An Eco-Critical Cultural Approach to Mars Colonization

Alessandra Calanchi
Dept. Science of Communication, Humanities, and International Studies
University of Urbino, Italy
Email: alessandra.calanchi@uniurb.it
Almo Farina
Dept.of Basic Sciences and Foundations
University of Urbino, Italy
Email: almo.farina@uniurb.it
Roberto Barbanti
Département Arts plastiques
(UFR 1) Université Paris 8
Email : roberto.barbanti@univ-paris8.fr

Abstract Colonization is a term common to many disciplines, from political science to anthropology, from sociology to microbiology. In all of these cases it has evidence-based historical or scientific roots. On the contrary, when this term is referred to the Outer Space, its use still draws from the realms of imagination, since no colonies exist as yet outside planet Earth. Nevertheless, we know that this might happen soon, and believe that the realms of imagination have played — and are playing — a fundamental role in the matter.

It is the object of this essay, the authors of which belong to three different disciplines (Anglo-American Literature and Culture, Ecology, and Philosophy), to discuss and problematize the cultural, environmental, and ethical implications of the project of Mars colonization, a project which is rooted in politics and economics.
It is not our aim to advance any doubts about the consistency of the current agenda concerning the *mission* of colonizing Mars. However, we want to underline the absolute necessity of adopting a truly sustainable and multidisciplinary *vision* which involves a deeply ethical, ecological, and cultural approach. By *ethical* we mean that we ought to be aware that a new phase in the Anthropocene has come, since we are challenged to enlarge the *semiosphere* so as to include the Outer Space, which means proposing new ecosophic paradigms; by *ecological* we mean that owing to a

change in our *Umwelt* we should follow an ethical management of the environment, that is respectful of Mars territories as well as of those we will continue to inhabit on Earth; by *cultural* we mean that it has to take into account all of the following: the literary narrations of the past, both utopian and dystopian; the intuitions of Sci Fi fandom and scholarship; and the perspective of post-colonial studies, which problematize the cultural legacy of colonialism and imperialism and analyze the consequences of external control and economic exploitation of people and lands.

Key words Mars colonization; ecology; ecosophy; literature; culture

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1. Why Responsibilities Matter (ac)

Mars colonization started much earlier than most people think. Like any other colonization of the past, it began in the human imagination and narratives. The "discovery" of America, for example, and the subsequent settlement of Europeans in the trans-Atlantic wilderness, had actually been accurately prepared or foreseen through folk tales, story-telling, and myths of various types, such as Atlantis and the Garden of Eden. However, unlike the previous experiences we know from ancient and recent history, this particular type of colonization is taking longer and involves wider strata of society and culture throughout planet Earth.

For the first time in history we are witnessing a process of colonization happening in a globalized world, with a worldwide mass media coverage. The fact that nobody is likely to meet a *colonizable* people, and nor to experience any symbolic encounter with Otherness, which happened in all previous cases, is not really relevant if we think, to continue with our example, that Natives Americans, though undoubtedly human, were rarely perceived as such in the first stages of

colonization. Puritan literature from early America abounds in descriptions of devils, beasts, and monsters — not men or women — and the discussion about these creatures' possessing or not possessing a soul was virulent and lasted for decades.

From a cultural perspective, Martians have represented a propulsive force in the literary and filmic construction of the Martian project, in either sense (humans as the invaders or the invaded); however, from a merely scientific perspective, the debate about the plausibility of the existence of life on other planets, which was very lively in the past centuries, can only continue if we reach an agreement on the definition of life. The fact that the only aliens we could reasonably expect to meet on Mars are extremophiles means that we do not need worry about the possible drawbacks of colonization in terms of the encounter (and possibly struggle) with the Other — that is, we do not have to worry about our responsibilities.

Or should we? The problem is that the risk of repeating the same errors of the past does exist. While our planet is being destroyed by environmental crises, overpopulation, and natural catastrophes enhanced by human intervention (e.g. building along sea shores, deforestation, and terrorism) we happily plan to terraform Mars, to extract mineral and gas resources, and ultimately to create human settlements. But who can guarantee that the investors of today and settlers of tomorrow will show more respect to the environment than humans have granted their own home-planet so far? Who can promise that our missions on Mars will not cause new forms of class struggle, intolerance, racism, radicalization of poverty, and the rise of new totalitarian regimes and new commercial lobbies on Earth?

