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Space and the planet: taking the extra-planetary seriously in planetary thinking

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Abstract. In light of recent developments in space technology, services and commercialisation, human geographers have started to consider space exploration and extractivism as areas of critical concern. A debate that has not yet fully embraced the extra-planetary, however, is that on planetary thinking, in which scholarship has to bracket out the space environment to some extent in that it represents a mere distraction from the actually important terrestrial crises. Against such a background, the present intervention engages with the relations between the planetary and the extra-planetary, advocating explicit consideration of the latter in critical planetary thinking – notably not as a diversion from but rather as a reinforcement of the need to engage with earthly concerns. To elaborate its argument, the text first reconstructs the disregard of the extra-planetary in planetary thinking by revisiting two books that have shaped the contours of the related debate: Bruno Latour's *Down to Earth* and Donna Haraway's *Staying with the Trouble*. It then critically reflects on "Humans on Mars", a publicly funded research initiative at Bremen University which justifies an expansionist agenda by adopting a planetary mindset, or at least planetary rhetoric. Conceptualising the extra-planetary as imagined-and-real counter-space, planetary scholars are finally being called upon to connect with off-Earth ecosystems, weaving their non-human and more-than-human components into a cosmopolitical ethics of care and responsibility. At the same time, a *rupture pratique* is suggested which, in turn, designates the extra-planetary as a space in which there is literally no room for humans and certainly not for the very frontier expansionist and extractivist practices that have resulted in socio-ecological crises on planet Earth.

1 Introduction

On the evening of 14 November 2023, traffic was jammed for hours in the area around the exhibition centre in the city of Bremen in Northern Germany. Stacks of burning tyres had blocked off the street behind the exhibition halls, and fireworks had been thrown against the facades. Inside the centre, the European space community met for *Space Tech Expo/Europe*, the continent's largest event for space technology and services. A day later, the local newspaper reported that the networking event continued undisturbed by the attack (Barth, 2023). Furthermore, a confession letter was published online by anti-militarist environmental activists who blamed the aviation and aerospace industry not only for being one of the central players of the defence industry but also for selling ecological destruction as progress (Anonymous, 2023).

I recall these events in order to illustrate how close, at least in Bremen, the local is linked not only to the global and the planetary but also to the extra-planetary. While it can be argued that every place on Earth is related to outer space in one way or another, it seems that Bremen is particularly tightly connected to the universe. Accountable for the close bonds the *Space Tech Expo* testifies to are a large number of aeronautics and space companies based in the self-declared "City of Space" (Aviaspace Bremen, 2024). According to the local economic development agency, more than 140 companies and 20 institutes with around 12 000 employees "generate over 4 billion euros a year" (Bremeninvest, 2024). Due to players "such as the Airbus Group, ArianeGroup, Rheinmetall Electronics, OHB, and their suppliers", Bremen is said to "play a leading role in shaping the national and European space programs" (Aviaspace Bremen, 2024). The *German*

Offshore Spaceport Alliance's mission to install, from Bremen as the "home port" (https://www.offshore-spaceport.de/en, last access: 15 August 2025), a floating space port for small carrier rockets in the North Sea is emblematic of the ever-increasing use of (near-Earth) outer space for both civil and security purposes by a growing number of actors.

In light of the significant role Bremen is playing in the continuing "humanization of the universe" (Dickens and Ormrod, 2007), this paper suggests actively engaging with the extra-planetary. In so doing, it makes reference to an argument put forth by Fraser MacDonald, who, as early as in 2007, addressed a wide range of space-related topics for a critical geography. My echo of the appeal to "establish outer space as a mainstream concern of critical geography" (MacDonald, 2007:592) does not imply that MacDonald's call went unheard. In particular, the fields of geopolitics (e.g. Dalby, 2015; Klinger, 2021), political economy (e.g. Beery, 2012; Cheney, 2024) and (visual) culture (e.g. Geppert, 2012; Lane, 2011) have contributed to a certain interdisciplinary "'turn to space"' (Dunnett et al., 2019:315), as it has been seen in the last decade in response to a surge of interest in space exploration (for an overview of the "new space race", see Pekkanen, 2019).

