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Beyond the Blue Marble: Artistic research on space and ecology

Ralo Mayer

University of Applied Arts Vienna, Department of Site-Specific Art, Austria

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ABSTRACT

This paper discusses the relation of space and ecology through examples of artistic research on the closed ecological system experiment Biosphere 2 and the history of space settlements. While the idea of artificial ecological systems in space dates back to the first visions of space exploration, the best known link between ecology and space is probably the Whole Earth photos of the Apollo program. Following recent reconceptualizations of Ecology beyond the nature-culture divide I argue that this popular icon of ecology and space by now has become a limitation to both space exploration and a new ecological understanding in the Anthropocene. By interpreting Biosphere 2 as a model of our world that is not limited to biological relations but also includes socio-political aspects, culture, economy and technology, my performative research supports the idea of "Ecology without Nature" as proposed by Timothy Morton and others. Furthermore, through an artistic exploration of the local history and legacy of 1970s' space settlement enthusiasm in the San Francisco Bay Area and its ties to the later *digital frontier* and *Green Capitalism*, the paper discusses the 1990s as a pivotal transformational period for space and ecology. While so-called "globalizations" have often been illustrated by the Whole Earth image, associated developments have essentially revealed vast dimensions of space and time that have unsettled our very concept of world and are characteristic issues of the Anthropocene. At the same time, this "end of the world" could be employed to relate the Anthropocene to space exploration and rethink ecology as a theoretical framework transcending planet Earth.

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1. Introduction

Common conceptions of ecology and "outer space" make my investigations of their relations, even in the form of artistic research, often seem an unlikely combination to a general public. "Isn't space dead and empty, and ecology about nature and living systems?" Only recently their interconnections came into the public's attention again, thanks to the success of Ridley Scott's 2015 film *The Martian* and its ever-resourceful protagonist, astronaut botanist Mark Watney [1]. As an important subset of relations between the seemingly incompatible fields of space and ecology, the idea of growing plants in space has a long history that also predates that other famous spacefaring botanist from Hollywood, Spielberg's *E.T. – The Extraterrestrial* [2].

At the very beginning of human conceptualizations of space travel, Russian pioneer Konstantin Tsiolkovsky envisioned extraterrestrial greenhouses to support human life in space [3]. The very same idea continued to prominently feature in Science Fiction narratives like the 1972 movie *Silent Running* [4] and in designs for space settlements like Gerard K. O'Neill's work [5]. Controlled growing of plants and ecological recycling of air and water were also tested in real-life experiments of testing closed ecological life support systems for space exploration, like the Soviet BIOS-3 experiment [6] or Biosphere 2 in Arizona [7].

On a more peculiar level of means of artistic production, the greenhouse-motif is also linked to the very first Science Fiction movie about space-traveling, Georges Méliès' *Le Voyage dans la Lune* (1902) [8]. It was shot inside a glass-house, one of the first film studios ever built. Through the studio's construction Méliès made use of the sun for lighting his fantastic scenarios [9].

Yet the most prominent link between space and ecology was brought to us when humans traveled to the moon for real during the Apollo missions. The astronauts' various photographs of the Earth, from Apollo 8's *Earthrise* (1968) to the *Blue Marble* of Apollo 17 (1972), are an influential pictorial legacy of the classical Space Age. As a more or less unplanned byproduct of the Space Race, the Whole Earth photo spurred the public's imagination, especially the US-counter-culture of the 1960 s. The stories of Stewart Brand's campaign *Why Haven't We Seen A Photograph of the Whole Earth Yet?* and his *Whole Earth Catalog*, with their links to the rise of the Internet in the 1990s, are well explored in both academia and art [10,11]. But most importantly, the picture of our planet instantly became an icon for the new ecological movement of the 1960s and 70s.

Based on two interrelated artistic research projects I want to

E-mail address: rrralo@gmail.com

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show that the relation between space and ecology can be interpreted on a more comprehensive level. I will also argue that the paradigmatic image of this relation, the photo of the Whole Earth, has – as much as we all have come to love it – perhaps actually become an impediment for both ecological understanding and space exploration.