We believe in the necessity of a common agenda that implies respect for the environment and geo(Mars)-bio-diversity — whatever it may be. Also, the contribution of the humanities and in particular literature and film studies is important in order to become fully aware of Mars colonization as an ongoing cultural, political, and social process, and also in order to improve the level and quality of life of future settlers. In particular, a deep knowledge of literature and mythology concerning Mars, together with postcolonial studies, gender studies, and cultural studies, will provide both humans on Earth and humans on Mars with a robust background. Finally, humans must become aware that this particular colonization will be — and actually is already being — performed under their very eyes. Any time of day and night it is possible for humans to browse the Internet in search of information, news, photos, and comments that have travelled millions of miles before reaching their eyes, and will travel on. Even though from a distance, every single human being who has access to the World Wide Web will participate, in a way, in this mission.

This is why Mars colonization should be studied under multiple perspectives, starting not with economics and politics but with ecology and ecosophy, and including those disciplines which are based on the study of imagination, on the patterns of representation, on the dynamics of myth formation and transmission, and on simple story-telling. Literature offers an extraordinary reservoir of stories, and each story tells us something about ourselves, about our dreams, our projects, and our responsibilities. This means that we should also invest in such sectors; it means that investments should not only concern business and profit, but involve cultural values and cultural education as well.

2. A Trans-Planetary Transplantation? (ac)

As literature shows us, Mars colonization started in the arena of imagination long before real exploration began. In particular, in the U.S. the idea of progress and the myth of the Frontier were at the basis of all activities performed in the Outer Space. The concept of *transplantation*, introduced by J. Hector St John de Crèvecoeur (1782), is clearly to be found in the present-day plans for Mars colonization:

> The most important concept to bear in mind about colonizing Mars is the art of defying apparent natural laws by pulling oneself into the air by the shoestrings — the "bootstrap" philosophy. When settlers crossed the Atlantic hundreds of years ago, they didn't bring with them all that was eventually to be on the North American continent. Rather, they brought simple tools and supplies that were to be *the seeds of a continental culture based on indigenous resources*. They were aided in no small way by trans-oceanic trade and sustenance but everything that grew up in the New World didn't arrive fully formed. It was seeded and nurtured by the vast resources of the continent and the multiplying human population.
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> The same will be true for colonizing Mars. […] Before leaving England, the Pilgrims didn't study the greenhouse cultivation of corn or techniques to purify precious water […]. (Mallove 339. Italics mine)

O'Sullivan's theory of the Manifest Destiny is also responsible for the projects of colonization regarding the Outer Space: as he wrote as early as the 1830s, in fact, "The expansive future is our arena. We are entering on its untrodden space, with the truths of God in our minds. […] We are the nation of human progress, and who will, what can, set limits to our onward march? Providence is with us, and no earthly power can" (427). And everybody surely remembers president J. F. Kennedy's

famous "New Frontier Speech" (15 July 1960):

> […] Today some would say that […] there is no longer an American frontier. But I trust that […] we stand today on the edge of a New Frontier — the frontier of the 1960s — a frontier of unknown opportunities and perils — a frontier of unfulfilled hopes and threats.
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> […] I tell you the New Frontier is here, whether we seek it or not. Beyond that frontier are the uncharted areas of science and space […] I am asking each of you to be pioneers on that New Frontier.

Robert Zubrin's "The Significance of the Martian Frontier" (1994) culminates in the following statement:

