioethics, can be given solid scientific bases. Consequently, under empiricism, progress in the search for life in the universe is bound to induce us to abandon the idea that ethics is uniquely human.

However, we should keep in mind the other major approach to ethics. In philosophy, from Socrates to Singer, there is a long history of transcendentalism. The following short selection of outstanding contributions clearly illustrates this remark: John Locke's *Second Treatise on Civil Government* (1689), David Hume's *A Treatise of Human Nature* (1739), Immanuel Kant's *The Categorical Imperative* (1785), Georg Wilhelm Friedrich Hegel's *The Philosophy of Right* (1831), George Edward Moore's *Principia Ethica* (1903), and John Rawls' *A Theory of Justice* (1971).

With these major philosophical contributions, we are once again in the satisfactory position that has characterized progress: When empirical bases have been identified, rationalism arises as its inevitable complement. In science, from Democritus to Darwin, the concert between empiricism and rationalism has been the general rule. For example, in classical mechanics, early empirical observations of Galileo were later rationalized by Newton's theory of gravitation. Exceptionally, in the astrobiological context, empiricism arose long after rationalization had preceded it in the form of transcendentalism. Fortunately, both sides of the current debate on ethics, and *a fortiori* on astrobioethics, provide solid bases for a consensus. We are ready to face astrobiology's most pressing objective due to the programs on exploration of the Solar System: our eventual interaction with life beyond our own horizons.

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May 2021

Preface

Science is awesome. Well, actually, it's not the science that's awesome. It's the natural world that science helps uncover, expose, reveal. My friend and Nobel Prize winning physicist, the late Charles Townes, once averred to some students visiting in our home, "science is a form of revelation."

In this sense, astrobiology is awesome. Among the revelations over the last quarter century are exoplanets, more than 4,000 confirmed with thousands more waiting in line for confirmation. Our space spectroscopists are watching and our SETI scientists are listening for biosignatures that could reveal extraterrestrial intelligence. Meanwhile, our solar system spelunkers energetically mine the subsurface of Titan and the atmosphere of Venus, looking for possible microbial neighbors closer to home. Astrobiology offers video game adventure for grown-ups.

Astrobiology provides one component to the more comprehensive matrix of science and technology that comprise space research. Just standing in awe at the numinosity of the cosmos is only part of the picture. Funding launch and orbital technology in the midst of geopolitical competition and tension occupy private entrepreneurs and governmental leaders alike. A competition has arisen between stockholders investing in off-Earth mining, on the one hand, and scientists wishing to maintain pristine off-Earth laboratories for their research, on the other hand.

This competition provides honest work for philosophers who then ask: would critters living in an off-Earth biosphere have intrinsic value? And, if so, would the imputation of intrinsic value protect them from terrestrial profiteering? Regardless of how we respond to these ethical quandaries, the answers should rise to the level of public policy formulation to guide the next generation of space explorers.

We need a book. We need a book that looks at *Astrobiology: Science, Ethics, and Public Policy*. You are now reading this book. Yet, as we delve into the details of reading this book with our eyes focused on the pages, we dare not forget the awesome beauty of the cosmos that can be glimpsed only when we turn to look in the direction of the stars.

Let me alert you to some subtleties of vocabulary. With the term, *astrobiology*, we work with standard definitions summarized as: Astrobiology is the scientific study of the origin and evolution of life on Earth and beyond Earth that draws upon a host of disciplines such as astronomy, physics, planetary science, geology, chemistry, biology.

What about ethics? In general, the term, *ethics*, refers to the theoretical work undergirding standards of value and moral responsibility. Be alert to overlaps and distinctions in various chapters. The panoptic terms, *astroethics* and *space ethics*, are inclusive. They include reflection on the broad scope of ethical concerns arising from concrete procedures in space exploration as well as speculations regarding extraterrestrial life. A more focused term is *astrobioethics*, which concentrates on matters having to do specifically with *bios*, life. Astrobioethics, you will read in Octavio Chon-Torres' chapter, is a branch of philosophy and astrobiology that studies the moral implications of the search for life in space.