2. Biosphere 2

Since 2007 I have artistically investigated Biosphere 2, an experiment that has been much more controversial than the acclaimed photo of our blue planet [12]. During its first mission from 1991 to 1993, eight people lived inside this giant greenhouse in the Sonoran desert of Arizona (Fig. 1). Based on Russian geologist Vladimir Vernadsky's concept of the biosphere, the 1.27 ha hermetically sealed closed ecological system housed over 3800 species of plants and animals in eight main biomes of the Earth's biosphere, including its own ocean and rainforest. The system recycled the atmosphere and water and the so-called Biospherians grew their own food.

Unprecedented in scale and scope, the experiment was designed both to test future self-sustaining living in space as well as to explore global ecological relationships. After initial praise it was soon the target of sensationalist media reports and its scientific value being questioned by parts of the scientific community. Discussing these controversies and reflecting them in a broader historical and scientific context would go beyond the scope of this article, but has been done in great detail by other authors [12,13] as well as being addressed by several actual crew members and involved scientists [14–16].

Concerning my own work, I'm particularly interested in the wider social, political and cultural context of Biosphere 2. I understand the closed system not only as a "miniature" of Earth's biological-ecological relations, but as a more extensive model of our world and its transformations over the past decades [17]. Biosphere 2's founders have a background in the 1960s' counter-culture and theater scene of San Francisco and were highly influenced by Buckminster Fuller's idea of synergy [12]. This historical background is especially intriguing in relation to the actual contemporary context of the 1990s, specifically a general dismissal of 1960's counter-culture and its alternative lifestyles, and the era's various transformations that have shaped and are still shaping our present reality. In short, I see Biosphere 2 as a miniature world that links various utopian and alternative ideas of the 1960s and 70s, from counter-culture to space enthusiasm, with many of today's issues often associated with the epoch of the Anthropocene.

Fig. 1. Biosphere 2, photograph from 2012. Courtesy R. Mayer, O. Gemballa and Bildrecht.

2.1. The Ninth Biospherian

My artistic investigations are often based on an approach of "performative research", employing concepts of performativity for research processes [17,18]. In the case of Biosphere 2, I investigate the experiment and its history through stepping into the role of a translator that translates an imaginary novel into various media like installations, sculptures, videos, performances and texts [17]. My invention of the fictitious novel *The Ninth Biospherian* takes its premise from on an actual anecdote from the first crew of eight Biospherians. Facing individual weight loss during their mission (up to 20% per person), they wondered what would happen to this loss within the closed system and came up with the story of a ninth crew member that could have formed inside. The anecdote has been affirmed in personal communication by crew member Mark Nelson, based on his mission diary. My work employs this story, packaged as a proclaimed Science Fiction narrative tracing the whereabouts of this phantom crew member, to investigate broader implications and contexts of the experiment. The figure of the *Ninth Biospherian* becomes not only a Leitmotif of loss, most generally speaking of "futures", but foremost of the emergence of new and unexpected formations withdrawn from traditional understanding and depictions. Specifically, the phantom Biospherian "embodies" the interconnected systems of biological and cultural/technological elements as a meshwork of ungraspable relations, echoing other Biospherians' accounts describing Biosphere 2 itself as the "ninth crew member". Spread out across Biosphere 2 as matters of loss, encompassing organic molecules as much as immaterial fragments, it figuratively speaks of ecological relations as the *space in between*. In this sense, the *Ninth Biospherian* can be read as an artistic device to render aspects of a new understanding of ecology.

2.2. Biosphere 2 as "Ecology without Nature"

As a giant greenhouse, the most intriguing visual feature of Biosphere 2 to me has always been the intrinsic interweaving of technical and biological elements. Even if the facility, now run by the University of Arizona as a greenhouse, is today no longer a closed system, it still offers endless vistas of overlappings of space-frame architecture, sensors, pipes and motors with organic structures of leaves and branches and remaining smaller animals (Fig. 2). Biosphere 2's blending of technological and biological elements was frequently discussed by the media and a wider public: Is this an artificial Garden of Eden? Can humans play god? Is this some kind of Frankenstein ecosystem [12]?