> I believe that humanity's new frontier can only be on Mars […] Mars has what it takes. It's far enough away to free its colonists from intellectual, legal, or cultural domination by the old world, and rich enough in resources to give birth to a new. The Red Planet may appear at first glance to be a desert, but beneath its sands are oceans of water in the form of permafrost, enough in fact (if it were melted and Mars' terrain were smoothed out) to cover the entire planet with an ocean several hundred meters deep. […] For the rest, all the metals, silicon, sulfur, phosphorus, inert gases and other raw materials needed to create not only life but an advanced technological civilization can readily be found on Mars.
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> The United States has, today, all the technology needed to send humans to Mars. […] Once humans have reached Mars, bases could rapidly be established to support not only exploration, but experimentation to develop the broad range of civil, agricultural, chemical and industrial engineering techniques required to turn the raw materials of Mars into food, propellant, ceramics, plastics, metals, wires, structures, habitats, etc. As these techniques are mastered, Mars will become capable of supporting an ever-increasing population, with an expanding division of labor, capable of mounting engineering efforts on an exponentially increasing scale. Once the production infrastructure is in place, populating Mars will not be a problem — under current medical conditions an immigration rate of 100 people per year would produce population growth on Mars in the 21st century comparable to that which occurred in Colonial America in the 17th. […]

In the new millennium president Obama, speaking at Kennedy Space Center on 15 April 2010, proclaimed: "By the mid-2030s, I believe we can send humans to orbit Mars and return them safely to Earth. And a landing on Mars will follow. And I expect to be around to see it."

Nevertheless, it is also worthwhile to remember that alongside this optimistic vision concerning progress and advancement there exists a literary production that has been warning humans against the risks of space colonization. I am not referring to Science Fiction, which has already been extensively studied, but to earlier works. In the 19th century many people thought Mars was inhabited and this led to a number of utopian works based on the planet's superiority in political and social terms. It is sort of astounding that the first American novel set on Mars was written by two women from Iowa, Alice Ilgenfritz Jones and Ella Merchant, in 1891. It is a proto-feminist utopia entitled *Unveiling a Parallel: A Romance by Two Women of the West* (1891) and tells of an American man who visits planet Mars where he finds a society based on gender equality. Women can do any job there — "They are becoming doctors, lawyers, editors, artists, writers" — and they can vote. Religion is also based on equality. Creation is described in this way: "A pair of creatures, male and female, sprang simultaneously from an enchanted lake in the mountain region of a country called Caskia, in the northern part of this continent. They were only animals, but they were beautiful and innocent. God breathed a Soul into them and they were Man and Woman, equals in all things." Two years before another utopian novel was written by a man, William Simpson: it is entitled *The Man from Mars*. *His morals, politics, and religion* and tells of an American citizen who is visited by a Martian — through a sort of hologram *ante litteram* — who criticizes planet Earth's politics — he speaks of "misgovernment" "relics of barbarism" and "breathless pursuit of wealth, beyond all reasonable limit" (217, 219, 272).

It is not irrelevant that, at the turn of the century, astronomer Percival Lowell published as many as three books on Mars — *Mars* (1895), *Mars and Its Canals* (1906), and *Mars as the Abode of Life* (1909) — which contributed to the lively debate on the possibility of life in the Outer Space. But what interests us even more is his ecological and eco-critical vision, which becomes particularly strong in his third book. As early as 1909, Lowell — who published articles in such reviews as *Nature* and *Scientific American* — was worried about the Earth's environmental decline and sky pollution: according to him, man "has enslaved all that he could; he is busy exterminating the rest […] Already man has begun to leave his mark on this his globe in deforestation, in canalization, in communication" (in Markley 94).

The contribution of literature to our current *vision* and *mission* regarding Mars

is therefore twofold. On the one hand, in the course of time literary imagination has given a sort of powerful propellant to American (and human) projects of Outer Space colonization. On the other hand, however, it has repeatedly warned humanity against the risks of duplicating the errors that have been committed on planet Earth — *deforestation, canalization, communication*, and whatsoever. True, it is quite unlikely — but not impossible — that there is life on Mars; however, we strongly believe that we should grant the planet full respect for its landscape, resources, climate, and everything we will meet up there. The examples of human colonization in the past are not good at all — while busy exterminating or enslaving or converting people, we also exterminated vegetation and wildlife, and even today the way we behave toward our home planet is not exemplary. Therefore we strongly advocate that ecology and ecosophy will have a place on planet Mars.