A debate that has not yet fully embraced the extra-planetary, however, is the one on planetary thinking. While Mould (2023), for instance, makes at least some reference to (outer) space, Verne et al. (2024), in their keynote of the 62nd Geography Congress in Germany, Frankfurt am Main, manage entirely without it. This void, to me, is remarkable in two ways: on an epistemic level, where concepts grow out of distinctions, I find it hard to conceive of the planetary without some defining "counter-concept" (Junge, 2011:25). Just as the global made sense in the face of the local in globalisation thinking, the planetary calls for its opposite – and, in my view, the extra-planetary is a manifest candidate. In more practical terms, the events that took place in Bremen on 14 November 2023 epitomise how near outer space has become and how important it is to "look beyond our Earthly provincialisms that anachronously place the Moon and near-Earth outer space beyond the purview of global political economy and hence, of critical concern" (Klinger, 2017:26).

Having said that, I am sympathetic with anyone who defends, in Klinger's words, their Earthly provincialisms in order to make Earth a better place. Put differently, I understand why, "in the light of multiple crises" (Verne et al., 2024:164), scholarship has to bracket out the space environment to some extent in that it seems to be a mere distraction from the actually important terrestrial matters. In the fight "for social, environmental, climate and yes, planetary justice" (Mould, 2023:10), Earth-centredness is as mandatory as it is an integral part of the political identity of debate itself. However, by not engaging with outer space, planetary thinking is able to neither challenge the frontier expansionist projects of space-promoting organisations nor criticise the social–ecological cost of spaceflight activities and their unequal allocation.

In the light of this dilemma, this intervention engages with the relations between the planetary and the extra-planetary, suggesting explicitly "bracketing in" the extra-planetary into critical planetary thinking – notably not as a diversion from but rather as a reinforcement of the need to engage with earthly concerns. In order to develop my argument and explicate why planetary thinking, in my view, should engage with the extra-planetary, I proceed in three steps. I will first reconstruct the disregard of the extra-planetary by revisiting two books that have shaped the contours of planetary thinking: Bruno Latour's *Down to Earth* and Donna Haraway's *Staying with the Trouble*. I will then return to the starting point, i.e. space flight and exploration activities in the German "City of Space". More specifically, I will critically reflect on "Humans on Mars", a publicly funded research initiative at Bremen University which initiated my own conceptual thinking about the extra-planetary.[1] Arguing that outer space is more than a mere backdrop for SF fabulations (cf. Haraway, 2016) or the imagined vantage point of the Galilean Global (cf. Latour, 2018), I suggest radically extending the scope of planetary concerns by conceptualising the extra-planetary as imagined-and-real counter-space.

2 Disregarding the extra-planetary: *Down to Earth* and *Staying with the Trouble*

In 20 short chapters, *Down to Earth* pursues the hypothesis that "we can understand nothing about the politics of the last 50 years if we do not put the question of climate change and its denial front and center" (Latour, 2018:2). According to Latour (2018:3, orig. emphasis), the climate crisis "is at the heart of all *geopolitical* issues and . . . directly tied to questions of injustice and inequality". In order to map the political landscape of the present and to familiarise readers with "the New Climatic Regime" (Latour, 2018:subtitle), Latour suggests turning "away from the Global . . . and toward the Terrestrial" (Latour, 2018:66) as a political reorientation.

It is of particular interest in the context of this intervention that Latour relates the Global to Galileo and the latter's revolutionary idea of seeing the Earth "as one planet among others, immersed in an infinite universe of essentially similar bodies" (Latour, 2018:67). As a consequence, Latour's Global stands for grasping "all things from *far away,* as if they were *external* to the social world and completely *indifferent* to human concerns" (Latour, 2018:66–67). Contrary to this perspective, the Terrestrial "grasps the same structures from *up close,* as *internal* to the collectivities and *sensitive* to human actions" (Latour, 2018:67). To further illustrate the contrast, Latour designates James Lovelock as the

[1] I was initially involved in the research initiative as a member of its core team. For reasons of (research) ethics, I will not be drawing on internal information but rely exclusively on publicly available material.

godfather of the terrestrial.[2] Represented as Galileo's counterpart, Lovelock is praised by Latour for having considered "living beings as agents participating fully in the processes of generating the chemical, and even in part the geological, conditions of the planet" (Latour, 2018:75).

