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EARTH AND THE ONTOLOGY OF PLANETS

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Introduction

The perseverance of climate change and inability of humanity to safeguard a sustainable future on our planet gives rise to speculations about the possibility of space exploration and the settling of human colonies on other planets. While Mars colonies were still science fiction in the 1950s, nowadays the experience of our dying planet revitalizes the ambition to explore the universe to find a new home for humanity (Burges, 2014). In Frank Herbert's book *Dune* (1965), the terraforming of Arrakis to make it more habitable for humans was still science fiction. Nowadays, terraforming is a serious field of scientific research – interested in, for instance, how human interventions can help the self-regulation of the Martian biosphere to support life and make Mars a habitable planet (McKay et al., 1991), for instance by creating a greenhouse effect (Sagan, 1994). For instance, the Persephone project envisions to "prototype exovivaria – closed ecosystems inside satellites, to be maintained from Earth telebotically, and democratically governed by a global community".[1]

Philosophers like Hannah Arendt conceive the promise of a space age impossible because "the earth is the very quintessence of the human condition" (Arendt, 1958: 2–3). According to Arendt, the colonization of other planets testifies to human escapism – our tendency to move away from the *givenness* of our existence on Earth and to replace it with a world of our own construction. While Arendt could still ask whether we should use our human abilities in this direction, the perseverance of climate change outdates her position. Even if we reject the possibility of the terraforming of Mars because humanity is an Earth-bound creature, it can be argued that climate change enforces the terraforming of Earth to keep it a viable habitat for human existence in the future. After all, the Earth is correctly understood as a planet like any other, and it is also

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increasingly depicted as a spaceship (Buckminster Fuller, 2008): not primarily "given", but the subject of management and control by humanity (Blok, 2022).

Whatever our ambition with terraforming might be, and before we can ask whether it is feasible or not, we need to ask the preliminary question how this "terra" has to be understood – irrespective of whether our subject is planet Earth or any other planet. This brings us to the main question of this chapter: what is the ontology of planets? Philosophical questioning of the ontology of planets is still in its infancy; yet some understanding of it seems necessary, if we are to theorize about the premises, challenges, and promises of space exploration. In this contribution, we map the philosophical terrain for our understanding of the ontology of planets as a core concept in the space age.

Our access point to this question is the ontology of planet *Earth*. Although the presence of life marks planet Earth as special among other planets, Earth shares a basic commonality with them – namely, its material existence. We take this commonality as a point of departure for our reflections on the ontology of both planet Earth and other planets. In this chapter, we ask for the ontology of this materiality of planets. We consult the ontology of planet Earth as I developed it in an earlier contribution (Blok, 2019), explore the ontology of planets as absolute boundary of the natural habitats on Earth, and reflect on the opportunities and limitations such ontology provides for future human colonies on other planets.

In the next section ("A Unique Feature of Planet Earth: the Disaster of Climate Change as Access to Earth and World"), we distinguish between Earth and World and argue that Earth, not World, provides access to the ontology of planets. In the section that follows ("The Ontology of Planet Earth"), we develop three principles of the ontology of planet Earth. In "The Ontology of Planets", we consider these principles as constituents of the ontology of planets. In this context, we also consider to what extend other Worlds can also be conceived on other planets that are founded on the materiality of planets. In the final section of the chapter, we draw some conclusions.

A Unique Feature of Planet Earth: The Disaster of Climate Change as Access to Earth and World

We start our reflection with a negative indication on the ontology of planets, as provided by the climatic disaster that threatens human survival on planet Earth. Etymologically speaking, a disaster concerns the loss of a guiding star that determines our destiny, fortune, or fate – the loss of ground beneath our feet. What is this star that can take away its guidance due to climate change?

In the phenomenological tradition, World is the meaningful environment in which we are intentionally involved and know how to live and act with other human and non-human beings. It concerns a relative stable background condition for our engagement with human and non-human beings, which is rather in the foreground. The climatic disaster confronts us with the experience that this stable worldly background is not freestanding but embedded in the instabilities

and volatilities of the Earth system. In times of climate change we learn that World depends on Earth. In this sense, climate change shifts our attention from World to Earth (Blok, 2022).[2]

With this reference to the disaster of climate change, we also receive a first indication of the difference between planet Earth and other planets. Human and non-human beings already live in a meaningful World in which they are intentionally involved. This World not only happens but depends on Earth. We could then say that human and non-human acting and living in a meaningful World is a characteristic that distinguishes planet Earth from other planets.