3. Insatiable and Uncontainable! (af)

If we build a fence to limit the pasture of our cattle, sooner or later — no matter how large these pastures are — our cattle will reach its borders and repeatedly trample on them. This innate tendency all biological species have to push themselves to the end of their territory, solicits a reflection on the very concept of *territory*, a concept which is apparently linked to a restricted temporal vision. Every biological species, be it vegetable or animal, tends, in fact, to occupy new spaces, either in search of new resources or trying to escape from intra- and inter-specific competition. This process includes the great migrations of human populations in more or less recent times, from the great exoduses of the past, following unfavorable climatic periods such as minor glaciations or persistent droughts, up to the current migrations due to the often huge economic and social inequalities between western nations and underdeveloped countries.

From an ecological point of view, biological consciousness urges the species to look for new resources (reproductive territories, food, safety) through complex mechanisms that we call, in short, "migratory" Human beings not only cannot escape this biological and ecological logic, but they are even helped by a technology that now permits them to avoid the great fatigue of walking long distances. From this perspective, Man can dare to escape the "prison" of Mother Earth and travel to worlds far away.

The idea of colonizing a planet like Mars mirrors, as has been written, the ancient idea of colonizing the New World. Nonetheless, in ecology the term "colonize" is not very effective, since all the species that find a favorable environment out of their own bio-geographical areas do not necessarily exert

hegemony. First, they have to adapt to new conditions, and the stronger they are, the more quickly they will adapt. For example, the domestic sparrow and the starling occupied North America in rather a short time, but they had to adapt to the new conditions in terms of seasonality and food resources. The same is true for the Japanese nightingale, which, once escaped from captivity (it was kept as a pet in many countries due to its attractive appearance), found in Mediterranean Europe a favorable milieu but had to adapt to a new climate and to environmental conditions (e.g. the structure of vegetation) which were very different from the native areas in the Asiatic South-East from where it came. So we do not really speak of a "colonizing" but of an "adapted" species, which changes the perspective completely. Only later will the "adapted" species have to make a choice: either to avoid competition with the indigenous species, or become dominant by subtracting resources from the indigenous species. This is exactly what Man has always done. The problem is that in so doing he prevents resources from self-renewal (General Theory of Resources[1]) and from this moment on his decline starts. Each species that "exaggerates" is destined to extinction in the end.

If we consider Man as the colonizing species of a planet like Mars, we can imagine at least two very contrasting scenarios. The first scenario envisages a strict protocol of territorial expansion onto Mars. Such protocol regulates all actions in order to reduce, but not eliminate, all risks of biological contamination. The second scenario does not take into consideration the potential fragility of the planet; for example, if potatoes could grow on Mars they would be cultivated with no problem. In both cases the terrestrial contamination of Mars would only be a matter of time, because we know that when two systems come into contact we must expect a reciprocal influence.

Our preoccupations, however, ought not to be confined to our possible biological exportations to Mars, but should comprehend all that we will import from Mars; and here the matter gets more complicated. Obviously, if we were able to erect a formidable ecological barrier between us and Mars, and if our exportable/importable product only consisted of information (images, sounds, and data), we would create a strange Earth clone, something difficult to understand. What would be the point of going to Mars if no physical (both mineral and biological) elements were shared? Which kind of investor would be content with just a tele-knowledge?

If, by mere hypothesis, we landed on Mars and renounced all that we have on Earth (food, plants, animals, and habits) and adopted integrally all that Mars can

1 http://www.codebiology.org/pdf/Farina%20A%20(2012)%20Towards%20a%20General%20Theory%20of%20Resources.pdf

offer us — provided it could be realistic from an ecological point of view — we would become children of Mars and lose our identity as terrestrial human beings. We consider this option really excessive, at least for the times closely following our landing on the Red Planet.

According to a more realistic scenario, Man lands on Mars, where he spreads out his/her biological offshoots (viruses, bacteria, spores, and seeds) and reconstructs conditions similar to those on Earth on this planet. As historical defaunation and the destruction of biodiversity in the last centuries testify, we did not stop in the face of the destruction of our home Earth: therefore, how could one ever think that, on a remote planet, our environmental care would be any different? We have "conquered" (so to say) the highest mountain tops of the planet, like Everest, and we have been able to create huge deposits of waste in places that our culture considers sacred and deeply symbolic. What can happen during Mars colonization? How long will it take for "Mars neighborhood committees" to impose their strict rules in terms of waste management and collective behaviors?