The construction of future public policy can be built on a solid foundation laid already in 1958 and 1967. As Jacques Arnould at France's *Centre National d'Etudes Spatiales* (CNES) reminds us, the United Nations Committee on Space Research was established in 1958 on the occasion of the International Geophysical Year. The result is a perduring UN mandate to develop recommendations that form the basis of what is now known as planetary protection.

To this foundational principle of planetary protection was added some superstructure in the 1967 UN Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. This prescient document 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.”

In many quarters, this moral foundation for public policy has been forgotten. New debates have broken out over weaponization of space, selling off-Earth real estate, competition for planting national flags, establishing colonies, and property rights for yet-to-be-discovered precious resources.

When we remind ourselves of the foundation laid in 1958 and 1967, we are inspired to see how the awesome magnificence of outer space revealed by the astro-sciences has been bolted to steel moral girders, one of which is to support the notion of a single Earthly society of moral deliberation. When we turn from staring at the stars and look back to Earth, we can perceive a oneness that might have been overlooked in previous centuries. The space sciences reveal something about the cosmos, and something about ourselves as well.

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January 1, 2021

Astrobioethics: Epistemological, Astrotheological, and Interplanetary Issues

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Abstract

The themes that arise as we enter the philosophical discussion on astrobiology are many and diverse. Of all these, ethics is presented as a rather complex one. Therefore, astrobioethics is the branch of philosophy and astrobiology that is responsible for studying the moral implications of the search for life in space. In this chapter I will analyze three fundamental aspects: epistemological, astrotheological, and interplanetary issues. Each has its own field of discussion and questions that need to be addressed, so that our new small step for mankind does not end up crushing the life we find in the universe.

Keywords: Astrobioethics, astrotheology, interplanetary, teloempathy, transdisciplinary

1.1 Introduction

For a long time, humans have wondered if we are alone in the universe. This has manifested itself in culture, in religion, in philosophy, and in a variety of forms as different as human groups can be on Earth. Although we have not found empirical evidence that we are not alone in the cosmos, eventually this can happen. We do not know exactly when this will happen. However, that is not an impediment to the question of what we should

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Octavio Alfonso Chon Torres, Ted Peters, Joseph Seckbach and Richard Gordon (eds.) *Astrobiology: Science, Ethics, and Public Policy*, (1–16) © 2021 Scrivener Publishing LLC

morally do about it. Science and technology advance by leaps and bounds in the search for extraterrestrial life.

Every so often we see news about habitable exoplanets being detected. We have the disciplinary nature of Astrobiology, which brings together several disciplines made up of different specialists whose *modus operandi* is to work in an orchestrated and coordinated way. But what about the humanities, specifically ethics? Can we have a breakthrough that is matched with the Natural Sciences? To make the comparison would not do justice to either of them, since the nature of both respond to forms of knowledge with their own characteristics.

No. Ethics is not a science that gives us answers like mathematical formulas or experiments in a laboratory or astronomical observations. Ethics is a branch of philosophy that studies the moral dimension of human actions and thinking and, as such, since it does not have a unified methodology in which all experts agree and whose proposal is immutable in time, there are no universal moral laws. However, thanks to reflections on morality we can realize and reflect on our actions and thoughts, on their consequences and implications. That is why it is much more difficult to establish a moral system with coherence and adequate sustenance. And if that is so for earthly matters, for matters that go beyond life on Earth this could become a great mental exercise which will take time and the results of which will not be available every few months as if they were the product of the latest technological advances. To be able to engage in the thinking of astrobioethics, one must approach ethics as a branch of philosophy in addition to astrobiology, because astrobioethics was born in conjunction with moral reflection on issues expressly related to extraterrestrial life and, unlike astroethics, it deals with aspects that are more broad and general such as the responsibility of taking care of space junk or the right to property in an interplanetary context [1.6] [1.10] [1.11] [1.24].

The first time the word astrobioethics was used was in 2016 at two international events: the 35th International Geological Congress in Cape Town, South Africa [1.20] and the 12th Rencontres du Vietnam in Quy Nhon [1.21]. The first academic article that directly addressed this issue was published in the *International Journal of Astrobiology* under the title “Astroethics.” It states that

“Astroethics is an interdisciplinary field of astrobiology and ethics; it studies the ethical implications of astrobiological research. However, astroethics must have transdisciplinary practices in order to enrich itself and propose a broader judgement according to the context where it is applied [1.8].”

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