Climate change shows us that the Earth is the ground of our living and acting in the World. The givenness of Earth is not only a prerequisite for the emergence of human and non-human beings at an ontic level, i.e. at the level of beings. In the philosophical tradition, a distinction is made between the ontic and the ontological, between beings and the being of beings, their essence or meaning. Traditionally, the origin of the being of beings is for instance found in a transcendent *idea* (Plato), in the categories of thinking (Kant), in our being-in-the-world (Heidegger), etc. But if human and non-human beings always live and act in a meaningful World in which they are intentionally involved, we see that the givenness of Earth is a prerequisite at the ontological level – the condition of possibility of our living and acting in a meaningful World.

As a geological entity, the Earth was there long before human and non-human beings emerged. Our living and acting in the World emerges, unfolds, and expands out of Earth, and threatens to go back into the Earth again due to climatic disaster. After our extinction, the Earth would no longer have the human and non-human World as its unique characteristic, but it would continue to exist. The disaster of climate change doesn't concern the Earth. So the notion of a disaster tells us that our normal vocabulary doesn't really concern the ontology of planets, but rather the World in which we are intentionally involved.

Relational philosophers like Bruno Latour acknowledge Earth's history before humans, but nonetheless think of the Earth only in relation to human existence – as World. This is less a mistake than a habit: philosophers generally tend to think of the materiality of planet Earth from the perspective of organic life or the biosphere, rather than from the geophysical, elemental perspective of the inanimate realms of the lithosphere, hydrosphere, and atmosphere (Harman, 2009). If we want to discuss the ontology of planet Earth, rather than World, we should reject any characteristic that is derived from our human and non-human involvement in the World. With this, we do not want to claim a priori that Worlds on other planets are impossible (we come back to this question in "The Ontology of Planets" later in the chapter), but that we should start with the materiality of planet Earth, when reflecting on the ontology of planets, not with the ontology of World.

To think the Earth beyond World is a difficult task, as it seems to reach beyond our living and acting in the world and, therefore, to challenge the very grounds of our thinking. Maybe the Earth is something like Kant's thing-in-

itself; or the exterior milieu that remains exterior to any interiority of World. This exterior milieu cannot be objectified by science, as it would become World thereby, something measurable and calculable – yet according to formulas that are strange to Earth as planet. We can only access this exteriority by allowing ourselves to be responsive to it as exteriority.

The Ontology of Planet Earth[3]

a) The Principle of Conativity as Characteristic of the Ontology of Planet Earth

The disaster of climate change enables us to experience the volatility of the Earth system and its destabilizing powers over our everyday World. Yet this volatility also provides a first positive indication on the ontology of planets.

The starting point for our considerations is an old philosophical insight that is nowadays increasingly accepted in science: the idea that not only humans, but all things, have agency (Latour, 1993). One of the sources of this idea that inanimate beings have agency is the philosophy of Spinoza. According to Spinoza, "each thing, as far as it can by its own power, strives [*conatur*] to persevere in its own being" (Spinoza, 1992, part 3, proposition 6). According to this view, not only trees, animals, and humans, but each and every being is conative, including stones, sand dunes, and volcanoes. For Spinoza, this conativity is not an *ontic* will or impulse of *living* systems toward self-preservation, but an *ontological* principle of *all* beings: "The conatus to preserve itself is the very *essence* of a thing" (Spinoza, 1992: part 3, proposition 7 (emphasis added)). We can take inspiration from Spinoza and frame Earth's conativity as a cosmogenic or worldbuilding capacity to generate and establish the being or identity of material entities that constitute our reality.

We are legitimized to refer to a worldbuilding capacity of the Earth, because conativity is not limited to living systems.[4] All bodies are conative, from stones to humans (see Bennett, 2010: 2–3). Conativity is not only a principle of living nature, but a more general principle of the materiality of the Earth. But conativity also extends agency, traditionally thought to pertain to the living, or some of them, and to the inanimate – thus establishing something like "living matter" as a key element in Earth's generation and self-regulation as a dynamic system (Vernadsky, 1998; Clark, 2011).

