THINKING PLANETS

HYPER-ANTICIPATION AND BIOGRAPHICAL DEEP TIME

ARMEN AVANESSIAN
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INTRODUCTION

Is there *anything stranger* than inhabiting a planet?

Especially when most planets look like Mars and Venus?

Clearly not. –

But is there *anything else* to inhabit other than planets?

Not that we know of. –

But is it not the case that, so far, we have not even inhabited *the planet*? That we are only now starting to do so and will hopefully and increasingly do so in the future?

That's right. –

A bundle of questions that boils down to a single, philosophical one:

"What does it mean to inhabit a planet?"

This question is at the center of a new discourse on planetarity. Since the early 2020s, we observe a real surge in considerations around planets within the humanities. They primarily concern the Earth as a planet, but also touch on what planets generally possess and what belongs to them (the 'planetary') or what is brought about by them or is in some way connected with them ('planetarity', i.e. the planet as principle and source of effects).

These reflections are developed in various formats, including academic publications and books (the Goldsmiths Press book series *Planetarities*, 2022–) as well as conferences ("Becoming Planetary as a Challenge,"[1] 2022), colloquia and other teaching formats ("Alien Earth: Introduction to Planetary Humanities,"[2]

2022), postgraduate programs and para-academic incubators (Digital Earth, 2018–22, The Terraforming, 2020–21; More-than-Planet-Lab, 2022–; Antikythera, 2023–)[3] as well as cultural events ("Where is the Planetary? A Gathering," 2022). All of these activities document the emergence of a *planetary humanities*, the outlines of which are now discussed more and more systematically ("Conceptualizing Planetary Humanities,"[4] 2022).

One occasion and focus of the new discourse on the planetary are the radical effects imposed on the planet Earth by the presence of the intelligent civilization of *Homo sapiens*. The semantics of 'planetarity' here comes in because older concepts and categories of analysis such as the globe, globality and globalization, with their focus on human agents and historical periods, are increasingly insufficient to describe an Earth-spanning history of the present that involves non-human actors and materials of vastly other-than-human dimensions and ontologies. Also, today we know the Earth is being transformed no longer only politically and economically, or even just ecologically, but also geologically.[5] The International Geosphere-Biosphere Programme has recorded these transformations in a report (2004) and noted the exponential increase in the human footprint on Earth since 1950[6] – a process that has since been referred to as the Great Acceleration.[7]

The discourse on planetarity thus emerges from the same horizon of problems – and, incidentally, is often led by the same protagonists – as the earlier discussion around the so-called Anthropocene (which, in its formal geological dimension, has not been formally ratified by the International Union of Geological

Sciences): the idea that the Earth has now entered a new geological age defined by said effects of *Homo sapiens*. But the underlying object described by the term Anthropocene is, precisely, the 'planet' – this is the more basic term. It makes sense, then, that the humanities are now more and more turning to it, thereby also making it possible to overcome some of the idiosyncrasies of the term Anthropocene, which have resulted from its anchoring in the special science of historical geology.

At the same time, the young discourse on the planetary has already developed some idiosyncrasies of its own, which can be explained through the diversity – and to some extent also the randomness – of the strands of theory that converge within it, and the absence of a conceptual center of gravity.

We think this gravitational center must be a philosophical reading *of astrobiology* – the young science that conceives of life on Earth as merely *one* example of life in the universe, and that (as generalized life science) thinks about that which determines the formation and evolutionary trajectories of life on habitable planets. A self-description of the present in astrobiological terms has so far been lacking from the humanities' engagement with the planetary. This book therefore aims to fill the gap with its astrobiological description of the present.

□ THE DISCOURSE ON PLANETARITY

But what is this new discourse all about – how do people think about planets today?

We distinguish two lines of discourse:

On the one hand, planetary thinking refers to the Earth system, i.e. to the flow of energy and matter through the planet's biosphere, atmosphere, hydrosphere and lithosphere, and their systematic linkage in biogeochemical cycles (cf. chapter A.3). This is a dimension of the Earth – its basic architecture that constitutes it as an integrated whole of interchanging components – which human action is only today having a significant impact upon.

The encounter with the planetary thus conceived is understood by its theorists as an encounter with an otherness that transgresses the interior space of purely human affairs and histories. For the historian and postcolonial thinker Dipesh Chakrabarty, author of the key work *The Climate of History in a Planetary Age* (2021), this is a dimension of being – "the Earth system, or what I have called 'the planet.'"[8] – which, in its protracted cyclicality, exhibits a very different temporality than human biographies and politics. As a product of the Earth's deep history, it links us to geological time as soon as we intervene in it:

> The planetary, ultimately, is about how some very long-term planetary processes involving both the living and the nonliving have provided, and keep providing, the enabling conditions for both human existence and flourishing.[9]

According to Chakrabarty, as soon as we encounter the planetary, we become shockingly aware of it as something strange and other:

> This falling into 'deep' history carries with it a certain shock of recognition of the otherness of the planet and its very large-scale spatial and temporal processes of which humans have, unintentionally, become a part.[10]

> Faced with the radical otherness of the planet, however, a deeply phenomenological urge on the part of many scientists is to recoil back into the human-historical time of the present and address the planet as a matter of profound human concern.[11]

Accordingly, otherness is here primarily determined temporally – the intrinsic temporality of the planet (= geological time) and the temporality of human action and historicity always seem to diverge in a fundamental way.[12] By that very feature, however, the planet also eludes the horizon of human categories and evaluations, i.e. it also marks an ethical-political outside: "[T]he planetary as such, disclosing vast processes of unhuman dimensions, cannot be grasped by recourse to any ideal form."[13]

Interestingly, the motif of radical otherness has accompanied the (recent[14]) discourse of the planetary from the very beginning. In the early 2000s, the literary scholar Gayatri Spivak (writing still outside the context of Earth system theory) put it like this: "The planet is in the species of alterity, belonging to another system; and yet we inhabit it, on loan."[15] However, the planet is not simply our Other; it is, absolutely underived, the Other per se.[16]

On this basis, Spivak is interested in the effects of defamiliarization and uncanniness that planetary thinking can evoke in (post-colonial) literature, which is important to her with regard to new foundational ideas for comparative literature. But in a

recent interview, she brings her planetarity thinking into noticeable resonance with Chakrabarty's scenario:

> The planet gives a damn. It is so other that it does not consolidate ourselves by being 'our' other. When I talk about "planetarity" we cannot think the planet; that is what it means to say that the planet is in the species of alterity. It is in the rules of the galaxy and the planetary system and we cannot touch it. The planet has gone extinct before not because human beings did anything. Thinking planetarity can show us our limits.[17]

A corresponding postulate of indifference – *the planet gives a damn* – can also be found in Chakrabarty.[18] As part of a research project by philosopher and design theorist Benjamin Bratton, the philosopher Lukáš Likavčan then makes this indifference postulate the linchpin of a position which, commencing from the otherness of the planet, aims at decentering the *Homo sapiens* civilization that dwells there:

> The central figure of comparative planetology is that of the Planetary – the cosmogram that presents Earth as an impersonal, geophysical process in which humans play the role of temporary mediators. This figure is informed by contemporary ecology and climate science.[19]

The idea that humans are merely "temporary mediators" of Earth system processes – i.e., redirect the energy and matter of the Earth system into their societies and bind them there for a brief time before vanishing from the face of the Earth (extinction) – implies that the emergence of an intelligent civilization does not add anything new or even essential to a planet and its

history: the civilization remains superficial and external to the planet. And this is a planet that Likavčan, like Chakrabarty, imagines as operating in geological deep time;[20] like Spivak (speaking of seemingly timeless "rules of the galaxy and the planetary system"), he also believes the Earth is always doing more or less its own (same) thing:

> There were eons of geological processes that did well without the help of this [= the human] species, and they will surely do well too after humanity's extinction.[21]

It is only logical, then, that this line of thinking – still uninformed by astrobiological insights or not interested in them – results in an image of the planet as unpopulated by humans. If you want to understand the planetary, goes the reasoning, you should focus on the Earth after the end or (as in the following quote) before the emergence of humanity:

> Earth-without-us is a figure that always already precedes and manipulates the human, and in doing so, moves us away from the idea of the human as the principle that constitutes the planet being the way it is.[22]

> [This figure] instructs us to think about the planet as existing always and fundamentally without us.[23]

We wonder, however, what sense it makes to look at the planet philosophically through the lens of its being unpopulated by humans, at a moment when a record number of 8 billion people are present on it?

Especially where humans have collectively begun to intervene so massively in the hitherto untouched architecture of the Earth system itself that it is catapulted into a new geological age, speaking of an "otherness" of the planet becomes questionable.

It is also hardly plausible that the Earth system should be immune to ethical or political evaluations and categories at a time when people are implicated in its deformation (global warming, land use patterns, extractivism) in an obscenely unequal way and are just as unequally affected by the costs or negative consequences of that process.

And is it true at all that the only temporality proper to the planet itself is the infinitely slow, geological one (as was Chakrabarty's starting point)?

Is this tenable from a natural-philosophical point of view? We're not sure at all, especially when considering that it was nothing but the Earth system that produced the people who are now deforming it: in what valid sense, then, could it be ontologically alien to them?

Aren't Earth-like planets precisely the places in the universe – and perhaps the only ones – that are outright *ready* for the intervention of the intelligent civilizations they have created, or even co-evolved with?

A second line of discourse in the new thinking on the planetary focuses on the question of how we can at all perceive the Earth *as* a planet, and how this perception could or should guide our actions towards it, both collectively and individually.

This question of perception is not exhausted by the astronomical understanding of the Earth as a celestial body in the solar system and the Milky Way, and of its formation (first in Kant's and

Laplace's nebular hypothesis on the formation of planets from a primordial nebula); nor is it fully addressed by the growing knowledge of the deep history of the Earth and the sequence of its geological ages or of biological evolution as the principle of its natural history up to this point. Likewise, it does not suffice to have a vague consciousness of the fragility of our earthbound existence and thus the dependence of our species on planet Earth. (As we shall see, the fashionable environmentalist slogan *there is no planet B* even points to a fundamental misunderstanding in this regard.) Rather, the question of perception is today focused on making the Earth system actually perceptible and understandable in its components (climate system, biogeochemical cycles, biodiversity, etc.) – including the interconnectedness and impact of life as part of this planetary whole. The formation of an empirically or quantitatively based conception of the planet as a system, however, depends on the existence of a planetary infrastructure and apparatus of knowledge, or in Benjamin Bratton's terms: on "planetary-scale computation" (Earth-spanning data processing and computational processes).

Today, the Earth is covered by a network of sensors such as weather stations, satellites, research stations, etc., that produce large amounts of data which are fed into elaborate computer models of the climate and Earth system. Bratton stages the emergence of this sensory system and calculation activity as a kind of natural phenomenon revealed to us in a fast-forward film that takes us through the entire history of the Earth:

> In the very last moments of the movie [...] you would also see something unusual: the sprouting of clouds of satellites, and the

> wrapping of the land and seas with wires made of metal and glass. You would see the sudden appearance of an intricate artificial planetary crust capable of tremendous feats of communication and calculation, enabling planetary self-awareness – indeed, planetary sapience.[24]

Earth-spanning sensor technology thus enables planetary awareness and self-perception, and even sapience. For Bratton, it forms the basis of any successful governance of the Earth system:

> I call this terraforming – not of another planet, but of our own. It is a deliberate, practical, political and programmatic project to conceive and compose a viable planetarity based on the secular disenchantment of Earth through the ongoing artificialization of intelligence and the emergence of a general sapience that conjoins human and nonhuman cognition.[25]

The same basic idea can be found in a text that sociologist Bruno Latour wrote with Earth system theorist Tim Lenton under the title *Gaia 2.0*. In the early years of Earth system theory, James Lovelock and Lynn Margulis had brought the concept of Gaia (much discussed from the beginning and also today mostly viewed with skepticism) into play for understanding non-human, therefore unconscious and non-anticipatory self-regulation processes that would secure the long-term preservation of terrestrial habitability.[26] Latour and Lenton would like to see a corresponding Gaia mechanism "2.0" become a reality in the 21st century as a man-made governance project:

> Creating an infrastructure of sensors that allows tracking the lag time between environmental changes and reactions of societies is the

> only practical way in which we can hope to add some self-awareness to Gaia's self-regulation.[27]

On the other hand, we observe that – within the same line of discourse – the planet and planetarity are repeatedly positioned against precisely such forms of representability.

The starting point for this is a passage in Spivak's text, which has been quoted many times (and partially already above):

> The globe is on our computers. No one lives there. It allows us to think that we can aim to control it. The planet is in the species of alterity, belonging to another system; and yet we inhabit it, on loan.[28]

In this way, Spivak suggests a difference between *the globe* as a cartographic representation, which – seemingly uninhabited by humans and other living beings – designates the Earth as a space of (colonial, imperial or capitalist) domination, and *the planet* as an object that is not represented but real and inhabited (even if only on loan) and therefore resists fantasies of seamless control.

The distinction between globe/globalization on the one hand and planet/the planetary on the other was here already encountered at the very beginning – albeit only with regard to the types of actors and depths of impact implied in each. Here, Spivak is concerned with something else: "dis-locating a position that only seeks to control by digital quantification."[29] This is not specifically formulated with Earth sensing and calculating technologies in mind, but it can be applied to them, which seems to be exactly what media and cultural theorist Jennifer Gabrys does in her critique of Bratton. In particular, she problematizes any

holistic or totalizing representation of the Earth, any "total view" that already characterized the figuration of the globe now being applied to the planet:[30]

> Technology – especially computational technology – is analyzed as something on the 'scale' of the planetary. Technology is seen to overrun and command the planetary. The planetary is discussed as a figure of massiveness. Its invocation suggests total dominion: the rolling out of behemoth systems that hold the planet and all of its entities in a space of complete capture. This total view of Earth has an even longer history within modes of control and colonialism.[31]

Following Spivak's impulse, Gabrys is then concerned with positioning the figure of the planet against the globe for the purpose of warding off the violence that historically had been (and still is) linked to cartography and satellite technology as techniques of power:

> The planetary can be a different figure for undoing the totality of globes and globality. Rather than bringing the Earth into view as a total object [...], the planetary remains that which cannot be fixed or settled. The planetary resists representation.[32]

This is somewhat reminiscent of Chakrabarty's dictum that the planet eludes humanistic and human value categories. Again, we ask ourselves how, exactly, the planet is supposed to elude its representation, when today it is obviously represented and measured on an ongoing basis – including as Earth system totality? Or is Gabrys's formulation not intended to be matter-of-fact but aspirational?[33]

It is obvious that Bratton's vision of planetary "sapience" by way of Earth sensing can appear as problematic where it does not sufficiently illuminate the concrete actors behind the data collections and the computer modeling and ignores their (intended or unintended) power effects. Even more generally, the concept of the planetary, used as a spatial concept – i.e., as a synonym for 'Earth-spanning' (as in: "planetary-scale computation") – is notoriously imprecise because it does not capture the specifics of spatial configurations; for example, the location and geopolitical affiliations of the institutions where climate and Earth system science is now conducted, most of which are located in the Global North.