In his juxtaposition of the Global and the Terrestrial, Latour portrays the extraterrestrial as an abstract, somewhat negative entity. Although (or precisely because) the book urges its readers to land somewhere on Earth – *Où atterir?* asks the French title – outer space is bracketed in the book, on page 30 even literally. In the bracketed passage, those "who want to escape from the problems of the planet by moving to Mars" (Latour, 2018:30) are accused of adhering to an "extreme form of 'neo-hyper-modernism"' which is said to be "of no importance" for the book. The only place in outer space, apart from Mars, that is named at all is Sirius, but it is "a Sirius of the imagination, to which no one has ever had access" (Latour, 2018:68). Later in the book, the imagined Sirius is given the role of the vantage point of the Galilean Global. In other words, Sirius, for Latour, serves as the "nowhere", the "Great Outside" (Latour, 2018:68), from which modern science has come to view, measure and know the Earth.[3] It is not surprising, therefore, that, for Latour, the view from Sirius ultimately obscures the Earth (Latour, 2018:89).

While Latour thus engages with the extra-planetary, albeit in a highly critical manner, Haraway, in *Staying with the Trouble*, seems to omit it completely. Focusing less on spatial constellations than on temporalities – such as "Anthropocene, Capitalocene, Chthulucene" (Haraway 2016:30) – *Staying with the Trouble* is more down-to-earth than *Down to Earth* in its strict focus on, in Latour's words, "terrestrial" matters. Haraway situates the concern of her book in the "nice space" of Terrapolis (Haraway, 2016:16). As "a speculative fabulation" (Haraway, 2016:11), Terrapolis is inhabited by "critters" (Haraway, 2016:10), "partners" (Haraway, 2016:12) or "companion species" (Haraway, 2016:10) who do not exist in epistemic isolation but "are relentlessly becoming-with" (Haraway, 2016:12) in "worldly subject- and object-shaping entanglements" (Haraway, 2016:13).

Hidden between many allusions, enumerations and repetitions, and thus in keeping with the book's troubling style, references to the extra-planetary only become apparent at second glance. For me personally, "terraforming" has been the most obvious.[4] According to the communication scholar Derek Woods (2019:7), the term was coined by American science fiction writer Jack Williamson in *Collision Orbit* (1942) in order "to name massive engineering projects to modify asteroids". It entered the *Oxford English Dictionary* in 1993, where it has been until today defined as the "process of transforming a planet into one sufficiently similar to the earth to support terrestrial life" (Online Oxford English Dictionary, 2024).

It is interesting to note that Haraway, in her usage of the term, reverses direction: what is terraformed, in *Staying with the Trouble*, is not some distant, distinct planet but planet Earth itself.[5] Haraway conceives of terraforming as an earthly practice that companion species, above all bacteria, are engaged in: "Of course, from the start the greatest planetary terraformers (and reformers) of all have been and still are bacteria and their kin, also in inter/intra-action of myriad kinds (including with people and their practices, technological and otherwise)" (Haraway, 2016:99). In today's struggle against imperialist exploitation and resource extraction, it is time for Haraway "to return to the question of finding seeds for terraforming for a recuperating earthly world of difference" (Haraway, 2016:121).

Haraway is not the only one to reverse direction. Over the past few decades, with the increasing fear of global warming, terraforming has evolved from a science fiction fantasy about the habitability of *other* planets to "a figure for both intentional geoengineering and accidental climate change" (Woods, 2019:7), i.e. something that takes place on (or near) planet Earth. Having said that, Haraway is far from promoting technological solutions for planetary challenges and harshly criticises what she calls "a comic faith in technofixes" (Haraway, 2016:3). At the same time, and despite Haraway's stipulation of "eschewing futurism" (Haraway, 2016:4), science fiction,[6] or rather "SF", is a "ubiquitous figure" (Haraway, 2016:2) in *Staying with the Trouble*. Standing for "science fiction, speculative fabulation, string figures, speculative feminism, science fact, so far", SF, for Haraway, is "not fundamentally a genre" but "a mode of attention, a theory of history, and a *practice of worlding*" (Haraway, 2016:213; emphasis added).

Given the parabolic nature of science fiction, it seems reasonable indeed to think of SF as a practice of worlding. By imagining speculative worlds and situations, SF texts seek to respond "to the political, social, economic, or cultural challenges of the times in which they are written" (Hannah and Mayer, 2020:191), allowing their readers to engage with real-world concerns in the modes of "as if" or "what if" (see also

[2] Somewhat ironically, Lovelock worked at NASA and became involved in the search for life on Mars while he developed, with Lynn Margulis, the Gaia hypothesis (Highfield, 2019).