To what extent can we consider conativity to be *essential* for the materiality of the Earth? Differently put: to what extent does conativity articulate the very *identity* of material entities? In Spinoza's view, only one common substance – *Deus sive Natura* – constitutes the universe. All separated material entities that compose our reality are *modes* or *modifications* of this one substance. As such a mode, each material entity is resistant to everything that can take its existence away, and this resistance is precisely the conativity or striving to preserve oneself as such a mode of the common substance (Spinoza, 1992: part 3,

proposition 6). Conativity is essential, then, because it *differentiates* the identity of material entities from the common but undifferentiated substance – it articulates and establishes the self or identity of the tree and the stone, for instance, *as* modes of this common substance (*self*-perseverance) – and prevents at the same time their relapse in this common substance (self-*perseverance)*.

Spinoza's idea of an undifferentiated common substance is not an example of a "demented ontology", "bending a continuous plastic material without separation" (Neyrat, 2019: 19), but the condition of possibility of separation, i.e. of differentiated identities of material entities. If we frame Spinoza's idea of a common substance in more profane terms and highlight the "naturalistic" framework that our ontology of planets is interested in, we could argue that all the material entities that we encounter on Earth – the stone, the tree, human beings, any artifact – are modes or modifications of the materiality of the Earth. We could then be tempted to bring the ontological fact that each material entity strives to preserve itself (*self*-perseverance) down to an ontic level – namely to the metabolic relation to the Earth as resource that constitutes the tree, the stone, human beings, and artifacts in their striving for self-preservation. But that would be a mistake. If that striving is indeed *essential* for each material entity, then conativity cannot be understood, at an ontic level, merely as powering a struggle for persistence in and by each individual entity. It must remain at an ontological level – as that impulse[5] in the undifferentiated materiality of the Earth to differentiate and establish material entities as modes (of the undifferentiated materiality of the Earth).

The essentiality of conativity for material entities shows that conativity is not a will or power of material entities to preserve themselves – a form of *autopoiesis* (Maturana and Varela, 1980) – but rather a principle of the *appearance* of Earth's materiality *as* stone, tree, human, artifact, and so on. Earth's conativity is literally an endeavoring, an effort – and its essentiality consists in the fact that it articulates and establishes the differentiated identities of material entities *as* modes of the undifferentiated materiality of the Earth.

The importance of these two aspects of conativity is also confirmed by recent insights into earth systems sciences; Earth's history is characterized by an inherent instability in which life forms but also inanimate conditions of life like climate changes emerge, adapt to the changing environment, and disappear again: "The vision that has been emerging, through a succession of discoveries, controversies and convergences, is one in which instability and upheaval, rhythmical movement and dramatic changes of state are ordinary aspects of Earth's own history" (Clark, 2011: xii). This rhythmical movement of the Earth indicates the mobile and active conativity of the undifferentiated materiality of the Earth, out of which differentiated material entities or relatively stable bodies like stones and trees up to the world of the biosphere and noosphere emerge (*self*-perseverance) and maintain (self-*perseverance*) themselves before they recede again in the undifferentiated materiality of the Earth.[6] This recession in undifferentiated materiality does not only apply to organic life that composts after its death; a stone also dissolves due to erosion in the course of (deep) time.[7]

A first round of reflection reveals the principle of conativity as the principle of planet Earth, which is not an ontic will or impulse of material entities but an ontological endeavor to differentiate the identity of material entities up to the world of the biosphere and the noosphere, and as such, deviations from this undifferentiated materiality. Conativity as *self*-perseverance and self-*perseverance* of Earth is the first characteristic of the ontology of planet Earth that we can discern.

b) The Pre-Individual Generative Capacity as Characteristic of the Ontology of Planet Earth

As a consequently of the principle of conativity as the first characteristic of the ontology of planet Earth, "I", as a material entity, am not primarily conative. On the contrary, "I" am the performative constituent of the conativity of the undifferentiated materiality of planet Earth. This means that conativity as a principle of planet Earth consists in the endeavor to differentiate and preserve the identity of material entities like stones and trees, me and you, from undifferentiated matter as modes of this materiality of planet Earth. As such an origin of the identity of material entities, the undifferentiated materiality of planet Earth itself, has to be understood as non-identity or pre-individual generative capacity. The material entities are transgressing the non-identity of the undifferentiated materiality of the Earth and remain at the same time embedded in this conative or "vibrant" materiality of the Earth (cf. Bennett, 2010), like a ripple in the water that emanates from the ocean and remains embedded in it at the same time.