Conversely, these activities cannot simply be wished away, but should be further analyzed as a field of conflicting interests, and it remains unclear how, for example, climate activists would get along at all without a holistic (i.e. "totalizing") view of the climate or Earth system.

After all, if you lose sight of the Earth system, will you still encounter the planet at all?

And beyond that, or back to our initial question: What does it mean to inhabit a planet?

□ ASTROBIOLOGICAL INTERVENTION

We consider contemporary thought around the planetary to be very productive. At the same time, it is obvious that the approaches mentioned remain rather disparate.

How do they fit together and what is it that connects them? We believe that astrobiology is, or should become, their (still largely undiscovered) conceptual center of gravity. To be precise: an astrobiologically informed philosophy of nature – something that hardly exists so far. Our thesis is that the concept of the planetary has its proper place in an astrobiological description of ourselves today; only in this context will the concept prove its inner consistency and productivity. From readings of key astrobiological texts we draw the philosophical consequence that intelligent civilizations must be a rare but nevertheless 'ontologically regular' property of Earth-like planets. This consequence is just as much a part of the "practice of planetary thinking" (Gotthard Günther[34]) as is the recognition that none other than the planets themselves (as producers of such civilizations) are the ultimate subjects of thought – hence the double legibility of our title *Thinking Planets*. For us, such considerations are a key by means of which many of the conceptual ambiguities, unresolved issues and gaps within the still young discourse on the planetary can be rendered transparent and reconsidered productively.

With this approach, we pick up on an impulse of the human geographer Bronislaw Szerszynski:

> [The] discussion about the technosphere and the Earth's possible current geological transition needs to be expanded; it is only by situating the Earth's particular trajectory of development within a wider [astrobiological] 'phase space' of possible such trajectories, both real and imagined, that we can hope fully to understand what is occurring on the Earth.[35]

Similar formulations can also be found in Bratton's work:

> [A]fter several visits and flybys, from Europa to Pluto, and long-term robot inhabitants on Mars, debating "planetarity" should also be seen as the subject matter of a more general inquiry of comparative planetology.[36]

On the other hand, our approach is an objection to Latour's claim that the central astrobiological premise (the Earth being merely one of countless habitable planets in the universe) perpetuates an essentially still Galilean – objectifying, reifying – concept of nature.[37]

That's simply not true. On the contrary, we will see how astrobiology has the potential to revolutionize natural philosophy. Instead of looking at the Earth from the outside, as Latour suggests, astrobiology refers to the intrinsic construction and navigation of its future.

The affiliation of the planetary with astrobiology becomes obvious already by looking at the history of science, namely by the fact that the planetary – the recognition that planets are systems of living and non-living components that interpenetrate and shape each other – has its origin in the search for extraterrestrial intelligence (SETI, for short[38]) since the 1960s, i.e. in the precursors of astrobiology as a science:

> Consider this: it was the very technology of space exploration that came out of the Cold War and the growing weaponization of atmosphere and space that eventually brought the Gaia moment into our awareness.[39]

In this respect, it is perhaps no coincidence that the climate and biodiversity crisis is now regularly described – albeit rarely explic-

itly – in astrobiological terminology, more precisely: in terms of the Earth's habitability and the loss thereof (for example, in the works of Achille Mbembe or David Wallace-Wells[40]). Even more remarkable, then, is the lack of interest inside the nascent planetary humanities regarding approaches and scientific disciplines that have traditionally covered the study of planets. Even where planets or planetarity are not merely metaphors for alternative descriptions of our social and civilizational existence, the sometimes spectacular, even groundbreaking developments in astronomy and astrobiology of recent decades play almost no role.

It is our (natural-)philosophical conviction, however, that especially astrobiology offers decisive insights for a better understanding of the co-evolutionary development of planets and the (basic or complex) forms of life encountered on them at different points in time. Such co-evolution does not only apply to the intelligent civilization of *Homo sapiens* and its impact on the planet – especially in the so-called Anthropocene –, but begins at the latest with the stabilization of planetary temperatures by eukaryotic cells. And it is linked to a genuinely new astrobiological understanding of *The Origin and Nature of Life on Earth* (to cite a book title by Eric Smith and Harold Morowitz): "that life emerged early and has persisted robustly because the origin of life was actually a transition away from a less stable planetary condition devoid of life, and into a more stable condition that includes a biosphere."[41]

In a sense, then, astrobiology's achievement in the last decades consists in the consolidation of its very object of study: life on a plurality of planets (as well as the associated, entirely new approaches to an understanding of life in all its aspects; not just its

emergence). Above all, the focus on planets in the plural is associated with insights into the variability and general temporality of these celestial bodies:

> We all have a conception of our planet in the present day: dominated by oceans, a green and blue place, and our place. But as we go back in time and forward in time, we find that the Earth was and absolutely will be a place very different from the planet we now call home. Earthlike is really a time as well as a "place" definition, it turns out.[42]

Habitable planets are not inert lumps of matter. In our analyses, therefore, we consider them less as extended objects (which they also are) than as temporal phenomena. Analogously, nature is to be understood less as a stock of things than as the process whereby a possibilityspace is unfolded. Habitable planets are figures in time that, where they develop life, pass through a series of Major Evolutionary Transitions. The variety of such trajectories, their conditions and modalities form the subject of what we will call astrobiology's *general planetary model*.

Earlier reorganizations of the information and knowledge space of astronomy were already linked to media-technological shifts – with corresponding irritations of the accustomed understanding of space and time. This is true from Alexander von Humboldt's Cosmos Lectures (1827/28) with their reference to asynchrony – "the aspect of the starry heavens presents us with the spectacle of that which is only apparently simultaneous" – to the self-reflection of the Earth brought about by satellites in recent decades.[43]

It is only today, however, that planets become legible as constitutively temporal figures. *Thinking Planets* wants to create a

new natural-philosophical framework based on this recognition, and on recent knowledge about the potentially infinite series of exoplanets in the universe, trying to spell out its consequences. The consideration of the Earth in light of new astrobiological and philosophical concepts leads us to a new philosophy of nature, understanding 'nature' not primarily phenomenally (as a separate realm of reality with certain properties), but functionally: as the exploration of the Earth's possibilityspace by way of evolutionary and other natural-historical processes. Such an approach makes it possible to understand life in general, and intelligence in particular, as the driving forces of natural history, and to recognize human societies, cities, and technological systems as new natural phenomena on the planet (rather than merely identifying them as vague hallmarks of a new Anthropocene geological era). Planetary thinking means experiencing and coming to terms theoretically with the collapse of the established separation of geosphere, biosphere and technosphere. This follows from the astrobiological evidence that the world's human population is a planetary property just like the rest of the biosphere to which it is inextricably linked.

It is, therefore, not just that the distinction between culture and nature (which was historically constitutive of cultural studies) has become untenable. From an astrobiological perspective, we also recognize the world's population, its cultural histories and respective technological dynamics as the *main arena* of the Earth's natural history in its unfolding – and not only in the present and future:

> The creation of intelligent life and civilization has produced a fundamentally different planetary system than existed ten thousand years ago. One could argue that the potential for planetary change is almost as great as that caused by origin of life or the rise of oxygen.[44]

For us, learning to think and live the planetary way relates to the insight that life has only ever developed through a process of co-engineering with a constantly changing planet that it helped to create. This is true from the microbial invention of photosynthesis – whose production of the toxic oxygen gas led to the so-called Great Oxidation Event (or Oxygen Catastrophe) as well as to several Snowball Earth episodes of a frozen Earth – to, hopefully, the future evolutionary development of complex life.

Thus, we can already see how the astrobiological serialization and temporalization of the Earth fundamentally revise the image of the planet (present in parts of the planetarity discourse) as alien and static – and, correspondingly, of intelligent civilization as external and accidental to it and its natural state of affairs. Against this background, all the supposed constants with regard to 'nature' (or its successors: 'environment' and 'climate') turn out to be symptoms of a shortsightedness with regard to natural history and natural philosophy.[45]

□ HYPER-ANTICIPATION

Only where knowledge of the planet's changes is established are the conditions met for consciously inhabiting that planet, i.e., for living on the planet instead of just dwelling somewhere on its surface. Obviously humans have never lived anywhere but on

Earth. In a qualified sense, however, i.e., *as* a planet, we inhabit the Earth only to the extent that we (as biological beings understanding the geological and technological foundation of our existence) learn to recognize and then shape the new *geopolitical* and *geopsychological* playing fields of the present.

One starting point here is the radical shift introduced by a philosophical reading of astrobiology into earlier thinking around the planetary: transforming the planetary from a concept of space ('Earth-spanning'...) to a concept of time (the planet is its becoming, temporal signature).

In this context, computer models of the Earth system – the mathematical models of climate, population dynamics, economic activities, etc. – create a very much expanded time horizon for our societies. This point is easily overlooked. But what all these models have in common is a pronounced temporal dimension: modeling the planet = modeling its future. Planetary computation makes the planet's future more transparent to us as a space for action. We consider the model-based projections to 2030, 2050, 2100 that are ubiquitous in the media, in politics and business today, as indicative of the emergence of a new dispositif of governmentality: the dispositif of hyper-anticipation.

Hyper-anticipation is a new political toolkit that could enable us to collectively navigate the future course of the Earth's natural history – of an 'environment' or a 'climate', mind you, that have significantly changed their character. In terms of media theory, "calculation" more and more "becomes our environment."[46] At the same time, hyper-anticipation is a new battleground concerning questions of who produces, controls, and profits from this knowledge of the future – and who doesn't: which planetary

future should become real, and in whose favor? Instead of exhausting oneself in an illusory opposition or supposed conflict between a merely assumed planetary 'sapience' and an equally assumed unrepresentability of the planet, we believe that a political analysis of this dispositif is one of the major philosophical tasks when thinking about planetarity.

□ AUTOBIOGRAPHY AND NATURAL HISTORY

The temporality of planetary conditions as brought to the fore by the astrobiological intervention has further, hitherto unaddressed consequences for our psychological self-understanding as temporal beings. This idea is at the heart of the second part of the book, which takes the form of a philosophical dialogue.

Here, the natural-philosophical advancement of astrobiology as a science is the key for us to bring the conceptual worlds and realities of planetarity – which always seem 'too large' *vis-à-vis* individual observers and living beings – into the scale of our situated lives, i.e., to make planetarity visible as a principle *in* our lives and thereby also to gain new ways of self-relation. Usually, scaling down macro objects to a meso-realm that would be compatible and comprehensible to us – the dimension of the individual life – is achieved by moving into the local: by withdrawing from the scale of the planet (see Gabrys's citizen sensing projects). For us, conversely, the downscaling takes place through *the empirically observed synchronization of natural-historical and biographical time* on the one hand and *the anticipatory mapping of biographical time by Earth system models* on the other.

Quite unintentionally, economic forecasts for 2050 or simulations of population development up to 2070 also shed light on the biographical space that unfolds before observers as they age. In our analysis, such projections are associated with concrete subjectification effects – they generate a new sense of biographical wholeness or finitude. Focusing in on the temporal frame of the biography – the singularity of our own lives starting in 1973 and 1977, respectively – allows us to analyze the existential charge of what it means to inhabit the planetary today, which, in the age of hyper-anticipation, is marked by deep traces from the past and the future.

Today, the pace of natural history increasingly registers on the scale of biographical time: the morphological developments in computer technology, genetically modified organisms, energy technologies (like nuclear fusion) and tissue engineering since the 1970s exemplify an unfolding of the Earth's natural history that we can observe first-hand. Their timeline is inextricably intertwined with that of our lives. This interconnection is particularly existential in view of the developments in medical and pharmaceutical technologies in recent decades: With every year that we continue to live, they result in a further increase in our life expectancy, which in turn allows us a view into an ever deeper natural-historical future of the Earth. This not only gives rise to a planetary imperative to recognize and remedy the metaphysical crime of extremely unequal life expectancies in the world population (a crime that is metaphysical in not being purely situated *inside* the experiential physical world of a life). It also lays an emphasis on old age. The 'territory' that we inhabit when inhabiting the planetary is always the next couple of decades. If,

therefore, inhabiting the planet takes place in time – as we age –, it is in the oldest age that we encounter the planet in its highest degree of futurity.

PART A

ASTROBIOLOGY (DEEP TIME)

Astrobiology is a young science that only emerged as a discipline in the 1990s.[47] Its prehistory lies in the search for present or past extraterrestrial life within the solar system, especially on Mars (starting with the Viking 1 mission in 1975). From there it expanded to the search for signs of life on planets outside the solar system (exoplanets) and linked up with a puzzling question that was also very much present in the cultural imaginary of the time: why exoplanetary civilizations have not long since contacted or visited Earth (Fermi's paradox, Drake's equation[48]).

It is only in the last three decades, however, that exoplanets have actually been sighted in increasing numbers (using the Kepler, then the TESS space telescope) and examined for biosignatures – this is what is called the exoplanet revolution.[49] While around 30 exoplanets were discovered in the 1990s, there were almost 400 in the 2000s and several thousand in the 2010s.[50] The focus here is on the chemical-atmospheric changes that life causes on planets and that can be detected at great distances. This search is unspecific regarding the question of whether we are dealing with simple or complex, even intelligent life. Meanwhile, projects such as Breakthrough Listen (2016–) or FAST (2020–) continue to scan the sky for electromagnetic signals, which are assumed to be markers of intelligent, so-called "astronomically active" civilizations outside the solar system (SETI).

In the new millennium, these empirical undertakings in astrobiology were accompanied by a number of groundbreaking theoretical developments – most notably the Rare Earth Hypothesis of Donald Brownlee and Peter Ward, who, using the model case of the Earth, argue for a wide distribution of simple life but an extreme rarity of complex life in the universe.

> [A]nother insight of the Astrobiological Revolution has been that attaining the stage of animal life is one thing, but maintaining that level is quite something else.[51]

This is because such maintenance requires certain stabilization factors – such as a moon, plate tectonics, and the absence of fatal comet impacts – which happen to be present on Earth while presumably being absent on the vast majority of habitable planets. And even on our planet, complex (animal) life has passed through a whole series of catastrophic mass extinction events since its development in the Cambrian explosion about 500 million years ago, which it could easily not have survived (mass extinctions are characterized by a loss of ≥ 80% in a much shorter period of time, compared to the 'normal' extinction rate of about 30% of all species every 10 million years, or about 65% every 100 million years).