Leaving these popular concerns about human hubris aside, I think Biosphere 2 is a perfect example of the collapse of the nature-culture divide, a dichotomy that is still widespread in Western

Fig. 2. Video still from *And turns and turns and I turn pages* (…), 2012. Courtesy R. Mayer and Bildrecht.

culture. When we look at pictures from inside Biosphere 2, or contemplate its rich history spanning performance, its non-Western, Russian science background as well as its impact on the public imagination up to its unintentionally inspiring later Big Brother-style TV-shows, a multilayered network of biology, culture, politics, science and technology appears.

It is an ecosystem that can be read through the ideas of French philosopher Bruno Latour, who calls for a wider understanding of ecology that is not limited to natural actors and living systems. In his book *We Have Never Been Modern*, originally published in the same year the Biosphere 2 experiment started, he analyzes the Western separation of the spheres of nature and society [19]. Latour shows that this separation has been constructed in the 17th century through the establishment of scientific and political institutions. All things in the world were allocated either to the spheres of nature or society. Science was to deal with objects of nature, politics with society. This separation is fundamental to what he calls the Modern constitution of our Western world, and it's the base for Western society feeling superior to so-called primitive cultures with their magic objects, spirits and oracles. And while this separation had always been an artificial construction, it began clearly collapsing throughout the 20th century. With nuclear power humans interfered in the very substance of nature, with genetic engineering in life itself. This is where Latour argues for his new ecology, networks of both animate and inanimate, real and imaginary objects that shape today's world. Such an ecological understanding is also central to tackle “environmental” issues like Climate Change that are in fact made up of countless objects and actors: living systems, economy, resources, politics, and everyday culture.

A related ecological reconceptualization beyond the nature-culture divide can be found in the work of philosopher Timothy Morton. Disputing ecological views of nature as an environment that surrounds humans and society, he proposes an “ecology without nature” [20]. Beyond often populist criticisms and specific scientific debates, the experiment of Biosphere 2 can be interpreted as a conspicuous rendering of ecology that includes biological, technological and social systems – an *ecology of the Anthropocene*. Discussions of this proposed geologic epoch often include the question of its temporal starting point. Suggested temporal markers include the industrial revolution with its use of fossil fuels or the first nuclear explosion in New Mexico. Space archeologist Alice Gorman describes the Anthropocene as a cosmological phenomenon [21], arguing that Earth has always been linked to space through sunlight, meteorites or cosmic radiation. Regarding the expansion of human activities, the beginning of the Anthropocene could be marked with the launch of Sputnik, when human culture left the planet and went into space.

Biosphere 2's ecological approach might also be read akin to Donna Haraway's cyborg analysis of the (human) body. Ecology has never been about so-called nature, and “we have never been human” [22]. Every human being is a biome of billions of microorganisms. Biosphere 2 is a cyborg-ecosystem as much as our present world is. I find it extremely interesting that the often criticized, if not unfairly ridiculed experiment of Biosphere 2 displays a very contemporary ecological approach based on its basic premise of testing the feasibility of future self-sustaining space settlements. In contrast to the often clichéd visiotype of the Blue Marble [23], it offers a radically new perspective on the link between space and ecology that challenges an idealized traditional concept of nature and tackles present and future issues on Earth and beyond.

Working as a research-based artist myself, I find it intriguing that the founders of Biosphere 2, coming from a background of theater and performance, designed their experiment through a deep integration of artistic and scientific methods. This very idea of connecting art and science was another major point of criticism in the early 1990s. Can theater people do science as well? Are they allowed to do so? [12].

Fig. 3. *Proposal for a Monument at Lagrange 5, Dedicated to the Lost Space Age*, 2008. Exhibition view at Secession, Vienna. Courtesy R. Mayer and O. Ottenschläger (photograph).