The dynamic character of Earth's conativity can be conceived as *metabole* in the broadest sense of the word, i.e. change.[8] Unlike the metaphysical tradition, which finds its point of departure in a steady material being that can subsequently change, the movement of the Earth shouldn't be understood out of that which is generated by *metabole*, i.e. the material entities that are performatively constituted by the conativity of the materiality of the Earth. Conceptualized this way, the movement as character of the Earth's conativity is reduced to what is moved in favor of its presence as a being, while the Earth is not such a being; the being of the Earth *is* in the way of such movement. We can compare this endeavor to differentiate the identity of material entities with Kauffman's ideas about the *origins of order*, i.e. the spontaneous emergence of order out of chaos by the self-organization of complex systems (Kauffman, 1993). Earth's history with its evolution of a wide range of landscapes and species shows the limitlessness of the undifferentiated materiality of planet Earth as a domain of generative capacity out of which such differentiations emerge and in which they in the end recede again.

This second round of reflection on the Earth as planet reveals, then, a second characteristic of its ontology. The Earth has to be conceived as a pre-individual generative capacity that spontaneously articulates and emits the identity of

individual material entities. The Earth is a reservoir of spontaneous material flows as a condition of possibility for the emergence of each and every material entity. The materiality of planet Earth is not only characterized by a non-identity or a pre-individual generative capacity, but is also always heterogeneous to, and always res-cends (as opposed to the idea of trans-cendence) any actual material entity as differentiation from this undifferentiated materiality of the Earth. With this, we introduce a dualist notion of the ontology of planet Earth, namely as undifferentiated materiality that constitutes a domain of spontaneous generative capacity out of which the identity of material entities emerges as differentiations of this undifferentiated materiality of the Earth. The undifferentiated materiality of the Earth concerns the non-identity or pre-individual whereas differentiated material entities concern the identity of material entities up to the world of the biosphere and the noosphere in which we live and act.

c) The Responsive Conativity of a Subset of Conative Material Entities as Characteristic of the Ontology of Planet Earth

According to Spinoza, the materiality of the Earth is not only conative but also *associative*; this means not only that the conativity of the Earth articulates and establishes material entities as differentiated modes of undifferentiated materiality that can *affect* other such differentiated entities in the environment, but also that these differentiated entities are at the same time always already *affected* by other entities, which are in their turn also performatively constituted by the conativity of the materiality of the Earth. From a Spinozian perspective, each mode of the materiality of the Earth has to be seen as a composition of simple modes that affect and are affected by one another, i.e. that they are primarily *responsive* to one another and form the relatively stable bodies that we encounter in the environment, ranging from simple bodies like stones and minerals that constitute the geosphere, to complex bodies like human beings and to complex networks and alliances of bodies like the world of the biosphere and the noosphere. Or as Jane Bennett puts it:

> Because each mode suffers the actions on it by other modes, actions that disrupt the relation of movement and rest characterizing each mode, every mode, if it is to persist, must seek new encounters to creatively compensate for the alterations or affections it suffers. What it means to be a "mode", then, is to form alliances and enter assemblages: it is to mod(e)ify and be modified by others.
>
> *(Bennett, 2010: 22)*

While Spinoza inspires new materialists like Bennett to see a convergence between the geosphere, biosphere, and noosphere, as all these spheres can be characterized by conativity and associativity or responsiveness, we reject such a convergence.[9] While the world of the biosphere and the noosphere are

constituted by alliances of material entities that affect and are affected by each other and constitute a meaningful World in which these material entities are responsive to each other, this is not the case with the geosphere of the Earth. Stones and minerals, elements like water and air, Earth dynamics like plate tectonics, volcanoes and hurricanes *affect* this World by its destabilizing perturbations, may *afford* the responsiveness of the biosphere to sustain the Earth as condition for biological life (Lovelock, 1987), or may afford the responsiveness of the noosphere to sustain the meaningful World in which we humans live and act in times of climate change, but the Earthly geosphere is not itself *responsive* to affordances set by these human and non-human entities in the World.