In addition to this astrobiologically relevant increase in geological knowledge, new findings on the development of life under extreme conditions (extremophiles) and hypotheses on the extraterrestrial origin of life – together with its possible interplanetary import by meteorites, the so-called transpermia hypothesis – have led to a new theoretical understanding of life as a genuinely planetary phenomenon since the 1990s.

The emergence of life from non-living entities – from the not-yet-aliveness of young habitable planets – corresponds to a new ordering pattern for planetary matter and suggests that *biology* is in a sense always *astrobiology*: life basically being a planetary state. Conversely, inhabited planets cannot be described geologically

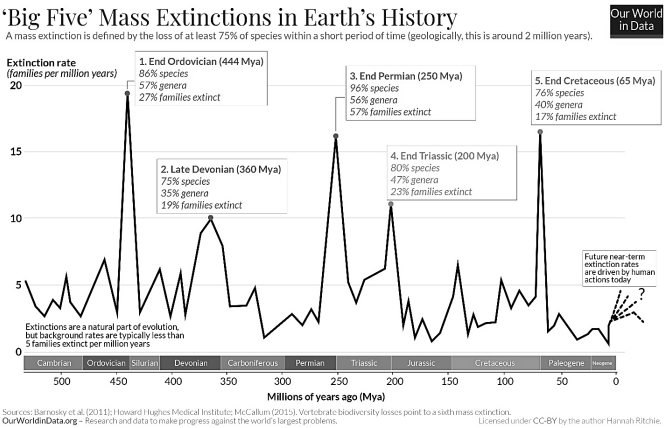


FIG. 1

without taking into account the geomorphological force of the living processes that take hold of them:

> This perspective, which makes life a planetary property [...], opens the way to a more general treatment of biology at its core as a system science rather than a strictly historical discipline.[52]

However, in order for the planetary state of ‘life’ to actually unfold its immense powers and potentials, two things are required: a lot of time – and a lot of attempts.

1. THE ASTROBIOLOGICAL SERIES

In his classic *Wonderful Life* (1989), evolutionary biologist Stephen J. Gould develops the thought experiment of replaying the history of life:

> I call this experiment "replaying life's tape." You press the rewind button and, making sure you thoroughly erase everything that actually happened, go back to any time and place in the past – say, to the seas of the Burgess Shale [in the Middle Cambrian, roughly 500 million years ago – AA, DF]. Then let the tape run again and see if the repetition looks at all like the original.[53]

Gould's thought experiment was not yet formulated in an astrobiological context. Nevertheless, his scenario is very helpful to conceptualize some of the central ideas and operations of astrobiological thinking (counteracting the above-mentioned deficits of contemporary theories of planetarity). For the basic theoretical operation of astrobiology consists in interpreting this replay of planetary history, which is *hypothetical* for the Earth, as *real* in the universe: The "tape" of life is actually replayed countless times in the universe, namely in the form of billions of Earth-like exoplanets each starting their histories anew.

This basic equivalence is based on the so-called Copernican principle:

> The consensual scientific position regarding the physical conditions for life elsewhere is underlined by the Copernican presupposition:

> Earth is not unique; Earth-like environments enabling life might occur on other planets and moons. Recent data attesting to the proliferation of planetary systems in the galaxy and the discovery of an Earth-sized planet in the habitable zone of its star give credence to this conception.[54]

Earth-likeness does not always equate to Earth-identity. While Gould's thought experiment starts from the identical initial state of an earlier Earth, the 'astrobiological replay' contains a more or less strong variation of initial conditions: every single feature that describes the early Earth can be thought of as being present (or not) on other habitable planets, and every single parameter by which we analyze a planet can deviate to greater or lesser extent from conditions here on Earth.

This understanding at once clarifies and expands what was still a mere thought experiment for Gould in the 1980s. Already in the case of *identical* initial conditions – e.g., two identical early Earths – one must ask whether the planetary process of life would unfold similarly in each 'replay'. But then even more so, types and degrees of deviation from the Earth's initial conditions will be associated with correspondingly different trajectories of life in the continued 'replay' of billions of planetary stories out there in the universe. The sum of these paths constitutes the morphological space of life as is possible in this universe.

From a philosophical point of view, the groundbreaking theoretical innovation of astrobiology therefore consists of two operations:

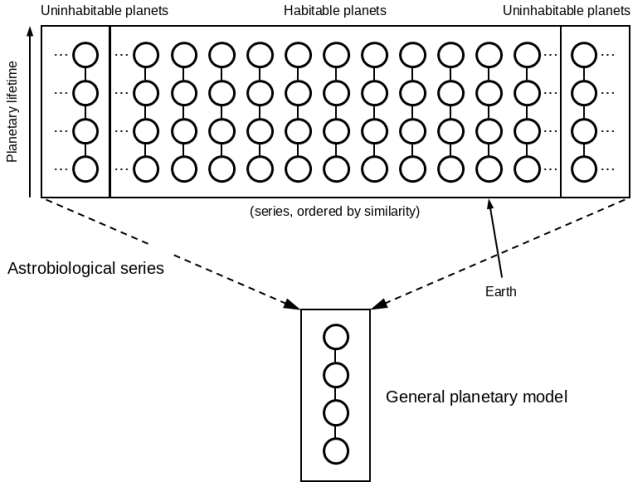


FIG. 2

(1) *Astrobiology serializes the Earth.* It places the Earth in a hypothetical, in principle infinite series with itself; and in a real, billion-fold series of Earth-like exoplanets in the universe.

What is easily lost in the multitude and diversity of astrobiological research designs and individual projects is that they in fact lead towards the elaboration of a single, uniform model space – a general planetary model that would exhaustively describe the possibilityspace of habitable planets in the universe. And while current astrobiological research is by no means there yet, the general planetary model is its vanishing point.

According to the Copernican principle, all habitable planets are subject to the same fundamental conditions: they all have the same set of chemical elements and physical forces or laws at their

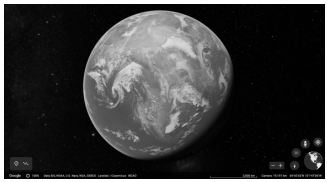


FIG. 3

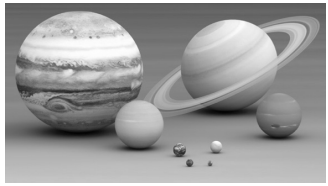


FIG. 4

disposal (gravity, electromagnetic force, strong and weak nuclear force, etc.), some of which have made up the universe since its earliest moments, some of which have only arisen in the course of time (like the heavier chemical elements from hydrogen in the early universe).

Bronislaw Szerszynski also thinks along these lines when he writes:

> The deepening understanding of our own solar system and the continuing discovery of diverse exoplanets orbiting other stars can help us to construct a far more expansive theoretical 'phase space' for planetary development, one that can accommodate diverse possible developmental trajectories of planets.[55]

(2) *Astrobiology temporalizes the Earth.* Artistic representations of planets of different types, which are placed next to each other like marbles of different colors, convey a reductive image of planets that takes the uninhabited planet as its archetype. The same is true of Google Earth, which confuses the 'Earth' with a digitally assembled patchwork of contemporary snapshots of the fully mapped globe. Viewed through the lens of astrobiology, however, planets appear neither as inert lumps of matter nor as snap-

shots, but as extended time sequences, temporal figures. Their gestalt lies less in their material nature and spatial configuration (at whatever point in time) than in the profile of their process between beginning and end.

Planets are flourishes in time.

In our astrobiological understanding, the morphology of planets is the morphology of their becoming, their temporal signature, the conditions and patterns of which the planetary model theorizes:

> [C]omparative planetology helps us to see planets as historical beings – entities whose states and trajectories change over time.[56]

Astrobiology thus becomes an ultimate horizon of any historical science, adding to historiography something it usually lacks, but which is absolutely necessary in any 'scientific' approach, namely repeatability. Even though philosophy still has a long way to go in figuring out the consequences of astrobiology for our understanding of history, that much has become obvious: *Without* a broadened horizon of the astrobiological kind, historiography can only ever look at the *one* history which has materialized, or at repetitions within this *one* history (recurring patterns), or synchronous repetitions in space (cross-cultural comparison) as a substitute for repeatability. And this is the way in which historiography, and even Big History, is usually conducted.

Astrobiology, on the contrary, offers an epistemology based on repetition and allows its application to the field of history. It encourages us – and also provides empirically derived tools and analyses – to place the observable history of the Earth in the

context of a virtual repeatability of Earth stories. In addition, astrobiology enhances empirical progress in the observation of repeated planetary trajectories by searching for Earth-like exoplanets (however fine-grained the empirical approaches may be at this point).

Incidentally, Oswald Spengler's idea of a homology of historical phenomena appears as surprisingly timely in this context, where homologies may no longer exist only between different places and times on Earth, but also within the astrobiological series. What do we mean by that? In his classic on the philosophy of history, otherwise untimely and problematic in many respects, Spengler observes a homology of historical phenomena, according to which phenomena or facts that are chronologically separated by thousands of years can still be simultaneous in a particular way, namely insofar as they have analogous or homologous significance within their cultures: "[A]nd we might have ventured to describe Pythagoras as the contemporary of Descartes, Archytas of Laplace, Archimedes of Gauss. The Ionic and the Baroque, again, ran their course *contemporaneously*. Polygnotus pairs in time with Rembrandt, Polycletus with Bach."[57] From an astrobiological perspective, however, homologies like the existence of 'astronomically active' intelligent civilizations at a certain level of technological development could even be expected on far-apart exoplanets that start their path through their evolutionary transitions (see below) billions of years earlier or later in the universe.

The two operations elaborated above, the serialization and the temporalization of the Earth, are thus intertwined. We will stick with them in what follows. Admittedly we are not friends of the

one history of the Earth and humanity, or even of this *one* political history that is unfolding before our eyes. We are tired of being presented with the same historical protagonists of the same story over and over again – the ones we can only observe. Instead, we are fascinated by the *space of all possible histories of the Earth*: we love the planetary model. It is this model that we desire, and in a certain sense we are much more willing to inhabit its modeled space than the abyss of the single history that has materialized out of it. This is how astrobiology adds to our quality of life.

□ EVOLUTIONARY TRANSITIONS (1–8)

If planets are temporal signatures, what is their mode of production, how does their process work? The answer follows the evolutionary paradigm that applies to all biology and natural sciences:

> [T]he philosophical Darwinian presupposition [holds] that terrestrial life emerged and evolved naturally and might do so elsewhere is not in doubt and is commonly guiding research in the field. [...] The origin of life itself is viewed by researchers as an evolutionary process, dependent on the prebiotic emergence of an evolvable physicochemical infrastructure that could have undergone primitive reproduction, variation, and selection.[58]

More specifically, the Earth's evolutionary process appears less as a continuum than as a passage through a series of key evolutionary innovations or "transitions" that add new mechanisms and/or actors to the evolutionary process and sharply divide it into a before and after. These major transitions in evolution – which also provide the title of an influential book by theoretical

Table 1.2 The major transitions

Replicating molecules	→	Populations of molecules in compartments
Independent replicators	→	Chromosomes
RNA as gene and enzyme	→	DNA + protein (genetic code)
Prokaryotes	→	Eukaryotes
Asexual clones	→	Sexual populations
Protists	→	Animals, plants, fungi (cell differentiation)
Solitary individuals	→	Colonies (non-reproductive castes)
Primate societies	→	Human societies (language)

FIG. 5

biologist John Maynard Smith and biochemist Eörs Szathmáry (*The Major Transitions in Evolution*, 1995)[59] – concern fundamental evolutionary inventions such as DNA, cells with nucleus, sexual reproduction, multicellularity and cell differentiation in the organism. The invention of multicellularity took place in the so-called Cambrian explosion about 500 million years ago (i.e., following some 4 billion years of planetary history), an event that effected the emergence of the Earth system in approximately its current form, with the biogeochemical cycles in place that are still active and known to us today.[60] It led to a unique multiplication of multicellular lifeforms – also called "adaptive radiation" because of its suddenness (in Earth-historical terms, it happened as if with the speed of light...).[61]

But Smith/Szathmáry have counted two further key inventions of biological evolution – that of social behavior (social insects, etc.) and that of human language use, setting in motion an open-ended process of socio-cultural evolution. According to the Major Transitions Theory, after each of these eight key in-

novations, subsequent Earth history is shaped by new rules, and, as a consequence, planet Earth is physically reconfigured as well:

> [...] the Earth seems to be less one planet, rather a number of different Earths that have succeeded each other in time, each with very different chemical, physical and biological states.[62]

Evolutionary transitions are not the only conceivable forms in which planetary processes of becoming are articulated. There are also plausible descriptions of the Earth's deep history based on energy paradigm shifts, such as that of Olivia Judson:

> The history of the life-Earth system can be divided into five "energetic" epochs, each featuring the evolution of life forms that can exploit a new source of energy. These sources are: geochemical energy, sunlight, oxygen, flesh and fire. The first two were present at the start, but oxygen, flesh and fire are all consequences of evolutionary events. Since no category of energy source has disappeared, this has, over time, resulted in an expanding realm of the sources of energy available to living organisms and a concomitant increase in the diversity and complexity of ecosystems.[63]

Increases in complexity and novelty are also frequently noticed qualities of planetary evolution. In the words of Brazilian philosopher-politician Roberto Unger:

> Then we have in the evolution of the universe a series of events which increased this power (that always existed) for the production of the new. Already prior to life in the geological record, we find the creation of novelties, like the formation of crystals. Then comes the mind, consciousness and more. The evolution and ascent of human-

> ity and the development of our powers of agency is related to this enhancement of our ability to create the new.[64]

The temporal signature of habitable planets can thus be described in different ways. Following our preference for Smith/Szathmáry's major transitions approach, the central question of the astrobiological research program regarding the Earth becomes whether and to what extent its known temporal signature, including the eight evolutionary transitions, would also be repeated or take on a similar shape time and again in the hypothetical re-runs of Earth's history.