2.3. Artistic approaches to Biosphere 2

One of my first exhibitions on Biosphere 2 was shown in 2008 at the Secession in Vienna. The installation included a 34 min. video essay and various sculptural works. One of these objects was a small ecosystem in a glass sphere (Fig. 3), manufactured by the same company that had widely advertised these so-called ecospheres as novelty interior design objects in the 1990s. Invented by Clair Folsom in the 1960s, such a system contains algae, seawater, shrimp and microorganisms [24]. Given a regular source of light, its ecological cycle could virtually sustain itself indefinitely. Hanging right at the entrance of the exhibition space, the glass sphere sculpture offered a simple introduction to closed systems to a non-specialized audience that, in the case of Vienna's sightseeing landmark Secession, often included tourists without any background in art or science.

Through the sculpture's title, *Proposal for a Monument at Lagrange 5, Dedicated to the Lost Space Age*, I referred to the long history of planned space settlements, especially to 1970s designs that were supposed to be built at the Lagrange 5 point by the year 2000 [5]. Leaving aside specific issues like cosmic radiation etc., I like to imagine my monument to be placed at the L5 point, remaining there until perhaps hit by some micrometeorite and then being vapor-frozen into some new bizarre sculpture.

After a series of other installations on Biosphere 2 that would often employ various textual strategies between fact and fiction, the video installation *frnknst9n Invocation (There's something lurking in-between)* (15 min, 2013) left out any textual information. Having collected dozens of hours of both historical archival material and my own video footage from inside today's Biosphere 2 facilities, I intended to create a visual celebration of the experiment and my interest in it. Employing a hypnotic, repetitive soundtrack, the video is a mash-up of audiovisual footage ranging from 16 mm, VHS, Hi8 to digital HD and time-lapse photography.

Instead of traditional editing, I made use of so-called “data-

Fig. 4. Video still from *frnknst9n Invocation* (*There's something lurking in-between*), 2013. Courtesy R. Mayer and Bildrecht.

moshing", a digital media technique of corrupting the very data and video codec of files [25]. This technique results in the "digital blurring" of scenes through pixels and vectors, or – more visually explained – in what looks like higher-dimensional beings erupting from "digital slime" (Fig. 4). Like *The Ninth Biospherian*, these digital phantoms are appearing in between the variety of footage of three decades. The monster, like Frankenstein's creation, is patched up from highly diverse parts, a formation that also resembles Biosphere 2's approach of bringing together species from all over the globe. The stitches and seams come into the center of attention. Like in ungraspable meshworks of ecological relations, "there is something lurking in-between".

3. Space Colonies and the San Francisco Bay Area

Extending my research about Biosphere 2, I began investigating the history of ideas for space settlements, specifically a widespread enthusiasm for space colonies in the 1970s. This movement was mostly catalyzed by the bestselling work of Gerard K. O'Neill [5] and promoted through the grassroots organization L5 Society, named after the proposed location at Lagrange 5 [26]. It brought together a diverse range of people, from engineers and physicists to counter-culture protagonists like Timothy Leary and Stewart Brand or free-market libertarians [27,28]. After the publication of the Club of Rome's *The Limits to Growth* in 1972 the idea of space settlements to them seemed like a perfect solution for predicted overpopulation, dwindling resources, the oil crisis, and increasing pollution of our planet. Their designs' main economic rationale was solar power stations in orbit. These would not only fuel the energy needs for the rotating colonies, but also for Earth after the depletion of fossil fuels [5].

During a two weeks trip to the San Francisco Bay Area in 2013, I investigated the local legacy of space enthusiasm and recorded two video interviews with Al Globus, NASA's space settlements archive's curator [29], and Rick Guidice, who created some of the most iconic illustrations for O'Neill's designs in the 1970s [30]. Both Globus and Guidice confirmed the various links of the movement to the socio-political transformations of the 1960s and 70s, as well as a sociopolitical change in space enthusiasm over the 1980s parallel to the Reagan administration. The L5 society's support of Reagan's SDI program and its subsequent merge with the National Space Institute in 1987 made Globus and others even leave the former grassroots organization. In his interview, Globus also gave a detailed personal account of adopting the term "space settlement" due to the historical and political connotations of "colony".