A first indication of the non-responsive conativity of the geosphere of planet Earth is that the Earth as a planet emerged in the cosmic history long before human and non-human responsiveness emerged on the planet. The emergence of the Earth in Earth history is a necessary condition for the emergence of human and non-human responsiveness, but not itself responsive to these human and non-human entities. Although the worlds of the biosphere and the noosphere are actually generated by the spontaneous generative capacity of the Earth (and the Sun),[10] it is in no way necessary; it would have been perfectly possible that World never emerged in the Earth history, just as Mars or Jupiter didn't give rise to a biosphere beyond their geosphere so far. The conativity of the Earth generates the identity of material entities, ranging from rocks to animals and from trees to the built environment. But to the extent that human and non-human entities always live and act in alliances, ecosystems, or worlds in which these entities are responsive to the Earth as geosphere and to other entities that constitute the world of the biosphere and the noosphere, the conativity of the Earth is a *prerequisite* for the responsiveness that constitutes World (Blok, 2022), but not necessarily responsive itself. The conativity of the Earth is a necessary condition for World constitution, but not a sufficient condition yet.[11] In fact, not only human activity can destroy the existing world in times of climate change, but also the elementary forces of the conativity of the Earth can affect, alter, or even disrupt existing worlds. This is indicated by historical examples like the eruption of Mount Vesuvius that disrupted the world of Pompei, the earthquake that disrupted the world of Haiti, or hurricane Katrina that disrupted the world of New Orleans, but constitutes a spontaneous generative domain that is devoid of any given responsiveness to these worlds.

The constitution of World requires the emergence of material entities that are not only constituted by their conativity, but also co-constituted by their responsiveness to other material entities; this responsiveness constitutes the World in which human and non-human entities are at home. While the conative material entities that constitute the Earth are a necessary condition for the emergence of life on Earth and our living and acting in the World, the responsiveness of a subset of conative material entities constitutes the sufficient condition for the emergence of the World in which entities become responsive to each other. An example of this responsiveness is the responsiveness of material

entities to the conativity of the Earth, that constitutes the world of the biosphere as atmospheric homeostasis of the Earth system (Lovelock, 2006).

If we conceptualize the conative responsiveness of material entities at an ontological level, i.e. at the level of the articulation and establishment of the identity of material entities in the World, we can conclude that the identity of these material entities is not only performatively constituted by the conativity of the Earth as its ground (first principle of the conativity of the Earth), because the identity of material entities in the World is at the same time constituted by their responsiveness to other material entities that are performative constituted by the conativity of the Earth. In the differentiation of material entities by the conativity *of* the Earth, a subset of these conative entities is co-constituted by its responsiveness *to* other conative and responsive conative entities that constitute the world of the biosphere and the noosphere, in which these entities are interconnected and interdependent. Together, these conative and responsive conative material entities constitute the World in which we live and act. A third round of reflection on the materiality of the Earth reveals the *responsive* conativity of a subset of conative material entities as a third principle of the ontology of planet Earth.

With this, we introduce a dualist notion of the conativity of material entities, allowing us to limit the first principle of the ontology of planet Earth to the conativity as *self*-perseverance and self-*perseverance* of all material entities. This principle enables us to acknowledge the Earth as rock and mineral, Earthly rhythms like plate tectonics and volcanoes, etc., which constitute the geosphere. The third principle of the ontology of planet Earth enables us to identify a subset of conative material entities, which are not only constituted by their conativity but are also co-constituted by their responsiveness to other material entities, ranging from their responsiveness to conative material entities like volcanoes and earthquakes to other responsive conative material entities like trees, animals, and humans.