Let us recall once again the evolutionary thought experiment:

> If each replay strongly resembles life's actual pathway, then we must conclude that what really happened pretty much had to occur. But suppose that the experimental versions all yield sensible results strikingly different from the actual history of life? What could we then say about the predictability of self-conscious intelligence? or of mammals? or of vertebrates? or of life on land? or simply of multicellular persistence for 600 million difficult years?[65]

For Gould, the reappearance of these phenomena in the re-runs is questionable. Proponents of the idea of so-called convergent evolution, on the other hand, consider such reappearance to be likely. They also affirm the directionality established by Smith/Szathmáry along the evolutionary transitions towards growing complexity on Earth.[66]

This does not imply the teleological supposition that the history of the Earth would be completely identical in every run, that in all runs all points of transition – one could also think of

doors or gates – would be 'found', or that no other transitions are possible that were not 'found' in 'our' run. However, it is assumed that they would be found in *some*, and that an infinite number of re-runs would result in a *robust and finite number* of transition points and corresponding temporal signatures. In fact, astrobiology as a science would be an impossibility if one saw a completely singular result in each run. The above phrase "planets are flourishes in time" refers to this tumbling, arbitrary, even chaotic passage of the planet through its possibilityspace.

But even after such an astrobiological clarification or reiteration of Gould's thought experiment, many questions remain when, once more, we turn from the Earth to Earth-like exoplanets. Do similar biological innovations also show up in their process – and even more fundamentally: Does the same general scheme – 'passage through a series of evolutionary transitions' – apply to them in the first place? Again, one finds positions within astrobiology that think of exoplanetary life strictly along the lines of life on Earth (because it can only be constructed in this one, carbon- and DNA-based way). Other approaches, conversely, theorize about life as we don't know it (LAWDKI[67]) and its evolution. Even these approaches, however, operate within the framework of the evolutionary principle and thus subscribe to some idea of evolutionary transitions:

> [P]icture an alien. If you are picturing something like unlinked replicating molecules or undifferentiated blobs of slime, then your aliens might not have undergone major transitions. But if what you are picturing has different parts with specialized functions, then your alien is likely to have undergone major transitions.[68]

We cannot emphasize enough that this plausible argumentation by no means implies any teleology (purposefulness) or 'teleonomy' (a conceptual solution to an age-old natural-philosophical problem that is currently much discussed in the philosophy of science, but which ultimately offers no solution to the recurring problem of teleology), nor even a noteworthy directionality of planetary processes. Ultimately, these things are optical illusions that simply result from dealing with virtually unimaginable quantities. If we – "picture an alien" – *pick out ten planets* with astronomically active intelligent civilizations and look at them in isolation, their paths to obtaining this property may appear rather directional (depending on how many and how different transition paths converge on them). Things look quite different, however, if we *restore these ten planets* to their series of billions of habitable exoplanets that start from similar initial conditions[69] and give rise to forms of life while not bringing about such civilizations: then any semblance of directionality vanishes, and the intelligent civilizations now appear as mere products of chance. We can look at the process in these two different ways, but it is always essentially the same process, the same picture that we are looking at.

The general planetary model of astrobiology, which is born out of the serialization of the Earth and that culminates in the idea of the habitable planet as a temporal signature of evolutionary transitions, encompasses all of these cases. We can therefore claim that the general planetary model is robust.

□ ONTOLOGICAL REGULARITY

The latest and 8th of the evolutionary transitions on Earth listed by Smith and Szathmáry is the biological evolution of the human capacity for language some 70,000 years ago: "The origin of language is the last transition of this kind that had a genetic basis."[70] As indicated above, the evolution of language is synonymous with the transition from biological to open-ended socio-cultural evolution. Its intermediate product is the Earth-spanning intelligent civilization of *Homo sapiens* and the present of the Great Acceleration. This civilization carries within it much inherited cultural difference and potential for political conflict, but it is, as we can clearly see already, subject to a single, common path of the development of collective intelligence.

Observing the occurrence of evolutionary transitions on Earth through the lens of astrobiology's general planetary model, it becomes clear that 'intelligent civilization' is a regular property of this planet: the 8th transition does not differ ontologically (i.e., regarding the status of its being) from earlier ones like the formation of eukaryotes or the transition to multicellularity. *All* transitions are based on chains of countless coincidences that would never materialize in a singular run: they only emerge and combine in a billion-fold series. In the astrobiological series, however, they are very real. The fact that habitable planets pass through an 8th transition less frequently than, for example, a 6th or 3rd transition marks a quantitative but not ontological difference.

We can, as is plausible, even assume that the Rare Earth hypothesis is correct[71] and that intelligent civilizations are relatively

rare in the universe (such that in the Milky Way galaxy as our closest cosmic environment, there may not be a single intelligent civilization concurrent with the terrestrial one). Still, there is, at any given time, a very large absolute number of planets with intelligent civilizations in the universe – simply due to its gigantic expansion.[72] In fact, they may be arbitrarily rare – it is never implausible that astrobiologists would in large numbers "pick them out and look at them in isolation" (see above). Their spatiotemporal distance from the terrestrial observer, again, is irrelevant to the question of ontological regularity in the astrobiological sense.

The idea of the ontological irregularity and ephemerality of the intelligent civilization on Earth, which we saw to be prominent in current discourse on planetarity, is thereby astrobiologically refuted.

Astrobiologists, for their part, have early on understood intelligent civilizations as regular planetary properties and even often readily overestimated their relative abundance in the universe (the SETI program and the whole discourse around Drake's equation are just two examples of this). The same is true of what can be called the speculative wing of the astrobiological research program, which takes a closer look at the factor "L" (= lifespan) in Drake's equation and attempts to guess future trajectories of intelligent civilizations – see the hypotheses about their use of electronic communications (which makes them visible to the SETI radio telescopes in the first place),[73] see Kardashev's scale, Dyson's spheres, Dick's idea of a 'post-biological universe,' or Tipler's reflections on a supposedly inevitable colonization of space, etc.[74]

As valid as the premise of this research may be, its hopes are unfounded: of *sighting* extraterrestrial intelligent civilizations, of *communicating* with them, even of *being colonized* by them or *colonizing* them (cf. the entirely un-planetary idiocy of Occupy Mars). Such hopes are based not only on an overestimation of the abundance of such civilizations, but ultimately on an almost childish underestimation of the extension of the universe.[75]

Conversely, it should be noted that from the non-occurrence of aforesaid desired events precisely *nothing* follows for terrestrial civilization. All theories regarding extinction risks and Great Filters derived from Drake's equation,[76] as well as corresponding initiatives like longtermism,[77] are baseless: we recognize them as a great hoax.

2. NATURE, I.E., THE EXPLORATION OF THE POSSIBILITYSPACE OF THE PLANETS

The 8th evolutionary transition to language and open-ended socio-cultural evolution has numerous effects for its host species, *Homo sapiens*. We would like to highlight two: first an initially moderate, later (with the agricultural revolution) noticeable, and finally (in the modern era) sudden increase in the size of its population; and secondly an increase in its life expectancy: over long periods of time hardly perceptible,[78] and then, for about the last 150 years, extremely rapid.

The growing size of a species' population and the increasing life expectancy of its individual members are indicative of how livable the planet is for them, that is, how planetary habitability has increased for that species.

The Great Acceleration, during which average life expectancy has jumped from 46 to 71 years since 1950, while the world's population has more than tripled, then marks the moment of

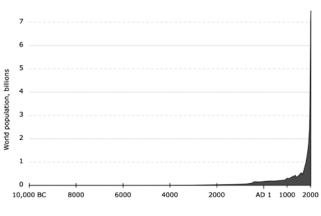


FIG. 6

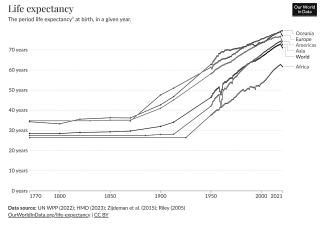


FIG. 7

an outright *escalation of habitability*. Despite all intuitions and proclamations to the contrary, *planet Earth has never been as habitable for humans as it is now.*

We can easily lose sight of this basic fact when putting our focus on the threats to habitability caused by global warming and species extinction – which we must do. For these threats are real and mark the central political problem as well as *the* planetary social question of our time. However, they do not change the fundamental reality that the planet is, for the time being, becoming increasingly habitable for humans. Accordingly, the risk of extinction of *Homo sapiens* is today *lower* than ever before – not the other way around, as a myriad of "collapse porn addicts" (Leigh Phillips) would have us believe.[79] Emblematic of this is the fact that the number of deaths from extreme weather events and natural disasters has *fallen* fivefold worldwide in recent decades.[80] Most end-of-the-world vibes and apocalyptic talk are disoriented about basic facts regarding the state of the Earth and miss the main phenomenon: the escalation of habitability.

At the same time, we are in a unique geohistorical and atmospheric moment: the historical moment in which the anthropogenic ecological niche has reached the scale of the planet itself. And it is obvious that the leap in habitability for the human species is associated with massive losses of the planet's habitability for non-human beings in the biosphere (not least due to the particular ways in which humans have made use of the new means of habitability at their disposal).

Is this, then, a moment of the 'desecration' of nature, of its 'destruction'? Is the planet 'broken' and 'humiliated'? Does this

moment even, as is often assumed, equate to an 'end' of nature in the Anthropocene?

At any rate, the Great Acceleration has led to great confusion in our thinking about our relations to and concepts of nature.

□ NATURAL HISTORY: ECSTASIES

Astrobiology has a number of still mostly implicit consequences for a new philosophical understanding of 'nature' that we now want to articulate and generalize more explicitly.

Let us go back to the general planetary model (cf. chapter A.1, Fig. 2). It describes the possibilityspace of Earth-like planets and interprets the process of planets as one 'path' through their possibilityspace. As much as this process *depends* on initial conditions, i.e. the nature of young planets, it is not *determined* by them. On the other hand, the process is not completely arbitrary (even if it involves a lot of chance), but is limited by the possibilityspace. The process of a planet can be understood as the 'exploration' of its possibilityspace in geological time, including the 'detection' of and 'passage' through evolutionary transitions (which function as 'gates' or 'doors' to each new 'room' in the space of possibility). The similarities that crop up in a large number of repetitions of such a process – i.e., in the astrobiological series of habitable planets as described above – may then create the appearance of directionality, without necessarily involving any determinism or teleology. The sub-ject of this whole process – the thing that underlies it – is none other than the respective planet, whose matter differentiates over time into the individual

carrier media of evolutionary innovations. In the case of planet Earth we can follow this from prokaryotes to cyanobacteria and humans to perhaps no longer carbon-based life forms and intelligences in the future.

It is this process of exploration and explication of the possibilityspace of planets that, by spelling out the implicit premises of astrobiology, we call 'nature'.

'Nature' understood in this way is not a stock or inventory of things at any particular point in the planet's history. Nature is a process that produces new structures and new forms of process on planets (as temporal figures): Nature = natural history.

If we are looking for 'nature' on Earth, we should not be looking for specific *areas or places* on the surface of this planet. Instead, we should watch out for specific *points in its history* – for the temporal 'hotspots', the temporal escalations or ecstasies of its natural-historical unfolding. 'Nature' on Earth has always signified first and foremost the evolutionary transitions as such, but also all the new evolutionary, ecological and Earth system innovations and constellations that took shape in their wake and make up the peculiarities of the geological ages.[81]

(With a brief comparison from the history of speculative philosophy: The distinction between short and hyper-productive transition phases – *natura naturans*, to use a term by philosopher Baruch de Spinoza – and long intermediate phases until the next transition results in a view of the inventory of the biosphere in the intermediate phases as the 'residual' or 'heritage' of the transitions – *natura naturata*, in Spinoza's terms.[82])

The 8th evolutionary transition mentioned above must be seen as an instance of nature, just as 500 million years ago 'nature'

signified the transition to multicellularity. About 70,000 years ago nature transitioned to open-ended socio-cultural evolution and the gradual elaboration of its geological consequences: since that time, *this* has been the process that explores the Earth's possibilityspace into hitherto unknown regions, and that constantly generates new structures and ever new forms of process on this planet.

The 8th evolutionary transition creates new natural phenomena (= biological, ecological, social, physical, chemical, etc. phenomena) initially only within the human species, i.e., within the very narrow boundaries of its ecological niche (while it is true that since then, categorically or qualitatively new natural phenomena have in fact *only* been created inside that niche).[83] Only when it gained in size and depth in the course of the Neolithic Revolution, as the world population slowly started to increase (not least due to climate change at the start of the Holocene), did the human niche begin to have a greater impact on its surrounding ecosystems. On the one hand, it integrated more and more organisms and materials found and transformed by it and mobilized their agency – the 'anthropogenic' ecological niche is in fact a complex network of human with non-human or more-than-human agents.[84] On the other hand, the human niche covered more and more continental area. The Great Acceleration since the 1950s marks the point at which virtually the entire biosphere of the planet became located inside this ecological niche and was captured and affected by *Homo sapiens*' process of socio-cultural evolution.

Accordingly, the present is overflowing with new natural phenomena in all shapes and sizes.

Let's put a few examples up for discussion:

The investigative activity of biologists in the biological world is itself a new biological fact.

So is the development and use of genetic engineering.

As well as the industrial organization of animal reproduction (insemination) for animal production.

And so is the demographic transition.

Tinder too.

The regulatory activity of ecologists in an ecosystem is a new ecological fact.

So are sensor-based ecologies in agriculture and nature conservation.

Factory farming too.

And also 'clean meat': meat without organs – a new ontology of flesh and life.

'Decoupling' (for conservation) as well.[85]

And climate models too.

Social media – the sociability of the internet – is a new social phenomenon (social phenomena are natural phenomena, cf. bonobo sociability).

CERN is a new physical phenomenon.

As well as nuclear waste.

So is the construction of the ITER fusion research reactor.

Extractivism and the material flows it sets in motion are new geological phenomena.

The sharply rising CO_2 ppm curve is a new climatic phenomenon, as will be its (hopefully soon to be observed) decline resulting from decarbonization efforts.

Geoengineering such as the introduction of aerosols into the stratosphere or the direct removal of CO_2 from the atmosphere would be a new climatic phenomenon.

The Three Gorges Dam is a new hydrological phenomenon.