[3] Sirius as a vantage point of the Galilean Global resonates with Haraway's "god trick" of so-called "objective" science (Haraway, 1988:581).

[4] Readers may also be familiar with the "Terraforming Mars" board game.

[5] According to Woods (2019:8), the idea of terraforming Earth is based on "a rhetorical tautology that includes the same term in both the subject and object of the phrase; or a logical paradox because 'terraforming earth' suggests that earth is both the cause and the effect of itself".

[6] While Chap. 4 makes explicit reference to Kim Stanley Robinson, the content of Chap. 6 is largely influenced by the writings of Octavia Butler and Ursula K. Le Guin.

Attoh et al., 2024). As US science fiction writer Howard Hendrix aptly writes, "Whenever we look at Mars, we are looking at the mirror of our own cultural dreams and concerns" (Hendrix et al., 2011:2). It can be argued, however, that drawing on SF as a practice of worlding has the same effect as reversing direction in terraforming, i.e. from terraforming *other* planets to terraforming *Earth*. By using places in outer space as backdrops for *real-worldly* stories, outer space is reduced to a "speculum" – derived from the Latin word for "mirror" – and subsumed under the Earth's horizon. Overcoming this Earth-centredness, however, would be a prerequisite for a planetary way of thinking that is capable of dealing with the extra-planetary as a space of "multiple geographies" (Liodaki et al., 2024) and, what is more, of considering extra-planetary places as real and concrete, i.e. not merely abstract and fictional.

3 Frontier expansionism in the "City of Space": "Humans on Mars"

The attack on *Space Tech Expo/Europe*, which took place on 14 November 2023 in the city of Bremen, appears to have been directed towards local exhibitors in particular. In the confession letter, reference is made not only to the five largest local employers in the industry, but also to smaller companies and institutions, amongst them "the city and its university (Humans on Mars)" (Anonymous, 2023). Under the title "Humans on Mars", colleagues of mine at Bremen University are developing a "vision for human Mars exploration made in Bremen" by investigating "pathways to a long-term sustainable human presence" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/our-initiative, last access: 15 August 2025).[7] Launched by MAPEX – Center for Materials and Processes at the University of Bremen – and funded by the federal state of Bremen (Busch, 2023), the interdisciplinary team is made up of members of 8 faculties (out of a total of 12), including social sciences, and 4 extramural research institutes (https://www.uni-bremen.de/humans-on-mars-initiative/team/participating-institutions, last access: 15 August 2025). Seven individual projects have been set up (Busch, 2023), three of which I briefly touch upon.

The first one is concerned with the "living habitat", i.e. extraterrestrial habitation equipped with a life support system that enables humans to survive in environmental conditions that would otherwise be lethal to them. The "living habitat" consists of three components: the (human) crew, a life support system, and networks of sensors which "monitor both life support system and crew" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/research-projects/the-living-habitat, last access: 15 August 2025). The experiments related to this project are carried out in the MaMBA laboratory at one of the four extramural research institutes involved in the initiative, namely the *Zentrum für Angewandte Raumfahrttechnologie und Mikrogravitation* (ZARM). MaMBA, "short for Moon and Mars Base Analog" (Heinicke et al., 2020:404), has been developed to fill the lacuna of a "coherent and functional prototype for a lunar or Martian base" (Heinicke et al., 2020:404).

According to the MaMBA website, a habitat "must enable astronauts to survive in an extraterrestrial environment" (https://www.zarm.uni-bremen.de/en/research/mamba-moon-and-mars-base-analog, last access: 15 August 2025). The question of why humans must survive on the Moon or Mars in the first place is neither asked nor answered on the MaMBA website or in the MaMBA paper. As Messeri (2016:18) explains in her ethnography in the field of planetary sciences, exploration "is an unquestioned good for … planetary scientists". While this may be true or not for my colleagues in Bremen, I find it important to note that it is primarily the aspiration, if not the desire, for human settlement on Mars and for living and working on Mars that makes the living habitat project in "Humans on Mars" seem rational and essential.