We must therefore expect a massive biological as well as ideological contamination following our landing on Mars. Such contamination will be of unprecedented and unimaginable dimension both for colonists and for the whole of humanity which will see in the Martian New World the hope for a better future. If millions of American buffaloes were brought to the verge of extinction in a few decades — an extinction that was fully accomplished as far as the passenger pigeon is concerned — we cannot expect any hypothetical forms of life we might encounter on Mars would meet a better destiny, unless they were functional to our own model of development. Man will land on Mars following an expansive model of development, so we cannot expect any respect for the Martian milieu. It is recognized that every single species modifies its own surroundings, but Men are more skilled because they tend to expand not only their own ecological niche but their eco-semiotic niche, so that, thanks to their particular form of creativity, they produce new life areas that demand ever-increasing energetic inputs.

In the end, we ought to work out an ecological "twinning" between Earth and Mars in the shortest time possible. Maybe such a twinning will allow us to reduce the consequences of the bipolar and often hypocritical policies that have heavily marked Earth's biological and ecological destiny so far. Our agenda therefore implies that we should acquire a deeper environmental knowledge, since Mars colonization could offer an opportunity to know Earth and biodiversity better and make us ready to negotiate respective ecologies with mature awareness. In order to be really ready to land on Mars we should empower our knowledge of the ecology

of biodiversity as the only defense of both the terrestrial natural and cultural capital and Martian yet undiscovered resources.

4. Ecosophy and Conclusions (rb)

The innovative and legitimate research here proposed, also involving the historical construction of cultural imagery around pre-figurative projections of appropriation of new worlds, undoubtedly requires the fundamental contributions of ecology, as we have seen, and ethics, as we are going to see. An ecosophic approach to planetary — and specifically Mars's — colonization cannot but question the multiple levels that any complex phenomenon brings into play. In this sense, in agreement with Felix Guattari's ecosophic methodology (1989), we ought to approach the present and future Mars colonization according to mind ecology, social ecology, and environmental ecology, which means taking into consideration the relations between human beings, the other species, and the whole inorganic nature in all of its vast and cosmic extensions.

If, on a purely conceptual level, there are no doubts that "humanity's new frontier can only be on Mars" (Zubrin 1994), it is also true that this unprecedented and extremely contemporary horizon of which we are all planetary witnesses is proposed by techno-science as a globalizing metaphor of its own power.

Such concept forces us to remember an essential assumption of current techno-scientific research, which invalidates many of the utopian dreams that for some years have animated a particular kind of fantastic techno-philia. This techno-philia, publicized and fostered thanks to the substantial funds of millions of dollars offered by such companies as Google[1] (which is certainly not devoted to any future public welfare but, much more prosaically, is just interested in the centralization of power and control, in market monopoly, and in current profits), has taken the names of transhumanism and post-humanism. These movements, however, are driven by the great American technological multinational companies whose acronym is known as GAFAM (Google, Amazon, Facebook, Apple, Microsoft) and whose objectives (immortality, the transplant of individual human consciousness into machines, and human migration to other planets), though intriguing and maybe desirable, are intrinsically propagandistic and tend, in fact, to build forms of neo-colonization of the imagination by manipulating human aspirations.

1 The transhumanist project is embodied by the Calico branch of Google (Californian Life Company), created in 2013 with an initial allocation of 425 million dollars. Google also finances Ray Kurzweil, the futurologist manager who directs Singularity University (SU) in Silicon Valley, active since 2008.

The essential limit of the physical world is light speed. Actually, the nearest planet to ours, which could possibly offer the same qualities of habitability for human beings, is *Proxima b*[1], which is about 4.2 light years far from Earth. This means that with the present technologies it would be reachable in about 76,000 years. This is the main limit to star migration, which also implicitly posits a conceptual limit to Mars colonization. As French geneticist Albert Jacquard claims, we are now becoming aware of the finitude of the space we have been given: "Dans l'histoire des hommes, c'est le constat de la finitude de l'espace qui nous est alloué" (2006; see also 1991). To be aware of our "internality" is something new, to which the certainty of being prisoners on planet Earth necessarily follows. This "internality" must also be framed within the global ecological crisis and the destructive apex reached by techno-scientific advancement, as philosopher Hicham-Stéphane *Afeissa* argued.