Etc.[86]

This list illustrates first of all:

(1) *Nature blooms in the Great Acceleration.* This is not a normative statement – obviously, such 'blooming' is not per se a good thing for all people and other living beings – but a statement of fact: the Great Acceleration marks an absolute heyday, an ecstasy of nature. It describes the age of a natural-historical productivity so enormous that it corresponds to the formation of a new geological 'dimension' or 'sphere' of the Earth, which encompasses it and which overlays, exploits and radically reshapes the planet's pre-existing geospheres – hydrosphere, atmosphere, lithosphere, and biosphere. We are referring here to the technosphere, of which geologist Peter Haff says:

> The proliferation of technology across the globe defines the technosphere – the set of large-scale networked technologies that underlie and make possible rapid extraction from the Earth of large quantities of free energy and subsequent power generation, long-distance, nearly instantaneous communication, rapid long-distance energy and mass transport, the existence and operation of modern governmental and other bureaucracies, high-intensity industrial and manufacturing operations including regional, continental and global distribution of food and other goods, and a myriad additional "artificial" or "non-natural" processes without which modern civilization and its present 7×10^9 human constituents could not exist.[87]

It's not just that the technosphere has long reshaped and replaced the biosphere as human habitat. The distinctions between the spheres as such have also become brittle since the geosphere has been covered by a technologically shaped layer of human and artificial intelligence. We are beginning to understand that our lives are led in parallel – not to say radical simultaneity – with the planet. Life as we know it, our lives and the planet we live on, developed co-evolutionarily, even co-biographically. In this respect, we disagree with Dipesh Chakrabarty when he speaks of a planet with "a perspective on humans and other forms of life without humans being at the center of the story."[88] The opposite is true today and for the time being.

At the same time, we retrospectively see that the distinction between the ecological niche of *Homo sapiens* and its outside (as long as there has been one) was never an *ontological* distinction between nature on the one hand and society or culture on the other, but always merely a *temporal* distinction between earlier and later, older and more recent developments and products of nature. Even if we don't like to hear and see it: As with many previous evolutionary transitions, it is also the case now that new nature, new natural phenomena, overflow the world of the older nature in a highly destructive manner; the difference being that today, we have the cognitive means that would allow us to minimize the degree of destruction (or not to minimize it – against our better judgment).

(2) *It is the collective intelligence of Homo sapiens, the intelligence of the anthropogenic ecological niche, which is the main producer of new natural phenomena on Earth – not only today, but since the start of the 8th evolutionary transition.*

Since then, the further development of the planet's possibilityspace has hinged upon this single factor. Intelligent life has become the *main site* of nature in its unfolding. This introduces a fundamental change into our understanding of thought. From now on, thought is no longer just a *product* of evolutionary processes (qua biological evolution), exercised for the most part at the level of the individual organism capable of learning (the intelligent raven, dolphin, etc.), without itself being the motor of natural history. No: thought now fundamentally changes how nature unfolds. As a collective and transgenerational process, thought becomes the producer of natural history, rather than just being its product. The 'sociocultural evolution' set in motion by the 8th evolutionary transition refers to nothing other than the transgenerational process of collective intelligence – with Marx this could also be understood as "general intellect,"[89] or with Hegel as "spirit." In the context of his natural-philosophical reflections on several earths or planets, Hegel speaks of the Earth as "our home, and not only our physical home but the home of Spirit too."[90] In fact, planets are the home of the mind, and thought unfolds on them in a productive way. Therefore, philosophy informed by astrobiology (i.e., a planetary philosophy of nature) will not so much be characterized by some great new knowledge *about* nature, *vis-à-vis* nature. Rather, its central insight relates to its own (planetary) ontology: *sub specie planetatis, thought itself is the hotspot of nature* – natural history flows from it.

'Spirit', like the 'culture' it brings forth, is not opposed to nature, as a long Platonic, monotheistic and scientistic tradition has always dogmatically presupposed. Planetary thinking must

be understood as a (now hyper-performative) part of a geotechnological history, which encompasses an almost infinite series of technologies that we are only just beginning to learn to understand as natural-historical phenomena:

> [I]f current geology, to understand finished epochs, has to study nature irrespective of man, future geology, to understand our own epoch, should study man irrespective of nature. So that future geologists, wishing to study our epoch's geology, would end up narrating the history of human intelligence.[91]

What the history of philosophy had so long considered immaterial – the mind, collective intelligence – is therefore not only a material practice in itself, a complex network of actors in the ecological niche.[92] After several tens of thousands of years of existence, collective intelligence is also, today and for the time being, the most explosive material agent on the planet: an overwhelmingly productive natural phenomenon to be tamed by nobody, an insane 'computational process', a never-ending course of self-differentiation of Earth's matter.

□ TRANSITION 9 – A CRITIQUE OF THE ANTHROPOCENE CONCEPT

Following these natural-philosophical considerations, we can now take up and deepen the hypothesis elaborated at the beginning of the chapter regarding intelligent civilizations as rare but ontologically regular properties of Earth-like planets. Ontological regularity also applies to phenomena like the Great Ac-

celeration. "This perspective entails viewing the current transition of Earth and civilization in their full astronomical and planetary contexts. This means seeing civilization as another manifestation of the long co-evolution of the biosphere and other coupled Earth systems," write astrophysicist Adam Frank and colleagues.[93] Accordingly, they characterize the Anthropocene, and hence the Great Acceleration, as a "generic consequence of any planet evolving a successful technological species."[94] In other words, given an evolutionary transition to language and open-ended socio-cultural evolution, a geological age dominated by that transition's host species is the (not inevitable but possible) consequence and by no means a singular event in the large series of Earth-like planets. To put it bluntly: Increasing habitability for the host species and setting in motion a Great Acceleration – that's what collective intelligence can do on or to a planet (given enough time).

But can the Great Acceleration 1950ff., in its relative suddenness and incommensurability (it was not recognized as such until 50 years later...), really still be interpreted as the ultimate consequence of the biological evolution of the capacity for language?

For as such, i.e. as the ultimate consequence of a process whose prerequisites and initial spark lie several tens of thousands of years in the past, we have so far (implicitly) understood the Great Acceleration. Aren't we thereby merely perpetuating a problem that is also smoldering in numerous Anthropocene debates, where the date of its alleged beginning is constantly moved back and forth? What if we have to think the other way around and start to understand the Great Acceleration as the *beginning of something completely different*? May it even signal the start

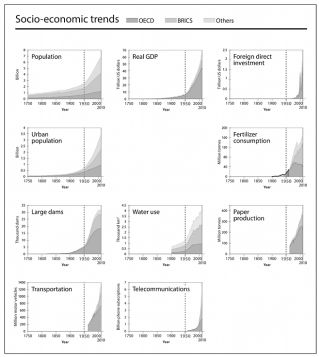


FIG. 8

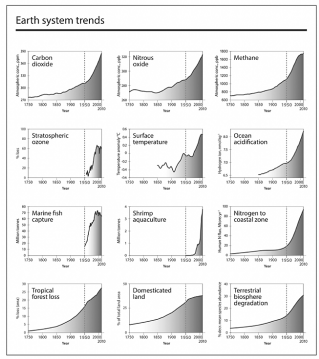


FIG. 9

of a new evolutionary transition – a new 'take-off' of Spaceship Earth (see the battery of upward-pointing exponential graphs above[95])?

This is at least what Smith and Szathmáry suggest at the end of *The Major Transitions in Evolution*:

> We are today in the midst of yet another major transition, to a society in which information is stored and transmitted electronically. It is impossible to foresee where this latest transition will lead.[96]

Two years after this publication, in an interview, Maynard Smith looks back at their book and explicitly marks this as an omission: "we don't cope [there] with *the transition we are now living through, which is the electronic revolution*, in which information in fact is transmitted electronically between people and between generations."[97]

If the emergence of the capacity for language as a media revolution corresponded to an 8th evolutionary transition, then the media revolution of computation and AI would correspond to transition number 9.

This focus on media and information transfer within the horizon of major transitions does not constitute a special position of these two historically most recent transitions: Rather, being a media revolution is common to *all* the evolutionary transitions recorded by Smith and Szathmáry:

> This book has been about the major changes that have taken place in the way in which information is encoded, and transmitted between generations. The origin of language is the last transition of this kind that had a genetic basis, but it is not the last transition.[98]

The phrase "major changes that have taken place in the way in which information is encoded" relates to human information technologies as much as it relates to earlier 'information technologies' involved in the transitions to sexual reproduction or earliest multicellularity. For astrobiology and its evolutionary principle (= principle of the *evolutionary* generation of planetary complexity through a number of key innovations in geological time), it has always been the field of information generation, transfer and processing that one must focus on to understand the revolutions (= hotspots, ecstasies) that shape and structure the natural history of planets. This also applies to the natural-historical excess of today's Great Acceleration: it must be understood in light of contemporary media revolutions of collective intelligence.

This focus confirms the above idea of collective intelligence currently being the main origin of new natural phenomena. At the same time, it allows for its specification, because collective intelligence is always already mediated. "[T]he pace of cultural evolution has accelerated over time," anthropologists Alexander Bentley and Michael O'Brien observe, noting that "much of it [has been] tied to the ways in which humans have been able to harness and manage information."[99] Accordingly, the Great Acceleration is to be thought of in conjunction with the developments in digital information processing since the Second World War. Researchers from the Max Planck Institute for the History of Science have recently pointed this out:

> The computer revolution coincided with the inflection point of the Great Acceleration around 1950, which, as it happens, is also considered as the beginning of the Anthropocene as such. [...] To exaggerate, one could say that the Anthropocene appears to be a material effect of increased computing power. In current historical research, such chronological and material connections are still largely obscured. [...] Future research must, therefore, look at the mutual penetration and reinforcement of expanding information technologies and the equally expanding rates of production and consumption. The exponential rise in the connectivity of telecommunications since the 1950s, as depicted in one of the graphs of the Great Acceleration, is just one of many such indicators. The first digital computers began to significantly augment human capabilities.[100]

Writing in the seventh decade after the dawn of the computer revolution, it is true especially for the sciences that they have now penetrated into areas they would never have come close

to touching and entering *without* electronic computation – including Earth system theory since the 1970s, astrobiology since the 1990s, and current climate models that anticipate the future. This is indeed an "augmentation of human capabilities" of such radical consequence that it could once again sharply distinguish Earth history into a before and after. Recent neural networks and large language models are just a foretaste of potential future evolutions of nonbiological intelligence.

From a media-theoretical perspective – media understood here in their basic transforming function of transferring, storing, and processing – Transition 9 becomes visible as a process of *debiologization of collective intelligence*.[101]

While the invention of writing and the printing press already shifted *information storage* from biological (= brains) to nonbiological media, today, more and more *information processing and generation* is taking place in chip-based machine systems:

> [This] tipping point was the appearance of technology capable of accumulating and manipulating vast amounts of information outside humans, thus removing them as bottlenecks to a self-perpetuating process of knowledge explosion.[102]

By understanding the Great Acceleration as a sign of the debiologization of collective intelligence and the early stage of a potential 9th evolutionary transition of life on Earth, we come to realize that this is in fact a natural-historical event of great significance, a great mutation in the being of the Earth. –

We prefer this *astrobiological* description of the present in the light of a 9th evolutionary transition – its signs and its conditions for success – to its description in the terminology of *historical*

geology. For as important as the geological concept of the Anthropocene is, and as compatible and productive as it has been for us in recent years, it also complicates things a lot. It puts the cart before the horse by grasping the present according to the criterion of its geological (dead) residuality: what's new about the present when regarded as Anthropocene is that today's generations will leave behind a distinct and novel geological stratum. And so what kind of stratum will it be, how can we determine it as accurately as possible by way of stratigraphic methods? Contrary to what is usual for the objects of historical geology, however, in the case of the Anthropocene, we have not only a geological stratum at hand to study this age of the Earth. We can directly observe its process as we live in that present.

In contrast to the astrobiological theory of evolutionary transitions, however, the term and discourse of the Anthropocene lacks any theory – or even a scientific hypothesis – explaining the emergence of the Anthropocene. We already mentioned a symptom of this, namely the disputed date of its beginning, for which there only seems to be one relevant criterion, one that is based on residuality: are there enough geological signals to place a 'golden spike'? The Anthropocene discourse understands the present as an 'incavation site' for future excavations. The Anthropocene can only ever be, and allow us to think, what we *have been* – an imaginary retrospective from *The Earth after Us*, to quote the telling title of a book by Anthropocene geologist Jan Zalasiewicz.

Astrobiology, on the other hand, is interested in the operational, living principle, the ongoing process of planet Earth, the revolution of its mechanisms that we experience *in actu*, and our possible futures within that process.

□ CLOUD AND BEEHIVE

We have seen how the planetarity discourse allows an understanding of technological growth as a natural property of the Earth, a theme that we can now pursue further. In a passage quoted above, Benjamin Bratton speaks metaphorically of the "sprouting of clouds of satellites" or a "planetary crust capable of tremendous feats of communication and calculation" with which the Earth is now covered. And elsewhere he formulates: "Earth has [...] evolved a smart exoskeleton."[103] The aforementioned Jan Zalasiewicz seems to be saying something similar: "skyscrapers and coral reefs are basically large masses of biologically constructed rock"; "we live in and drive on Anthropocene rock constructions that we call houses and roads."[104] Or as the science journalist and ecomodernist socialist Leigh Phillips puts it: "Our skyscrapers are not separate from nature; they are nature, as much as a termite colony's cathedral mound or a chaffinch nest or a beehive."[105]

Such naturalistic descriptions go back at least to the geochemist Vladimir Vernadsky (1863–1945), one of the first to popularize the concept of the "biosphere."[106] However, it is only in the astrobiological context that its natural-philosophical basis and its scientific (that is, by no means metaphorical) truth becomes transparent.

The astrobiological concept of nature – nature as the process of unfolding the possibilityspace of habitable planets – differs from all previous theological and regulative or normative concepts of nature. It also overcomes any Holocene-centrism by replacing the assumed static character of nature – a false extrapola-

tion from Holocene experience – with the hyper-dynamic, often catastrophic processuality of actually observed planetary history in deep time. Intelligent civilizations are not the other of nature, but its latest 'rocket stage' itself.

But the astrobiological concept of nature also allows us to qualify Vernadsky's naturalistic position with regard to its political implications:

> Before our eyes, the biosphere changes sharply. And there can hardly be any doubt that its reconstruction (which is being manifested in this way by scientific thought, through the organized human labor) is not an occasional phenomenon depending upon the will of man, but an elementary natural process whose roots are deep and were prepared by an evolutionary process which has lasted for hundreds of millions of years.[107]

The astrobiological concept of nature on the one hand confirms and intensifies Vernadsky's objectivism: Yes, the intelligent civilization and its Great Acceleration are not an ontologically futile aberration. For not only here and now on Earth, but also on many other planets in the universe (and at different times), living beings like us are born into intelligent civilizations that undergo Great Accelerations, that experience the debiologization of their collective intelligence. And indeed, such a course of events fundamentally does not depend on the "will" of the living beings involved (*on the will of humans*).