Fig. 5. *SF Colony* (*Space Post Colonialism*), 2014. Digital collage of a 1975 illustration by Rick Guidice and a 2013 San Francisco neighborhood. Courtesy R. Mayer and Bildrecht.

3.1. Space Post Colonialism: Vertigo of space and time

It's a curious overlapping of real and imaginary geographies that many space settlement designs for curved worlds at the High Frontier were drafted around San Francisco [31], where curving streets often disappear in the Pacific fog, and where the Pacific Ocean also manifested a topographical end of the classical American frontier (Fig. 5). Traveling the Bay Area, I stumbled upon a range of other links and serendipitous discoveries. Almost unintentionally these fragments generated a multilayered narrative that I later translated into the video and installation work *Space Post Colonialism* (mixed media, 2013–2015) (Figs. 6 and 7).

The idea of space settlements had more or less faded out of the public's eye by the 1990s. A big part of space exploration projects was no longer about establishing human outposts in the solar system, but focusing on Earth Science and research about various environmental issues, from studying the Ozone layer to Global Warming. At the same time, *cyberspace* was being declared the "new frontier", and the Bay Area became its epicenter. The silicon first thought to be the raw material for solar power stations in space had now become the eponymous material for the chip-based economy and culture of Silicon Valley. Steve Job's famous description of the *Whole Earth Catalog* as "Google in paperback form, 35 years before Google came along" at Stanford University

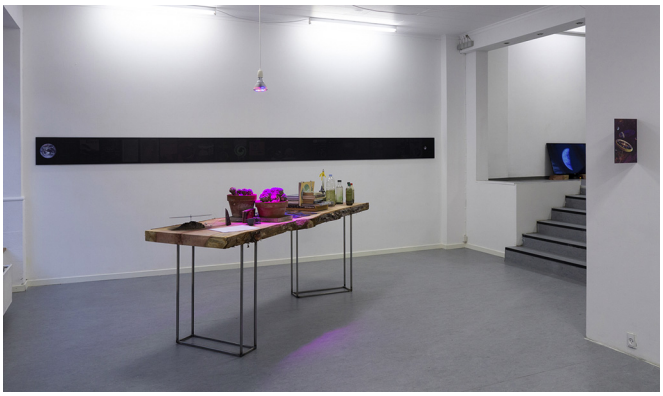

Fig. 6. Exhibition view of *Space Post Colonialism* at X AND BEYOND, Copenhagen, 2015. Redwood display with mixed media, scaled distance between the Earth and Moon (background wall) and proposed settlement location at L5 (right wall). Courtesy R. Mayer and Bildrecht.