This dualist notion of the conativity of material entities implies a fundamental *asymmetry* between the conativity of Earth and the responsive conativity of World. This asymmetry is not only an epistemic asymmetry as limitation of what is known – the Earth as *terra incognita* – but also an ontological asymmetry; the Earth as pre-individual generative capacity that differentiates and emits the identity of material entities without the possibility of being identified itself (second principle of the ontology of planet Earth). This generative capacity of the Earth constitutes the material entities that are characterized by self-perseverance (first principle of the ontology of planet Earth). This Earth is a condition of the possibility for the constitution of World. This World is not only constituted by the generative capacity of the Earth that constitutes material entities, but co-constituted by their responsiveness to the conativity of the Earth (third principle). Earth and World are interconnected but not interdependent – the conativity of Earth is a necessary condition for the responsive conativity of the World but not the other way around – and Earth remains heterogeneous in

relation to each and every World. World is dependent on Earth, which can disrupt it by its perturbation, and can spontaneously generate new conditions for the World.

The Ontology of Planets

Until now, our ontology of planet Earth didn't take into account that this particular planet is characterized by human and non-human life as the peculiar characteristic that marks this planet out as unique in the universe. For this reason, we were able to refer not only to stones but also to trees and humans as performative constituents of the responsive conativity of Earth that constitutes World in the previous section. If we now want to try and transfer this ontology of planet Earth to other planets, the question is how to distinguish between the responsive conativity involved in the constitution of Earth and World in comparison with the conativity involved in the constitution of other planets.

In "A Unique Feature of Planet Earth: the Disaster of Climate Change as Access to Earth and World", a distinction between Earth and World was introduced. We later suggested that, in building an ontology of planet Earth, we should reject any characteristic derived from World, In "The Ontology of Planet Earth", we reflected on the materiality of planet Earth, pivoting it on the notion of conativity. Although we concentrated on the principle of conativity to establish the identity of material beings on Earth, we can argue that the same principle of conativity functions on other planets like Mars, leading to another set of material entities, such as stones, sand dunes, and minerals. To the extent that each material entity is resistant to everything that can take its existence away, *self*-perseverance and self-*perseverance* occur as much on/with planet Earth as they do on/with Mars or any other planet that exists. The conativity of planets differentiates these material entities from the undifferentiated materiality of planets in which they are embedded (*self*-perseverance) and prevents their relapse into the undifferentiated materiality of planets again (self-*perseverance*). The conativity of the materiality of planets is the first principle of the ontology of planets. It establishes the identity of material entities like sand or rocks that constitute planet Earth or any other exoplanet as differentiation of the undifferentiated materiality of planets.

If the principle of conativity of planets differentiates the identity of material entities like rocks and stones that constitute planets from the undifferentiated materiality of planets as modes of this materiality of planets, then the ontology of planets is twofold. The principle of conativity differentiates the identity of material entities (stone, sand, rock, minerals) that constitute the planet, which remains embedded in the non-identity or pre-individual generative capacity of the undifferentiated materiality of planets, like a grain of sand emanates from the desert and remains embedded in it at the same time. The ontology of planets is not only characterized by the non-identity or pre-individual generative capacity that constitutes the identity of individual material entities, but this

non-identity of the materiality of planets is always heterogeneous to, and always res-cends actual material entities as differentiations form this undifferentiated materiality. The materiality of planets is limitless and undifferentiated as a domain of generative capacity out of which differentiations emerge, such as certain rocks and minerals. The non-identity or pre-individual generative capacity of the materiality of planets constitutes the identity of material entities and always res-cends actual and possible material entities as differentiations from this undifferentiated materiality of planets, and is the second characteristic of the ontology of planets.

In the case of planet Earth, the principle of conativity is accompanied by the principle of responsiveness that also differentiates plants, animals, and humans from the undifferentiated materiality of planets as modes of this materiality, while in the case of planet Mars, plants, animals, and humans are not differentiated until now. Our conceptuality so far enables us to understand where the difference might be found. Based on the dualist notion of planets as undifferentiated materiality (non-identity) out of which the identity of the material entities emerge that constitute these planets, we can argue that the commonality has to be found at the level of the conativity of material entities (first principle) and the non-identity or pre-individual generative capacity of undifferentiated materiality (second principle), while the difference has to be found at the level of the responsiveness of a subset of differentiated conative material entities that constitute the World (third principle), which differs in the case of Earth and Mars. At the level of differentiated entities, several commonalities can be found – i.e. oxygen, iron, magnesium, aluminum, and similar composite rocks can be found on both planet Earth and Mars – but planet Earth also contains different differentiated entities like trees and animals that are not only conative but also responsive, and constitute the World in which we live and act.