If a 9th evolutionary transition takes place on different planets in the universe, a seemingly contingent process in the history of technology like the one described by Moore's Law turns out to be not a singular but a serial event. In this case, however, proces-

sor technology is not so much 'invented' as it is 'discovered', and the morphological trajectory of its miniaturization must be seen as the recurring exploration of an objective structure rather than a one-off, freehand construction, the making of artifacts *ad libitum*. A crystallization process is a practical investigation of the physical rules of crystal formation. The evolution of the eye is the solution to the evolutionary problem of constructing organisms in an environment where electromagnetic radiation is present. Likewise, Moore's Law describes a *morphological process* in the sense of an exploration of objective possibilities given in the planetary matter itself. It is on these grounds that we understand that such processes can, in principle, be encountered again and again in repeated runs of the exoplanets. As a consequence, the semantics of natural processes – for example, Bratton's "sprouting clouds of satellites" (see above) – is indeed more appropriate for this than a semantics of technology and construction that stems from *looking at a single path of a single planet* and therefore captures (only) idiosyncratic, one-off processes that could actually be interrupted by a single decision of will.

On the other hand, an astrobiological understanding by no means implies that the natural process is completely withdrawn from, or unavailable to, the members of this intelligent civilization – for, after all, it is their own process.

A naturalistic conception of the Great Acceleration and the technosphere does not degrade people's actions to automatism or reduce their room for maneuver to zero. If we consider Transition 9 as a rare but ontologically regular property of habitable planets, we do not thereby suggest that any such transition (for example, here on Earth) will necessarily take place. Nor, that it

always has to happen in the same way – as if there were no variability within the phenomenon. Especially when taking place right before our eyes, why should we be unable to *collectively give a certain direction* to the natural history of this planet?

3. HYPER-ANTICIPATION

In what sense can it be said that we live on a planet, that we collectively inhabit it? This was our question at the beginning of the introduction. Even if we can't imagine the cognitive horizon of hunter-gatherers tens of thousands of years ago, for all their astonishing orientation and knowledge of regions, they probably had no idea of planets as astronomical objects in the solar system and outer space. We get an idea of this looking at our present – not because of our much more extensive knowledge, but exactly the other way around: the fact that our species lives and only survives in a technosphere characterized by Earth-spanning material, economic and cultural processes *has not at all translated into a corresponding everyday understanding of these processes and the Earth system as a whole*, at least not so far. It is in this sense that humans have not yet started living and thinking in planetary terms. Strictly speaking, the planet is still awaiting its inhabitants. Factually living on a planet's surface is not the same as inhabiting it.

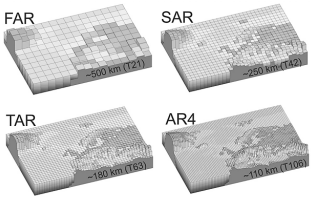
Conversely, today's discourse on planetarity is premised precisely on the fact that we are now increasingly in the process of imagining and forming a concept of planet Earth in space, as well as of the Earth-spanning processes that materially generate our living conditions. Talking about 'planetarity' entails not just an implicit or circumstantial reference to those processes themselves, but also a reference to our explicit knowledge of them.

Planetarity does not exist without this self-reflexive or recursive knowledge. This epistemic dimension is particularly present in Bratton's reflections on planetarity. According to him, the technosphere – the sum of man-made infrastructure that now contains as much terrestrial matter as the entire biosphere[108] – is not simply a new geological dimension of the planet. It is a new sensorium of the planet – a thing that Bratton refers to as "planetary-scale computation":

> The Earth is in the process of growing a planetary-scale technostructure of computation – an almost inconceivably vast and complex interlocking system (or system of systems) of sensors, satellites, cables, communications protocols and software. The development of this structure reveals and deepens our fundamental condition of planetarity – the techno-mediated self-awareness of the inescapability of our embeddedness in an Earth-spanning biogeochemical system.[109]

This new "techno-mediated self-awareness," which for Bratton constitutes the core of our "fundamental condition of planetarity," is based on two very concrete things: First, the rise of mathematical models (computer simulations) as an epistemic tool in the natural and social sciences.[110] Second, the emergence of Earth-spanning infrastructures or protocols of data collection to feed the models.[111] And one of the most prominent products of this planetary-scale computation are the climate models:

> The models that we have of climate change are ones that emerge from supercomputing simulations of Earth's past, present and future. This is a self-disclosure of Earth's intelligence and agency, accomplished by thinking through and with a computational model.[112]



Increasing spatial resolution of climate models used through the first four IPCC assessment reports: first ("FAR") published in 1990, second ("SAR") in 1995, third ("TAR") in 2001 and fourth ("AR4") in 2007. (Note, there is also a fifth report, which was completed in 2014). Source: IPCC AR4, Fig 1.2

FIG. 10

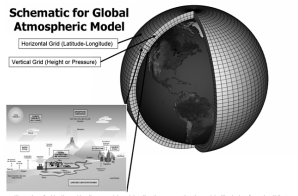


Illustration of grid cells used by climate models and the climatic processes that the model will calculate for each cell (bottom corner). Source: NOAA GFDL

FIG. 11

Climate models are by no means simulations simply of the Earth's atmosphere and the way in which solar energy is absorbed, triggering Earth-spanning air circulation patterns, before it is ultimately radiated back into space. This was only the case with the first climate models in the 1950s and 1960s. Since then, these models have been successively fed with more and more climate-relevant information, from the heat exchange between the atmosphere and oceans or land masses, the ice formation processes at the polar caps and on land, to data from atmospheric chemistry and ocean ecology, to biogeochemical cycles such as the carbon or nitrogen cycle[113] – with all of these factors being themselves represented by mathematical models. Climate models have thus increasingly turned into recursive models of all models, i.e. into Earth system models. Today, the increasingly high-resolution climate models produce simulacra of the entire planet, which they break down into ever more finely calculated cells with increasing computing power.

Meanwhile, the intelligent civilization is also part of the Earth system – and crucial for the future development of the climate. And so-called Integrated Assessment Models[114] use mathemati-

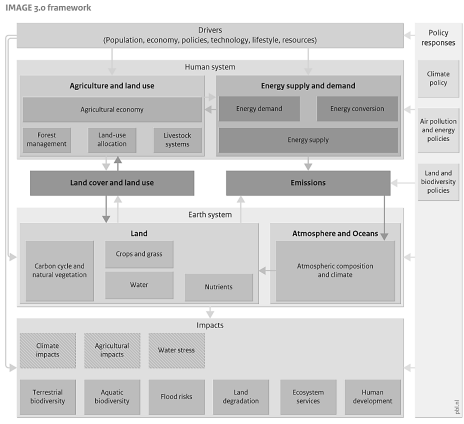


FIG. 12

cal models of their population development and economic activity, as well as corresponding energy and resource requirements, land use patterns, etc., to simulate their effect on the climate and other Earth system components.

Thus, we are seeing a cascade of recursively nested models, developed and tested by scientists in the natural and human sciences, and algorithmically welded together into large-scale models of climate and the Earth system. At the same time, they also lead an independent existence, play a central role in a wide variety of individual sciences and make their results known to wider news audiences – and thus to our lives.

□ PLANETARY TIME COMPLEX

We now want to look at the models that have been put into circulation in the light of the astrobiological temporalization of the Earth. For, in contrast to Bratton and other previous contributions from the humanities to the discourse on planetarity, the planet is for us explicitly and primarily a figure of time.

This becomes clearer when we look at what all the abovementioned models produce – namely, statements like the following:

– The world's population will have peaked at 9.7 billion people in 2064 (compared to 8 billion today).[115]

– By 2030, 1.9 billion additional people will belong to the global middle class (= 5.3 billion in total).[116]

– The average life expectancy at birth will be 79 years in 2070 (compared to 73 years today).[117]

– By 2050, more than twice as many people worldwide will live in cities as in rural areas (compared to parity in 2007).[118]

– Global GDP will have more than doubled by 2050.[119]

– "[W]orld energy consumption will grow by nearly 50% between 2018 and 2050. Most of this growth comes from countries that are not in the OECD."[120]

– The required agricultural production will have doubled by 2050,[121] not least because:

– "Between 2010 and 2050, global meat and dairy consumption is on a course to increase by nearly 70 percent, with beef consumption increasing by more than 80 percent."[122]

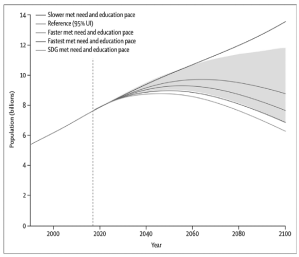


Figure 5: Global population in the reference, slower, faster, fastest, and SDG pace scenarios, 1990–2100
The reference scenario is presented with 95% UIs, which are represented by the shaded area. Past estimates are from GBD 2017 and values are in billions. GBD=Global Burden of Diseases, Injuries, and Risk Factors Study. SDG=Sustainable Development Goal. UI=uncertainty interval.

FIG. 13

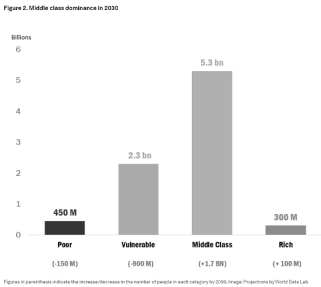


FIG. 14

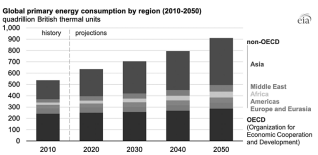


FIG. 15

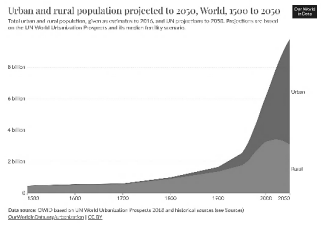


FIG. 16



FIG. 17

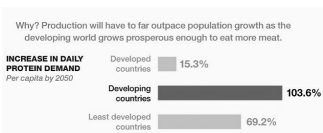


FIG. 18

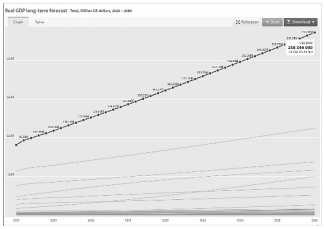


FIG. 19

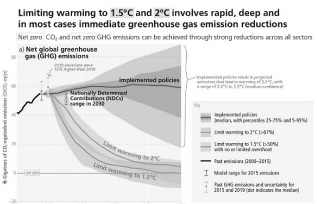


FIG. 20

– "Implemented [climate] policies result in projected emissions that lead to warming of 3.2°C [by the year 2100], with a range of 2.2°C to 3.5°C."[123]

– "[D]epending on scenarios of population growth and warming, over the coming 50 y, 1 to 3 billion people are projected to be left outside the climate conditions that have served humanity well over the past 6,000 y."[124]

– Between 2030 and 2050, climate change is expected to cause approximately 250,000 additional deaths per year, from malnutrition, malaria, diarrhea and heat stress.[125]

– Etc.

It becomes clear that all such models, which ultimately conjoin in the large-scale models of climate and the Earth system, have at least one thing in common (however varied they may otherwise be): they are always already and constitutively temporal models – they concern the planet in its temporality.

This predictive element is axiomatically inscribed in scientific modeling: as forms of algorithmic experimentation, computer models can only be tested on their predictions (for example, by having them 'predict' empirical climate data from the past).[126]

And it is precisely in their grip on the future that the pragmatic value of these models lies, which in turn explains their enormous popularity. In this regard, philosophers of science speak of a veritable culture of anticipation:

> [C]ultures of prediction based on computer modeling and simulation expanded enormously in the postwar period and have become a salient – although often invisible – feature of late twentieth- and early twenty-first-century societies with tremendous cultural and political import.[127]

This points to a fundamental mutation in the temporal techniques used by contemporary societies, and thus of the ecological niche we inhabit. The anthropogenic ecological niche is a self-made spatial and material envelope around our lives; but it is also a temporal envelope and, in this sense, a *temporal niche*. The anticipatory planetary models must be understood within the context of the evolution of this temporal niche – the evolution of the temporal self-relations of human practices and societies, including the technologies that shape them and are shaped by them: from early calendars and agricultural planning cycles to the modern synchronization of calendars and clocks to the containment of the contingency of future time in risk theory and insurance.[128]

The mathematical models developed since the middle of the last century, on the other hand, represent a form of data-based forecasting or futurology-as-science that is entirely new in its ubiquity and quality. We claim that they converge in the new reality of an emergent *dispositif of hyper-anticipation*. Here, the temporal niche expands from reaching *days, weeks, or years* into

the future to reaching ahead *decades* and constituting these future decades as a new habitable temporal envelope of the present.

The above outline of forecasts makes one thing unmistakably clear: the Great Acceleration is not over. On the contrary, the models show us that the planet's coming decades are marked by an extreme dynamism. They envisage the coming decades not as the steady state of a given Earth, as a static parameter surface, but as an exponential situation, a bulging Earth in which the 'explosion' of Earth system parameters and anthropogenic natural phenomena continues. Quite paradoxically, an important driver of this exponential dynamism is the development of the very same electronic computation that is responsible for making the dynamism visible in the first place. Thus, while the debiologization of collective intelligence generates unprecedented possibilities of anticipation, it also simultaneously undermines those very possibilities: through the natural-historical storm of events it unleashes into the Earth's near future, which makes any prediction all the more difficult the more extreme these events will turn out to be.

At the same time, we insist on the above formula: we live in the horizon of a dispositif of hyper-anticipation, which is to say: the dispositif is by no means fully developed. The staggering collective inability to mitigate global warming in an anticipatory manner (while having excellent climate models at hand that show us exactly what will happen if we don't) is driving younger people literally mad. And it makes it transparent that hyper-anticipation is not yet a comprehensive political reality. Hyper-anticipation is a psychological reality while so far remain-

ing a political virtuality, since it plays no constitutional role in the democratic self-government of the intelligent civilization.

It is true that hyper-anticipatory techniques are already being used in many instances, especially in economics, where business consulting and insurance companies regularly provide large companies with specific market, workforce and technology development forecasts up to 2030, 2050, etc. – not to mention algorithm-based, albeit shorter-term, forms of forecasting, for example in financial markets. Or we can think of the exploitative prediction of the behavior of customers and users on capitalist platforms and in social media, which one of us has analyzed in previous works under the umbrella term of the "time complex."[129] However, in the context of global governance – and even democratic self-governance in nation-states – hyper-anticipation is a work in progress at best. We cannot say for sure whether hyper-anticipation will grow into new forms of political and economic governmentality in the foreseeable future. And even less do we know whether this will contribute to a new Earth system governance that could effectively solve central questions of climate and resource justice.[130] Hyper-anticipation today is nothing more and nothing less than a new political battleground – a place of struggle over the conditions for the production and seizure of the future.