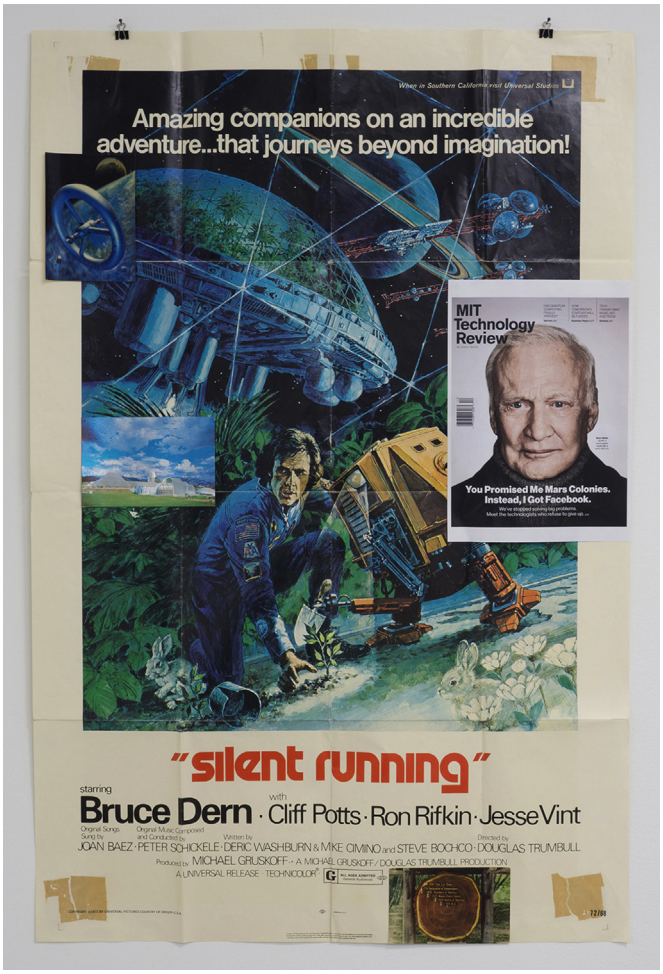

Fig. 7. Exhibition detail of *Space Post Colonialism* at X AND BEYOND, Copenhagen, 2015. Collage of printed material on top of an original poster of the movie *Silent Running*. Courtesy R. Mayer and Bildrecht.

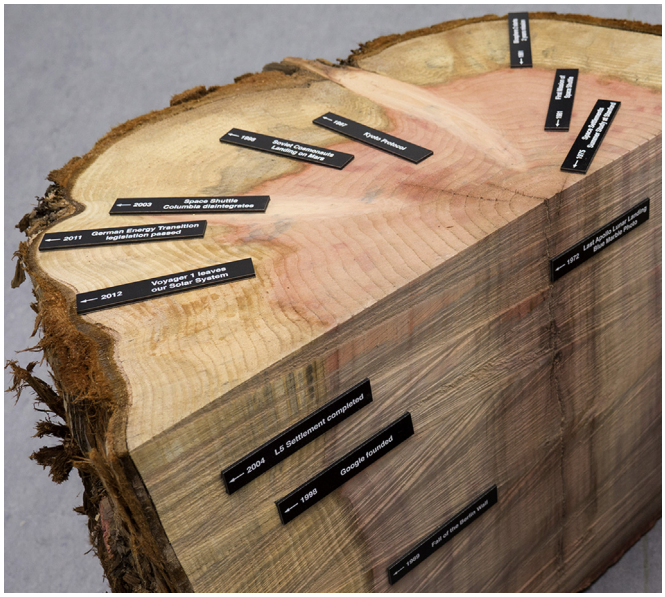

Fig. 8. Exhibition detail of *Space Post Colonialism* at X AND BEYOND, Copenhagen, 2015. A log of a sequoia tree, planted around the time of Apollo 17. Referring to annotated tree disks, its growth rings become a display for historical and fictitious developments since 1972. Courtesy R. Mayer and Bildrecht.

[32] only added to the picture. During the time of my visit, Apple Computers (so far located at 1 *Infinity Loop* in Cupertino) had just begun construction of its new headquarters, shaped like a doughnut, or like a Stanford Torus type space settlement. It soon earned the moniker *Spaceship Campus*. The actual giant solar power stations being built in the Californian desert in the past years are an example of the region's growing new economy of so-called Green Capitalism, from *Whole Foods* supermarkets to electric cars, built by Elon Musk's *Tesla Motors*.

During my trip I also visited the famous Redwood forests, their giant Sequoia trees prominently featured in Hitchcock's *Vertigo* [33] and in Chris Marker's films *La Jetée* [34] and *Sans Soleil* [35]. Like in Vertigo's title sequence by Saul Bass, the past, present and future created overlapping spirals resembling the gravity-inducing movement of my research subject. The growth rings of a thousand years old Sequoia tree suddenly looked like an abstract depiction of a rotating space settlement. I envisioned the Redwood parks' famous annotated tree disks displaying a *vertigo of ecology and space* (Fig. 8).

4. The 1990s: from the End of History to the End of the World

In both aforementioned and other art projects I have revisited the time period of the 1990s. It's an era of global transformations that I had also witnessed as a teenager myself. The decade's transformations, like political and economic changes after the Cold War, new communication and information technologies, and a growing awareness for global environmental issues, have often been subsumed under the vague term of *globalization*. These so-called globalizations were frequently illustrated by the Apollo program's *Whole Earth* photo. From climate change to the promises of world wide telecommunication and the free flow of digital information, the photo became globalization's ubiquitous icon. Al Gore, who promoted both the *information superhighway* and environmental consciousness as US vice president, would later feature the image throughout his documentary *An Inconvenient Truth* [36].