While the first two principles of the ontology of planet Earth can be extended to the ontology of planets, we can argue that the difference might be found in the responsiveness as the third principle of the ontology of planet Earth. In the previous section, we saw that material entities are not only conative but also affected by other conative entities, which are in their turn also performatively constituted by the conativity of planet Earth. The responsive conativity of planet Earth constitutes material entities that are responsive to one another and form the relatively stable bodies that we encounter in the environment, ranging from stones, seas, and landscapes in which we live and act. These types of complex entities, ecosystems, or worlds have not been found on Mars or any other exoplanet so far. We can argue, therefore, that the first two principles of the ontology of planet Earth are common with other planets, while the principle of responsiveness is the unique characteristic of the ontology of planet Earth. For this reason, we can say that the World in which we live and act is a unique characteristic of planet Earth, which cannot be found on other planets.

If the principle of conativity is understood as a necessary yet not sufficient condition of possibility for the emergence of World (first principle), this

principle has to be seen as a necessary condition for the emergence of material entities on each and every planet. In the case of Mars, the principle of conativity solidifies the magma on Mars and constitutes an igneous rock (self-perseverance), which due to wind and water is pulverized again in sand in the course of time. The difference has to be found in the particular arrangement of material entities in the case of planet Earth and in the case of planet Mars, for instance. In the case of Mars, the conativity differentiates a particular arrangement of sand dunes, rocks, and minerals that are incomparable with the arrangement of planet Earth.

In the case of planet Earth, different Worlds are nested within each other. The world of the noosphere exhibits unique properties like cultural phenomena, and is nested in the world of the biosphere in which plants and animals constitute a dynamic ecosystem on which humans living and acting in the World depend, which is again embedded in a "bacterial" World of metabolic processes of "microbial intra-actions [which] have nothing to do with humans", on which animals and humans living and acting in the World depend, etc. (Hird, 2009: 26). The condition of possibility of human and non-human metabolism in the human World has to be found in the bacteria that constitute the bacterial World, and in this regard we can say that the world of the noosphere is *grounded* in the world of the biosphere as its condition of possibility. In a similar vein, we can argue that this world of the biosphere is nested in the Earth as minerals, elements and rocks that constitute the planet on which human, animal, plant, and bacterial life depends.

While material entities like sand and stones can be found on both planet Earth and planet Mars, at least to a certain extent, the world of the biosphere or the noosphere cannot be found on planet Mars. With this, however, we don't necessarily have to argue for an evolution starting with the conativity of material entities, moving forward to the responsive conativity of material entities like bacterial, plant, animal, and in the end human life if certain conditions are met. First, although material entities like sand and minerals serve as a necessary condition of possibility for the emergence of World, in the case of planet Earth it is not necessary to assume that the principle of conativity is always accompanied by the principle of responsivity and will always lead to the world of the biosphere via a bacterial World in the future. Second, it might be the case that we discover planets in the future that are governed by conativity and responsivity, or that responsivity will emerge in Mars history, for instance. But this doesn't mean that Mars would necessarily evolve in a similar way as planet Earth. It might be the case that other planets evolve heterogeneously in completely different directions due to crisis – like the dinosaur World disappearing by accident due to an asteroid impact on Earth, or like the world of the noosphere that might disappear one day due to climate change. Other planets might evolve heterogeneously in different directions due to the unlimited richness of the conativity and responsivity of material entities, which continuously generate new material entities (*self*-perseverance) and probe new ways to preserve its own existence (self-*perseverance*), as

speculative biologist Gert van Dijk shows with his fictive planet Furaha.[12] Third, our World is not necessarily an end state of the World but remains open-ended, as the responsive conativity of the materiality of Earth is generative and evolves iteratively, with the responsive conativity of material entities generating novel material entities responsive to each other in unforeseeable ways and constituting new emerging Worlds. There is not one unique World, but open-ended Worlds that are nested in each other in a variety of heterogeneous ways.