The same can be said of the second project, which aims at "a continuous provision of consumables" for "a long-term human presence on Mars" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/research-projects/sustainable-bioproduction-on-mars, last access: 15 August 2025). To achieve this aim, "sustainable bioproduction processes" are being developed that combine "microbes and plants to produce essential resources, from fertilizers to food to bioplastics to oxygen, as well as to recycle organic waste – all starting from materials available in Mars's ground and atmosphere" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/research-projects/sustainable-bioproduction-on-mars, last access: 15 August 2025). To put it simply, the idea is to farm microbes, on Mars, which are able to photosynthesise under Martian conditions. "Fed" by their human farmers with Martian regolith, i.e. Martian soil, these microbes are meant to grow and produce either oxygen or nutrients for other organisms like plants which, in turn, are presumed to be the source of a variety of consumables. The project lead is also at ZARM, namely the Laboratory of Applied Space Microbiology. In a paper published in *Applied and Environmental Microbiology*, members of the lab's team suggest using *Anabaena* sp. PCC 7938 "as a model cyanobacterium for the development of bioprocesses based on Mars's natural resources" (Ramalho et al., 2022).

The two projects, i.e. housing humans on Mars ("The living habitat") and sustaining them by means of bioprocesses "based on Mars' natural resources" ("Sustainable bioproduction on Mars"), obviously convey a "manned" form of fron-

[7] Unless otherwise indicated, all quotations in this chapter are drawn from the initiative's website (https://www.uni-bremen.de/en/humans-on-mars-initiative/, last access: 15 August 2025).

tier expansionism.[8] Frontier expansionism refers to the belief or ideology that a nation, civilisation or group should expand its territory or influence into "new", allegedly unknown, areas, in the name of a "grand narrative" (Lyotard, 1979) like progress, growth or God-endorsed manifest destiny. The "grandness" of the narrative, in turn, naturalises expansion and downplays "the significance of what existed prior to the arrival of the brave explorers and settlers" (Kearnes and von Dooren, 2017:6). Most commonly associated with the violent colonisation of the American West in the 19th century, the frontier concept was, in the Cold War era, applied to space (see, for example, Sage, 2014). The popular depiction of the latter as "the final frontier" "evokes extraterrestrial places as sites that demand intervention, with evident colonial logics that work to legitimate expansion and exploitation" (Hunter and Nelson, 2021:231). Social and cultural anthropologist Anna Tsing (2003), for whom the frontier represents a "travelling concept" (2013:5101) in the history of capitalist expansion, has paid particular attention to the "resourcefulness" of the frontier, highlighting the extractivist dimensions of "frontier-making" (2013:5105).

Resource extraction brings me to the third project. Assuming the production of metallic materials on Moon or Mars to be "a challenging but essential task", it aims at "developing a new electrochemical process for the synthesis of alloyed metal powders" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/research-projects/extraterrestrial-fabrication-of-metal-alloys, last access: 15 August 2025). Under the title "Extraterrestrial fabrication of metal alloys", Martian regolith is supposed to be mined to allow for the extraction of metallic material. Again, the plausibility of the very idea of producing metal alloys on another celestial body remains unchallenged. More explicitly than in the previous projects, however, reason is derived from the will to make Earth a better place, specifically by contributing to "an emission-free and energetically sustainable metallurgy on Earth" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/research-projects/extraterrestrial-fabrication-of-metal-alloys, last access: 15 August 2025). To that end, the use of fossil carbon sources as an energy source in production is intended to be replaced by solar radiation. Energy generated from solar radiation, in turn, is supposed to support "a novel (bio)electrochemical reactor" in which "microorganisms will be employed both to selectively extract specific metal ions from the regolith and to actively support the electrochemical reduction" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/research-projects/extraterrestrial-fabrication-of-metal-alloys, last access: 15 August 2025).