But we already know what we are looking for:

A new and intelligent planned economy, which relieves the living of the pure real-timeness of (cultural) evolutionary processes and releases them into an expanded temporal envelope. A security dispositif to protect them against the storms of natural



FIG. 21

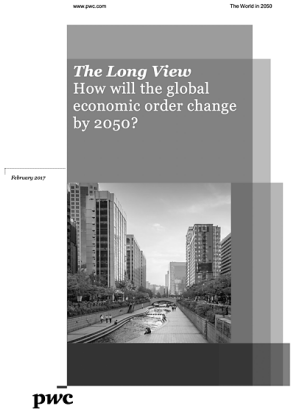


FIG. 22

history's future unfolding – to plan for them, to hedge against them, to appease or redirect them: a planetary time complex.

□ EXOPLANET FUTURE

The realization of a planetary time complex is crucial for our initial question – what does it mean to collectively inhabit a planet? Indeed: In order to consciously inhabit a planet, it was first of all necessary to understand its spherical shape, its location in the planetary system, etc. The dimension of cartography, which is part of the history of globalization, also belongs here. This is a cognitive as much as it is a practical matter: the measurement of the world, its mapping, takes place in the context of colonial history as a first-wave globalization process.

At the same time, however, globes and world maps are purely spatial displays and, as such, are always just snapshots of the Earth. They are nothing but tiny frozen slices of the temporal signature that the planet actually is. We don't inhabit the Earth as long as we only orient ourselves on it cartographically. Planetary inhabitation only takes place where people set up their tents in the Earth's temporality and settle there. The terrain we then inhabit is the next decades, the mapped out space of the coming decades in its temporal gestalt. Hyper-anticipation is the cartography of the planetary time that is ahead of us. *It is only with this cartography of time that a distinctive sense of 'living on' a planet – inhabiting the planet in its own medium – is becoming a reality.* Inhabiting its future is the only philosophically consistent and concrete way to inhabit a planet at all.

At this point, we come full circle to our astrobiological self-description as planetary dwellers – the recognition of the ontological regularity (despite its rarity) of intelligent civilizations like ours as products of habitable planets. And this is because the great models of hyper-anticipation, the climate and Earth system models that have synthetically integrated all the other models within them, are nothing else but fragments of astrobiology's general planetary model, specified for planet Earth at this specific historical moment.

Conversely, we understand the production of a general planetary model at the level of detail and resolution of current (and even more so future) Earth system models as the ultimate goal of astrobiology as a scientific discipline: it extends to the entirety of a planet's lifetime and to all possible habitable planets and planetary trajectories in the universe. Today's Earth system models

are still tiny HD fragments of an astrobiological general planetary model under development. They show us a tiny section – namely: a few decades of the total of 11 billion years of terrestrial planetary time from beginning to end – of the possibilityspace of this planet.

Only now are the full conceptual scope and political relevance of the astrobiological serialization of the Earth revealed. For such seriality is not only a reality with regard to exoplanets 'out there', while remaining hypothetical for Earth in every respect. That is true just for Earth's past. In terms of its future, however, the Earth is itself a series of possible paths. Temporally unfinished, the Earth is not one, but many, a multiplicity. This is already true of its past futures, i.e., of the completely different paths the early Earth *could also have taken* – just think of the literally billions of contingencies (from the forced formation of the moon to the comet of Chicxulub...) that went into its *one single* factual history. And it applies to its future, which lies ahead of us. We can therefore read the diagram from chapter A.1 (Fig. 2) from bottom to top, and thus in a completely new way:

The visual argument here is that the Earth's own future is a series of exoplanets, of which the Earth can 'enter' but one (the one it will become).

Interestingly, the Intergovernmental Panel on Climate Change (IPCC), which defines the mainstream of climate science, uses this argument in its publications: climate scientists' *Integrated Assessment Models* and their future scenarios (*Shared Socio-economic Pathways*[131]) are intended, precisely, to allow us to orient our actions in a model space of future Earths as different exoplanets.

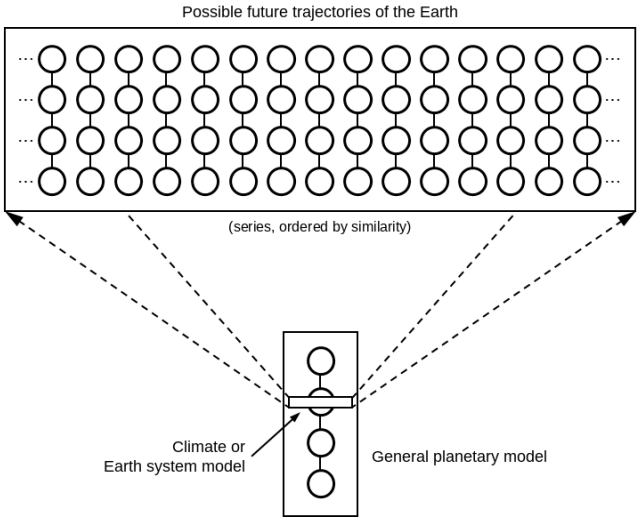


FIG. 23

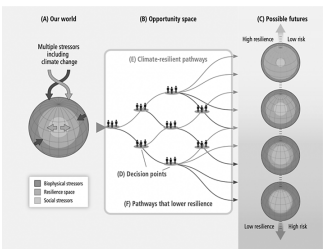


FIG. 24

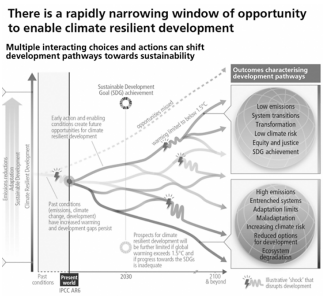


FIG. 25

These future Earths can only be reached via the present state of the Earth, but that doesn't mean that they are Earth-specific. They merely exemplify the general possibilityspace of habitable planets with intelligent civilization at the beginning of a Transition 9. As such they represent different unfoldings of the Transition that depend on our collective agency today – including scenarios in which Transition 9 comes to a standstill (for example due to extreme climate change, fatal AI world wars, but also exogenous chance factors) and thus retrospectively will never really have taken place.

As time progresses, the possible futures of the Earth will become more and more distinctive and dissimilar to each other.

And they will all become more and more dissimilar to the Earth today, unfolding into deeply foreign states of the Earth, which – as we know from the evolutionary transitions – can reach to the point of total unrecognizability (Zalasiewicz: "a number of different Earths that have succeeded each other in time …").

The deep unrecognizability of the exoplanet 'future Earth' vis-à-vis our present also applies to its hypothetical intelligent inhabitants, the future humans or androids in the *Homo sapiens* genealogy: these future terrestrials are the only aliens who will ever take note of us.

Such an alienology is entirely immanent to planet Earth. Just as well that we'll never meet these aliens in person.

PART B

US (BIOGRAPHICAL DEEP TIME)

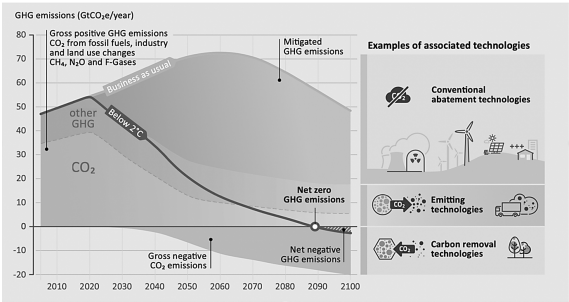


FIG. 26

What I find crass: All these prognostics, the hyper-anticipations, have an impact on me.

Um?

Yes, when I look at all these graphs, like this one,[132] which is about how the global emissions profile of the next few decades would have to look in order for the 2 degree target to be met, then this does something to me.

But what, exactly?

That's a tricky one. Come to think of it, I would say that it probably has to do with the fact that I won't live to see the year 2100. After all, I'd be 123 by then, so the chances are slim. But then this diagram contains a very special point in time: my time of death. You cannot see that point yet, but virtually it's already drawn there on the line, on the x-axis.

This makes me think of Heidegger's *Being and Time*, where he had the idea that we must take our finitude seriously in order to be able to grasp ourselves properly as individuals. He speaks of "running ahead to death" (*Vorlaufen zum Tode*) as something one should constantly practice in order to be able to experience oneself as a whole and highly individuated being. Of course such a heroism of death is always highly problematic, not just in the aftermath of World War I. But maybe there's something of that in what you were talking about?

The association of "running ahead" is apt, but I think this is going in a different direction. Heidegger's philosophy of death is vulgar at its core, that's how I've always felt about it. What he is concerned with in *Being and Time* is to instigate a permanent near-death mood in us by mentally "running-ahead," and thereby to create a heightened sense of existentialism and separation from our social environment. In the end, however, he says little more than 'live each day as if it were your last' ... All of this is based on the idea of a 'scarcity' of life by way of finitude, which I think is wrong (because finitude has in fact nothing to do with negation – I've written about this elsewhere[133]). Furthermore, Heidegger's "running-ahead" does not have the same diagrammatic-projective dimension as in the present case, i.e., it is not linked to concrete lengths of life and times of death.

My feeling has little to do with this flat pathos of finitude, even if the finitude of a life in the sense of its being a whole is important. For if the entirety of a life takes place in this diagram, this means you have *no existential mobility* vis-à-vis the diagram. We are not angels, we cannot escape, right? The diagram, as the

scene (of the world) of our lives, is therefore the only thing we will ever have encountered.

We are connected to it in an absolute way. If my death is drawn in this diagram, my life also flies off the table when this sheet of paper is blown away by a gust of wind...

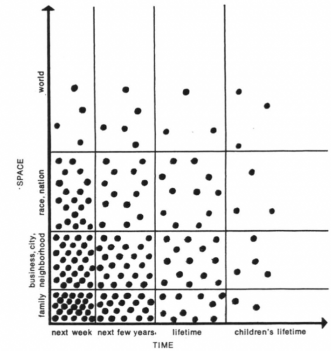
... it is drawn there, it is literally 'on the same page'.

Hasn't anyone written about this yet?

I don't know, even though we can't be sure. What I do know of are some analyses, within cultural studies, of graphs and diagrams connected to so-called 'cultures of prediction' – their term for hyper-anticipation. For example, the science historian Nina Wormbs has researched the IPCC's graphs and their projections to 2100.[134] For her, 2100 is representative of the "end of time" in the diagrams and she sees it as a reference to the apocalypse. However, she also seems to ignore the finitude or biographical temporality of the viewers *vis-à-vis* the projections, which interests us.

This is also true where other studies specifically focus on the time perception regarding climate change (which is always mediated by diagrams), observing a mismatch between climate change temporality and the temporal dimensions of our experience, for example the intangibility or abstractness of the year 2100 for us today.

50 years ago, the Club of Rome already put this mismatch into a beautiful diagram, take a look:



Although the perspectives of the world's people vary in space and in time, every human concern falls somewhere on the space-time graph. The majority of the world's people are concerned with matters that affect only family or friends over a short period of time. Others look farther ahead in time or over a larger area—a city or a nation. Only a very few people have a global perspective that extends far into the future.

FIG. 27

Closer to the present, Sabine Pahl and her colleagues from the field of ecological psychology are working on the topic of "perceptions of time in relation to climate change."[135] But I think we have to be very careful here. There is an (implicit) causal argument in Pahl's writing: it is *because* our perception of time is typically limited to the next few years at most, as is empirically well-documented, that it is so difficult to react to global warming, whose most dramatic effects lie much further in the future. But there is actually no evidence that this is the principal difficulty at play here.

You'd probably say this is ideological and a red herring: no, it's not this neutral anthropological fact that is blocking decarbonization. Rather, it's decades of industry lobbying and the structural circumstance that people in the Global North are still

overall benefiting from their emissions (that emissions are an insanely good thing for them) while the main damage isn't borne by us.

Indeed. But also methodologically, these studies are the opposite of what we are interested in: they take the 'perceptions of time' you just mentioned as a given or even as genetically encoded, while we are interested in how these perceptions actually change in the light of hyper-anticipation, when being confronted with the forecasts and future models that rain down on us on a daily basis now. Maybe our temporal perceptions are already changing, while most scientists don't notice it yet. And not only the perception of time in the narrower sense – more generally, I'd say, we are concerned with the *subjectification effects* of hyper-anticipation.

And this can only be investigated if we reverse Pahl's thesis. At the same time, I would say one also has to move beyond an assumption that has been shared in the discourse around planetarity since Spivak, namely the idea that the planet is unrepresentable or preferably should not be represented as a totality. I think, quite to the contrary, our starting point should be the reality of all the representations that are already floating around in great numbers (without necessarily having to imply any kind of collective sapience, as Bratton does), and recognize that these are representations of the planet as a temporal object.

As a template or analogue of these questions, I found some helpful passages from Norbert Elias's *Time: An Essay* – I'll read them to you: "Consider once more people's sense of their own

identity and continuity throughout life. In our type of society the trajectory of a person's life is meticulously timed. A precise social age time-scale — 'I am twelve, she is ten' — is learned very early by every person individually and integrated as a vital element into the image of the individual and others. [...] The continuous series of figures which mark the number of years of a person's life become impregnated with biological, social and personal significance, and thus plays an essential part in a person's sense of his own identity and continuity in, as we say, 'the course of time'."[136]

OK, so Elias says: Our historically contingent techniques of time – and he speaks of the calendar and of enumerating life years – determine our self-relationship: the way we perceive and describe ourselves.

In addition, we should not forget that recording one's own birth in a calendar, knowing one's exact age, holding birthday celebrations, milestone birthdays, anniversaries, honoring high and highest birthdays, but then also something like writing a diary, writing a life report, later perhaps also psychoanalysis, etc., understood as biographical or life-course-related self-techniques, are all relatively new inventions – and that they are therefore also correspondingly malleable, changeable.

And we add the hyper-anticipation of the computer models to this list of time techniques and compare one with the other. One thing to immediately note, for example, is that one's biography is now no longer constructed only looking backwards. But neither is it based on the simple pre-scientific supposition of a future that

we can assume to be stable and expectable – as yet another of our daily plans, or taking out a loan, or studying for a future job.

No, a new element is added. We are interested *in a further turn in the spiral of the technization of time* and the effects it has on us.

In planetary time as a form of subjectification.