In reality, despite our grand and expensive projects of Mars colonization, the great majority of us are destined to "internality" which means most of us are prisoners on Earth. No true escape is possible from the atomic bomb, terrorism, or the ecological crisis, which is already dramatically destroying our environment.

It is this "internality" that brings to mind a tale by Marion Zimmer Bradley. In the story, a crew made of the young descendants of the Starward, sent from Earth to colonize Alfa Centauri more than one century before, is coming back to Earth aboard the Homeward spaceship. After 130 years of human life, the equivalent of five centuries of space-time contraction, they expect to find a dominant humanity that governs many other planets and is extraordinarily powerful in its technological advancement, but the reality is very different: no will of conquest has survived, and what they find is a collective, federal, self-managed life, where science has recovered its role as a place of reflection and praxis at the service of human development, and the State has been dissolved into small rural communities supportive of one another.

Finally, let us not forget that together with the awareness of physical and ethical limits, at the core of our ecosophic reflection we find what such philosophers as Holmes Rolston III and John Baird Callicott, or biochemists such as Enzo Tiezzi, propose — that is, a vision that entitles the world and the possible future worlds in

1 Proxima b (aka Pale Red Dot) is an exo-planet which revolves around Proxima Centauri, the closest star to the solar system. Its discovery was announced on 24 August 2016 by the European Southern Observatory (ESO). Proxima b is about 4.2 light years far from Earth: it has a temperature suitable for liquid water to exist on its surface, but its surface might be exposed to the ultraviolet rays coming from Proxima Centauri, which are much more intense than those we have on Earth. In that case it would not be as easily inhabitable as some believe.

their natural (co-evolutionary) aspects *the right to exist independently from human will, desires, needs, and dreams*. This means that nature, the other species, the organic beings and even the inorganic matter, the terrestrial habitats, and even the extraterrestrial territories *do have an intrinsic value beyond and despite the domineering projections of our instrumental reason.* This is a conceptual revolution which should be transmitted to the future worlds now on the verge of being colonized, no matter if they exist only in our imagination. Our imagination is never neutral. In the same way as every story has the right to be narrated (Wu Ming Manifesto, www.wumingfoundation.com), it is necessary for humans to accept the fact that whenever we imagine, dream, or plan something we are exerting a cultural, ecologic, and ecosophic hegemony.

Works cited

Guattari, Felix. *Les trois écologies*. Paris: Galilée, 1989.

Ilgenfritz Jones, Alice and Ella Merchant. *Unveiling a Parallel: A Romance by Two Women of the West* (1891). <http://www.gutenberg.org/files/42816/42816-h/42816-h.htm>

Jacquard, Albert. Congrès OCCE de Sarlat, 2006. <http://www.acgrenoble.fr/occe26/peda/jacquard.htm>

Jacquard, Albert. *Voici le temps du monde fini*. Paris: Seuil, 1991.

Kennedy, J. F., "New Frontier Speech" (1960). <http://www.jfklibrary.org/Asset-Viewer/AS08q5oYz0SFUZg9uOi4iw.aspx>

Mallove, Eugene. "Off to Explore Mars." Ed. Sykes, S. C. *Red Genesis*. New York: Bantam Books, 1991. 333-358.

Obama, Barak. "Speech at Kennedy Space Center" (2010). <http://www.nasa.gov/news/media/trans/obama_ksc_trans.html>

O'Sullivan, John. "The Great Nation of Futurity." *The United States Democratic Review*, 6 (23), November (1839): 427.

Simpson, William. *The Man from Mars*. *His morals, politics, and religion* (1891). <https://archive.org/stream/manfrommarshism00simpgoog#page/n4/mode/2up>

St John de Crèvecoeur, J. Hector. *Letters from an American Farmer* (no. III, "What Is an American?", 1782). <http://xroads.virginia.edu/~hyper/CREV/letter03.html>

Zimmer Bradley, Marion. "The Climbing Wave" (1955). *The Best of Marion Zimmer Bradley*. Ed. Martin J. Greenberg, 1985. Kindle Edition, 2013.

Zubrin, Robert. "The Significance of the Martian Frontier" (1994). <http://www.nss.org/settlement/mars/zubrin-frontier.html>

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