As the mining project illustrates, "Humans on Mars" is not only about the human exploration of Mars but also, somewhat surprisingly at first sight, about preserving Earth. According to my colleagues, "the thin CO_2 Martian atmosphere, the scarcity of energy sources and water, the difficulties to produce food and consumables, and the need for cooperative human-robotic crews all present challenges whose solutions will be of enormous benefit to Earth" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/our-initiative, last access: 15 August 2025). The argument of "learning from Mars to protect Earth" (https://www.uni-bremen.de/en/humans-on-mars-initiative/research/our-initiative, last access: 15 August 2025) resonates with wider discourses among space actors on the benefits of space exploration in general[9] and "space sustainability" (e.g. Martinez, 2020) in particular. In the context of the latter, the concept of "sustainability from space" (Wilson and Vasile, 2023:3) represents space "as a platform to directly or indirectly address global problems".[10] The underlying logic has obviously been adopted by UNOOSA (United Nations Office for Outer Space Affairs) (2021), which depicts space activities as "essential tools for realizing the achievement of the Sustainable Development Goals" (UNOOSA 2021:1).

4 Taking the extra-planetary seriously as imagined-and-real counter-space

The Hanseatic city of Bremen was a centre of German colonial endeavours in the late 19th century; in the colonial revisionist movement of the 1930s, Bremen even laid claim to the title of the German "City of the Colonies" (see, for example, Aselmeyer and Kamche, 2024; Lossau, 2019). Around a century later, there are plans afoot for a new expansionist undertaking. Although the term "colonisation" is avoided on the "Humans on Mars" website, my colleagues nevertheless seek to establish a human presence on Mars. Characterised by a frontier logic of exploration and exploitation, their vision

[8] While the term "manned" (*bemannt*) is still frequently used in German in relation to spaceflight, it has become common in English to speak of "human spaceflight". My use of the word "manned" is hence deliberate, for the following two reasons: first, I aim at highlighting the masculinist history and gendered coding of spaceflight research and practice (see Deerfield, 2019). Secondly, the term "human spaceflight", like "human space exploration" and "human presence in space", resonates with the universalising notion of "all humankind". The corresponding phrase "all of us", however, is indicative of a false universality, which fails to address social and cultural inequities whilst also neglecting the question of who actually benefits from off-Earth capitalist expansion and the associated "outer spatial fix" (Dicken and Ormrod, 2007:49–78).

[9] See, for example, NASA's catalogue of "benefits for humanity", which epitomises the false universality referred to in footnote 10: https://www.nasa.gov/humans-in-space/benefits-to-humanity/, last access: 15 August 2025.

[10] In this vein, a paper published in *Nature Communications* argues that microbial biotechnologies developed in the context of space exploration can help to solve environmental problems on Earth (Santomartino et al., 2023).

necessarily entails the intention "to transform a place that is [largely, added by the author] unknown and ungoverned into the known and disciplined" (Klinger, 2017:14). Unlike the escapist "solutions" of post-planetarists like Elon Musk (Tabas, 2020; Taylor, 2022), however, the Bremen project is not motivated by feelings of "hatred or disgust for the Earth" (Tabas, 2020:68). Rather, it comes with a well-rehearsed motivation to safeguard the planet – not (primarily) on Earth but by means of space exploration.

In this way, "Humans on Mars" justifies exploration and extractivism with planetary thinking, or at least planetary rhetoric. In contrast, the debate on planetary thinking is, for valid reasons, reluctant to address issues related to space exploration. In the debate over planetary justice, where Earth-centredness remains largely unquestioned and terrestrial matters are paramount, scholars tend to disregard the socio-environmental costs of current space activities as well as the expansionist aspirations of spacefaring organisations. While this imbalance reflects an interesting shift in the relations of power/knowledge (Foucault, 1980) between the engineering sciences, on the one hand, and the humanities and social sciences, on the other,[11] it seems to me that it ultimately can be attributed the powerful imagining amongst critical theorists "that what lies beyond earth is in an important sense empty and limitless" (Kearnes and van Dooren, 2017:5).[12] In contrast to their counterparts in the natural and engineering sciences, most scholars from the social sciences still seem to imagine the extra-planetary as a realm "without contours or local specificity, … an amorphous blackness" (Kearnes and van Dooren, 2017:5).

In view of the time lag in the social sciences in relation to issues of space exploration, my intervention concludes by suggesting that planetary thinking would benefit from taking the extra-planetary seriously as *imagined-and-real counter-space*. In so doing, I obviously draw upon an expression that was widely used in the 1990s when human geography underwent its cultural turn. Inspired by the insights of post-structural and post-Marxist theories, geographers (most notably Soja, 1996) employed the phrase of places as "real-and-imagined" in order to highlight that their interest was no longer confined to objectivist or substantialist notions of space but increasingly included the symbolic and material production of space (Lossau, 2009). By inverting the phrase, i.e. by speaking of the extra-planetary as imagined-and-real, I aim at promoting the idea that outer space is not only imagined, or fictional, as Donna Haraway might have it, but also "out there" in an objectivist, substantialist and (why not?) geographical way.