The embedding of the open-ended futurability of Worlds in the conativity of planets has the advantage that it prevents our overly investing in future Worlds while neglecting the rich potentiality the concrete materiality of planets provides (Blok, 2019). The limitlessness and complexity of the materiality of planets consists in the fact that this materiality is never exhausted by the material entities it constitutes, is always richer and more complex than any actual material entity, and res-cends all actual and possible material entities. The conativity of planets is indeed characterized by the non-identity or pre-individual generative capacity that constitutes the identity of the materiality of planets, and as such *grounds* the futurity of any possible World that we will find on exoplanets in the future.

The conativity of the materiality of planets is not only the ground for the emergence of material entities like stones, rocks and sand dunes that constitute planet Earth and planet Mars at an ontic level. Moreover, if a subset of these conative material entities are already responsive to each other in the world of the biosphere or noosphere, the conativity of the materiality of planets is also the ground of each and every World at an ontological level, whether it is a world of the biosphere or the noosphere we find on planet Earth or any other World we might find on other planets in the future. Each and every World emerges, unfolds, and expands out of the conativity of the materiality of planets, and can go back into the undifferentiated materiality of planets at the end of this World.

Conclusions

In this chapter, we raised the philosophical question of the ontology of planets, as this is a prerequisite to theorize about the premises, challenges, and promises of space exploration. In the first section, we mapped the philosophical terrain for our understanding of planets as a core concept in the space age, by reflecting on the ontology of planet Earth. We argued that the ontology of the Earth provides access to the ontology of planets. In the second section, we developed three principles of the ontology of planet Earth: 1) the conativity of the materiality of planet Earth establishes the identity of material entities that constitute the planet; 2) the non-identity or pre-individual generative capacity of the materiality of planet Earth constitutes a domain of generative capacity that articulates and emits the identity of material entities and always res-cends actual and possible material entities as differentiations from this undifferentiated materiality; 3) the responsiveness of a subset of conative material

entities to other material entities constitutes the world of the biosphere and noosphere of planet Earth.

In the third section, we considered these ontological principles in the context of other planets. While the first two principles seem to also apply beyond Earth, the third principle enables us to distinguish between planet Earth and other planets. This does not mean that we should reject the possibility of discovering Worlds on exoplanets in the future. Although future research is needed to reflect on the interdependency of Earth and World in case of planet Earth, in order to explore the possibility of World constitution on other planets, the embeddedness of the open-ended futurability of Worlds in the conativity of planets enables us to engage in the cosmogenic or worldbuilding capacity of planets to explore new future Worlds, whether it is on planet Earth or any other planet.

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Notes

1 https://www.persephone-project.com/ourstory-1 (last visited July 5, 2022)
2 The notions World and Earth remind us of Heidegger's use of the terms, for instance in his essay on the origin of the work of Art. Although I am inspired by Heidegger's notion of World, I have also been very critical about his conceptualization of the Earth (Blok, 2016a). This criticism has been a major inspiration to develop a concept of World and Earth that can help philosophical reflection in times of climate change.
3 Parts of section 3 are based on an earlier contribution (Blok, 2019).
4 The distinction between *living* nature and *dead* matter is already questioned as a typical *modern* distinction (Jonas, 1966). Also for Spinoza, conativity is not limited to living systems. In this chapter, we conceive conativity as a principle of Earth's materiality, thus including nature.
5 *Conatio* is a translation of the Greek *horme*, impulse or onset.
6 In this conceptualization of the conativity of the Earth, we deviate from Spinoza's original intuitions, which were precisely monist by nature.
7 It should be clear that we only took inspiration from Spinoza's idea of conativity, without claiming that our philosophical reflection is in any way consistent with his framework or system. For instance, the idea of a recession in undifferentiated materiality is not to be found in Spinoza's work. Also, while I claim that "I" am not conative whereas the materiality that constitutes "me" is, Spinoza would disagree.
8 Originally, the Latin word *planeta* indicates a roaming or moving star.
9 In this, we do not only criticize Bennett, but also our own earlier work (Blok, 2016b).
10 In fact, the biosphere is as much generated by the Earth as it is generated by the Sun, as Vernadsky (1998) already indicated. The further discussion of the role of the Sun in World constitution is beyond the scope of this chapter.
11 The question how non-responsive conativity (Earth) can give rise to responsive conativity (World) is beyond the scope of this chapter.
12 www.planetfuraha.org/ (last visited: 14–7-22).

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