Despite its undisputed beauty, the photo perhaps initiated a development of no longer looking outwards but instead back towards Earth. In the late 1980s NASA established its *Mission to Planet Earth* and a focus on Earth Science [37], figuratively a new *geocentrism*. Did the popular impact of the *Whole Earth* photo actually stop human space exploration beyond the Earth orbit? And furthermore, does it really depict our world and its ecology, anyway?

Timothy Morton argues that the end of the world has already happened through the emergence of so-called *hyperobjects*, ungraspable entities of vast temporal and spatial dimensions, like global warming [38]. I would situate this end of the world, which Morton also ties to the Anthropocene, right within the transformational period of the 1990s. Instead of the infamous *End of History*, declared by Francis Fukuyama after the end of the Cold War [39], the 1990s brought us the *End of the World*. Global warming or digital technologies unsettle our very concept of world by revealing incomprehensible layers of reality. On a cosmic scale, such vast dimensions of space and time have become known through astronomy and space exploration.

Paradoxically, one of the best known images from space, the *Whole Earth* photo, has perhaps become a smokescreen. Ostensibly picturing a globalized view of our planet, it does no longer depict our world at all. On the other hand, the 1990s also brought alternative views. As I have briefly sketched out, the often-criticized Biosphere 2 exemplifies an alternative approach to ecology beyond the nature-culture divide. In Science Fiction, Kim Stanley Robinson's *Mars trilogy* about the terraforming of Mars described

Fig. 9. Reinterpretation of the iconic Aldrin bootprint. Digital collage, 2014. Courtesy R. Mayer and Bildrecht.

technological, economic and political scenarios of life beyond Earth, a truly new and non-terrestrial ecology [40–42]. And on February 14th, 1990, NASA's Voyager 1 probe sent us a notably differing depiction of our planet, the tiny half pixel of the *Pale Blue Dot*.

5. Conclusions

While the blockbuster movie *The Martian* has recently popularized the long historical relationship between space exploration and ecology, I argue that the space-ecology complex today reveals broader implications that go beyond an astronaut's survival on Mars through growing potatoes. Employing performative approaches of research my work contextualizes Biosphere 2 and the history of space settlement designs with various social, technological, cultural and economic developments since the 1970s. Based on theories of ecology beyond the nature-culture divide I link both Biosphere 2's history and background and the legacy of 1970s space colony enthusiasm to current discussions of the Anthropocene.

Whereas the photo of the Whole Earth–as an icon of ecological awareness–has branded the relation of space and ecological ideas since the late 1960s, I propose that this image by now limits both ecological thinking and potentialities of space exploration beyond Earth Science. The image's inflationary and indiscriminate use in the 1990s parallels that era's crucial role as a transformational period not only for global developments in general, but also for space exploration and ecology. The Anthropocene has been suggested to begin with the era of spaceflight. Based on my artistic research I would like to support this definition. Our planetary biosphere has always been linked to space both energetically and materially. In the Anthropocene, we are now not only actively involved in the shaping of our own planet, but of worlds beyond (Fig. 9). Ecology has never been limited to earthly affairs. Paraphrasing Bruno Latour and Donna Haraway with some poetic license, I claim that *We Have Never Been Earth*.

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Ralo Mayer is an artist, writer and filmmaker based in Vienna. Employing a practice of performative research, his work delineates "ecologies of contemporary history" and has been shown internationally and awarded several prizes and scholarships. As a co-founding member of the self-organized Manoa Free University (2003–2008) he started the research series *HOW TO DO THINGS WITH WORLDS* on performative aspects of models. Since 2007 he creates transmedia translations of the SciFi novel *The Ninth Biospherian*. Mayer teaches at the University of Applied Arts in Vienna. http://was-ist-multiplex.info.