In my opinion, consideration of the extra-planetary as *imagined-and-real* would allow scholars to think of, say, Mars not only as Mars "of the imagination", as Latour (2018:68) does with regard to Sirius, but also as Mars "of substance". Rather than being regarded as a mirror that allows Earthlings to engage with real-world concerns in the style of science fiction (cf. Haraway, 2016), Mars would be considered a substantial place, with its own geographies, with its own regolith(s), and with its own chemical, physical and geological conditions. As a cosmic body constituting ecosystems of energy, matter and forces, if not microbes, Mars could even be thought of as imposing ethical obligations on us here on Earth (Kearnes and van Dooren, 2017). If planetary thinking were to accept outer space as *imagined-and-real*, planetary scholars could – and in my view should – therefore start to "make kin in lines of inventive connection" (Haraway, 2016:1) with off-Earth ecosystems, weaving their non-human and more-than-human components into a cosmopolitical ethics (Stengers, 2010) of care (Puig de la Bellacasa, 2017) and responsibility (Levinas, 1985).

At the same time, however, my suggestion that we understand the extra-planetary as a *counter-space* is meant to imply an awareness of the differences between planet Earth and outer space in two ways. In epistemological terms, this awareness reinforces the importance of counter-concepts, as mentioned in the introduction to this intervention. Given that the meaning of the planetary is constituted and stabilised by counter-concepts, an important one of which is the extra-planetary, it seems crucial to me to refrain from submitting the extra-planetary to "our" – or indeed any earthly – conceptual scheme but to comprehend and accept it as truly different. In addition to the significance of the related *rupture épistemologique* (Bachelard, 2024),[13] I find it crucial to insist on the necessity of a *rupture pratique* between planet Earth, on the one hand, and the space beyond, on the other hand. In my understanding, this practical rupture designates the extra-planetary as a place which is literally not for humans and certainly not for the very frontier expansionist and extractivist practices that have resulted in socio-ecological crises on planet Earth.

[11] With the growing significance of "mode 2" (Gibbons et al., 2010), transdisciplinary and post-academic forms of scientific knowledge production can be argued to constitute a technological or even engineering turn which tends to place greater value on finding solutions than on opening up questions.

[12] In a similar vein, Valentine (2012:1050) has argued that "the social sciences have tended to treat 'outer space' … literally as an empty signifier, able to represent all the fantasies of modernist futures but with none of the material consequences social scientists assign to other modernist projects".

[13] Drawing on Bachelard's notion of rupture, the present intervention resonates with (a specific form of) modern intellectual thinking. In his historical epistemology, Bachelard (1968, 2002) claims that scientific knowledge needs to break with both previously taken-for-granted scientific ideas and everyday, ordinary experience. Against such a background, I find it important not to normalise my own understanding of the extra-planetary (as counter-space) but rather to highlight that people around the world have diverse cultural, spiritual and/or religious connections to "what Western sciences call 'outer space'" (Bawaka Country incl et al., 2020:1) in their life-worlds.

If agreed upon, the recognition of the practical rupture would enable planetary thinking to help save the extra-planetary, not only from those who want to abandon a devastated Earth by moving to Mars, but also from those who want to protect Earth by exploring Mars. Thus far, more than 15 landers and rovers dispatched from Earth have landed on Mars. Despite efforts in planetary protection[14], they all had, and continue to have, disruptive effects on extra-planetary ecosystems, not only due to invasive methods of exploration, but also because explored systems are affected by the act of exploring (see, for example, Arendt, 1977) – and by exploration debris, of course. How many more will add to their number before planetary thinking even starts to take notice of the ecosystem engineering that is inherently implied in space exploration activities, whether deliberate or inadvertent? To me, this is an unsettling question. We can only begin to address it, however, after we start to take seriously the extra-planetary.

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[14]Under the heading "planetary protection", the space community has implemented and continues to discuss measures for controlling contamination in the context of interplanetary missions, both "forward" from Earth to another celestial body and "back" again to planet Earth (see, for example, Coustenis et al., 2023).

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