Exactly. We have already highlighted one aspect, the articulation of the finitude (and thus wholeness) of our lives when looking at climate forecasts to 2100. But 2100 is just the outer margin of current hyper-anticipations (one that is especially present in the IPCC publications) – so this can only be one aspect. After all, it is obvious that most projections that are in circulation – see our list in chapter A.3 – do not move too far ahead, but look at the time up to 2070 or 2050, often only up to 2030. Not exactly every single coming year, but certainly every coming decade is covered in the projections and cognitively articulated by them. The dispositif of hyper-anticipation thus brings unprecedented transparency, it brings an unprecedented form of quantitative mapping to the 'territory' of the decades to come. This territory, however, is also the *biographical* space that is before us: our biographical time as it unfolds. 2030: what will you be doing in 5 years? 2050: What in 25?

This is the biographical space in which we age, and not just pass away. Basically, then, it is the exact opposite of Heidegger's "running ahead," which at all times cognitively fixates us at the

imaginary end of life. Ours is a temporal space that opens up the future.

Yes: hyper-anticipation involuntarily pulls the ages of life into the limelight. After all, all the future dates we talked about refer to concrete points, events, situations in our future lives. Everything that happens, happens on a certain day, in a month that feels different from any other. I'm taking my mother to a retirement home on a warm spring day in the year 2038. My daughter is starting school, we're having a party in a specific park, it's September 2024. I'm getting married again (2040). The employment office finances my retraining (2033). My father passes away (2030). Thus, the everyday prognosis of hyper-anticipation confronts us with a fact that we were well aware of, but that is still somehow often lost in a haze: that every life has a particular biographical *gestalt*, with certain growth processes, stagnations, intermediary passages, key events, phases...

That's interesting. The fact that we are beginning to inhabit the planet specifically in its temporality (as much as we are still at the beginning) pushes us towards a new articulation of our life in the entirety of its temporal signature. Why shouldn't our lives, too, become recognizable as flourishes in time – exactly as we wrote about planets as seen through the lens of astrobiology!

Billions of planets start from scratch. Every single one starts inanimate, most continue that way. *Some* create out of themselves temporal figures of simple life, *some* even animals, and *rare ones* also animals with cultural evolution. All end up inanimate.

Exactly, and at the same time:

Billions of lives start from scratch. All of them start as babies, some do not survive this youngest age. Some ... a few ... and so on. All end as inorganic.

We then have parallel figures: both are biographies or careers – both are life courses. Both are malleable, extremely compact, gestalt-like. Both are somehow 'sacred' time-spaces, spaces of ecstatic revelation.

Perhaps we could place these two flourishes in time – the Earth's and our life course – next to each other and get closer to looking at their interaction?

Only if we move beyond another idea one often finds in the discourse on the planetary.

Which one?

The assumption that the planet's intrinsic temporality is always (by human standards) infinitely slow, a glacially flowing deep time. If this were the case, then Earth time and biographical time would always be disjoint and there would be no contact whatsoever.

Have we written anything about this?

Implicitly, yes, via the Major Evolutionary Transitions model. Let me try it this way: we have to move beyond the intuitive but empty idea of deep time as a huge amount of time ('billions of years'). Once we understand deep time instead as the natural-historical time of the Earth, the time of the exploration of the possibilityspace of this planet, we already see that this exploration can actually be very slow in some cases – for example, Transition 4, the transition from prokaryotes to eukaryotes, took 1.5 billion years. However, it can also be comparatively faster – Transition 6, the transition to multicellularity in the Cambrian explosion, in which all the phyla of plants and animals emerged that still exist today, took no more than a maximum of 25 million years.

Still, these are all dimensions of time completely outside of that of a single human life ... But I get it – we realize that 'deep time' can operate on totally different time scales. In any case the time proper to the Earth is not a uniform time, it is not a priori bound up with a single order of magnitude.

So there is some precedent for assuming another extreme acceleration of deep time for the present and saying something like: what hyper-anticipation shows us with its projections are scenarios *of the natural history of this planet in the coming decades*. For not only are the time horizons of the Earth models roughly on the scale of a human lifetime – natural history itself unfolds on that scale: its speed, its own rhythm, now is counted in decades.

Yes, this is an empirical fact: natural history today unfolds on the temporal scale of a single biography, driven and accelerated by the debiologization of collective intelligence.

We are already breathing the 'air' of Transition 9: as if in a great prehistoric moment, which is happening just now, we *feel air from another planet* (Stefan George) that Arnold Schoenberg used to finally fling open the doors to atonality in his Second String Quartet a hundred years ago...

Except that this 'other planet', in the present case, is the Earth itself.

But the fact that deep time, natural-historical time, becomes interior to the individual life, this is something really new, isn't it?

Natural history has always been external to a life and therefore imperceptible to it – dozens, even hundreds of generations had to be 'strung together' in order to 'see' any significant change in natural history at all. It was therefore invisible to every single generation. Not anymore.

Seen in this light, sociological theories of ruptures, which in modernity increasingly take place *within* the time span of a biography, as well as theories regarding the collapse of the distinction between nature and culture, or between natural and cultural history, are only a foretaste or indicator of this interconnection of natural and individual history. It occurs in the context of an epochal planetary turning point, which we are obliged to interiorize – perhaps also because we feel a secret desire to let it become more and more part of our biography.

At the same time, this interiorization triggers strange feelings in me.

Why?

Well, I can't quite put my finger on it yet, but it seems to imply a peculiar disfigurement of the observer's position. This, too, is part of the subjectification effects of hyper-anticipation and, for me, it has to do with the structure of being a witness: being a witness to deep time, as an existential position. It has to do with a disfigurement to which we are subject when interiorizing deep time into the ages of our lives. And with an almost infinite exaltation that also comes with that.

I'm still not getting it.

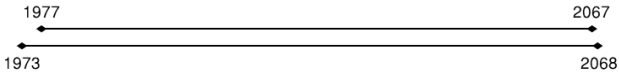


FIG. 28

Not sure I do either.

Okay, but then let's perhaps take a step back and try to describe what it feels like to grow up and come of age in the earliest stages of a potential Transition 9 of this planet.

So the idea is to use our two lives as detectors or visualization tools for the natural history that is taking place in them?

Exactly.

OK, but then let's really take our whole lives, from start to finish. Let us fill out this life expectancy calculator here...[137]

So my life goes from 1977 to 2067 – that's a long time. Yours?

Similar: 1973 to 2068. So this is really long, and probably you can already read from these numbers the position of privilege from which we are talking here – they are well above the global average of life expectancy for middle-aged men. We probably have to highlight that even more strongly later. But now let's start with natural history – you first.

OK, I'm born in October 1977, so I was probably conceived in January. This sets a morphological process in motion, the self-assembly of the nanotechnological apparatus 'fertilized egg' that I am at this time. It boots itself inside my mother's womb. In

particular, in the following months, my brain develops, billions of nerve cells grow.

1977 was also the year of the 'trinity' of the personal computer: Apple, Commodore and Tandy Corporation launched the first mass-market PCs. In April 1977 – I am about 1.5 cm tall and shaped like a raspberry – the Apple II is released, with its 8-bit MOS Technology 6502 processor, which runs at about 1 million operations per second (1.023 MHz). This is the state-of-the-art processor technology at the time, which in turn is subject to a morphological process, a process of the growth of a gestalt. Moore's Law describes this process. Already in October 1977, on the day I was born, the number of transistors on a computer chip had increased sharply, and in February 1979 it had doubled compared to the day I was conceived.

My brain, for its part, has been growing in the course of my mother's pregnancy and continues to grow after birth – its biological neural network is training every day on the perceptual data it receives from its immediate vicinity (Kassel, Germany), later it is self-training on my parents' bookshelf, etc. The Amiga 500 computers, on which I occasionally play at friends' houses in the late 1980s, have 16/32-bit Motorola 68000 chips and run at 7 million operations per second (7.16 MHz).

20 years after 1977, my brain is already quite mature. It is no longer growing, stuck in its confinement.[138] The processor and computer architectures, conversely, ...

... they are still growing, aren't they? And there's no holding back. The non-biological thinking substance is no longer con-

fined by the limitations of your or any skull bones. It unfolds freely in warehouses, proliferating according to its own natural law. There is an unbelievable morphological power at play here, which is visible not least in the almost grotesque shrinkage of the devices, which are now visible remnants of an extreme intensification: what was a supercomputer a decade or so earlier has become an iPhone in 2007.

Then, in 2016 and 2018, our kids are born and their brain growth begins. Shortly thereafter, your kids.

Yes. And in the 2020s – already about halfway through my life: I've already lost a lot of nerve cells and have gray hairs – the nonbiological neural networks come to life as well. Such networks existed before, but they made the big leap only after the so-called Transformer network architecture was developed in 2017.[139] In 2024, these networks are already passing university entrance exams and tests, which usually involve biological humans born around the turn of the millennium and not 5-year-old machine systems ...

... so that the readers of this book have no idea who actually wrote it. Which parts still sound like GPT, and which no longer do? But you realize this is a fully automated translation of the German original, don't you?

At the same time, this whole process of debiologizing intelligence – and that's another reason why it is unstoppable – comes in the format of an arms race: between large technology companies,[140] but above all between the tech-state conglomer-

ates of the USA and China.[141] I mention this because, once again, this is an extremely time-sensitive constellation in which being ahead a couple of months or years can provide political and economic supremacy for decades to come. This intensification or trembling of time is very much on my mind.

Same here. But let me try to tie some of this together now: Moore's Law, which (among other factors) underlies everything we talked about, describes a morphological process of transistor miniaturization. As things stand, this process is likely to come to an end in the 2030s.[142] This is because it is not possible to reduce the size of the transistors endlessly without running into quantum mechanical effects that prevent further miniaturization. If we believe the physicist James Powell, the natural-historical episode described by Moore's Law will end exactly in 2036 (I'm only in my 60s then and still have a few decades to go).[143]

My point is: Moore's Law will come to an objective conclusion. That's in the nature of things. It's part of its natural law. The process ends just like the process of the Cambrian explosion, where evolution's exploration of all possible body plans for multicellular organisms had simply come to an end after 25 million years.[144] Except that this ending takes place in a year of my life.

As we grow older then and almost without realizing, we walk into a new 'flora and fauna' of thought, into a changing materiality of spirit on Earth. The beetles and the monkeys in the zoo still think as before, and their embryogenesis (like ours) is statically repeating the same process over and over again. Your

brain and mine have also been the same since the 1990s, not even the cells are renewed anymore, they only decay. But everywhere – on my desk or on my lap (MacBook), in the warehouses of the cloud, in the data centers, etc. – there are these extremely vital changes, these new 'blossoms': new foldings or unfoldings of the matter of the Earth. And they are flowing from open-pit craters and underground tunnel systems into new material forms and compositions.

But there are also, and this seems important to me, new temporal foldings of planet Earth. Aren't the server farms actually time enclaves? In which parallel processes run so fast that the firing rate of my neurons, when I walk past the server farms on the sidewalk in the sun, comes across as a dull, slow rhythm in slow motion?

It is not unlikely that this temporal convolution is one of the key features of Transition 9. And for sure it is the linchpin of the debiologization of collective intelligence. For debiologization is the process that, like a temporal vacuum cleaner, sucks in, pulls in, and contracts many other processes from potentially much longer durations into our lifetime.

Case in point: Gene sequencing. My genome contains about 20,000 genes with a total of about 3 billion base pairs. In 1973, the year I was born, the human genome is still largely opaque, an intransparent something. Until 20 years before I was born, even the basic structure of DNA was completely unknown – nothing was known about C-G-A-T. Then, in the 1980s and 1990s, during my school years in Vienna, something else is happening. The

sequencing machines of the Human Genome Project are being installed and begin their tireless sequencing work in 1990. I sit in school from the 1st to the 6th grade, and during that time there is sequencing going on; over many months while I fall in love and have my first girlfriend. 13 years later, while I am working on my dissertation in Paris, the time has come: in 2003, the first human genome has been completely sequenced.

Meanwhile, in 1998, another player had entered the big sequencing business: Craig Venter's company Celera Genomics, which managed to present its results in that very same year of 2003: instead of 13, Celera took only 5 years to do the sequencing.

In 2022, sequencing a human genome takes only 5h 22min.[145] This, plus of course the extreme drop in prices, are effects of Moore's Law.[146]

Sequencing is definitely a benchmark process but in my view it's still not the main thing going on here. The actual natural-historical unfolding we are looking at in this context is the *emergence of post-evolutionary biological forms by way of genetic engineering*. Analyzing DNA is a part of this, but there's a lot more going on.

And again we have a delicate timing here: When you were conceived in September 1972, all gametes on Earth still combined randomly – in a process that, let's say, has been more or less identical throughout a 1.2-billion-year history of sexuality: in dinosaurs, primeval mammals or fruit flies (even though human breeders have consciously or unconsciously introduced consid-

erable accelerations into the process during the last 11,000 years or so). Then came 1973, the year in which the first transgenic creature emerged – a bacterium. Five years later, genetically engineered insulin is already available. In your tenth year, the first transgenic plant emerges, followed by the first transgenic mice in 1984, the first cows the following year, and so on.

Point taken. Genetic engineering is a new principle of natural history with regard to the biological world. It creates unprecedented biological forms, gives rise to a new 'kingdom' of biological organisms. They become more numerous and diverse the older we get. There are more of them with every decade and every year.

For the time being, evolution is no longer the main morphological source of new organisms.

But that's just the *one* big mutation of the biological itself that we'll have seen in our lifetimes.

Another is that the principle of the organism is increasingly accompanied and overridden by new, non-organismic forms of living matter – with Deleuze/Guattari one could speak of *flesh and tissues becoming 'organless'.* Tissue is created outside the organisms, relieving the organisms of the function of tissue production.

You mean artificial meat?

For example. In 2013, the first in-vitro beef patty was produced in Maastricht for 300,000 euros.

Sounds like a joke.

But it's not. As of this year (2024), in vitro meat is allowed to be commercially sold in the USA.[147] This is all just beginning. In addition, there is tissue engineering for medical purposes.

Do you really think that becoming organless is a natural-historical event of the first order?

Absolutely. Ultimately this is dependent, of course, on the extent to which artificial meat production will in fact replace conventional production, which operates through the organism and the animal body – personally, I hope it will replace it entirely. Let's keep an eye on that until 2067/68.

OK, then let's ... –

And what we should also keep an eye on until then...

... I guess it...

... is the young history of nuclear fusion. Since the new millennium, a number of model projects are working on *the natural-historical event of setting in motion, on a planet, the process of a star*. Igniting a star on a planet is what nuclear fusion is, right? In 2022, for the first time, a research reactor at the National Ignition Facility generated as much energy as had been put into it (break even).[148] In 2035, the European project ITER will be operational. In 2060, we will ...

We'll have to see about all that.

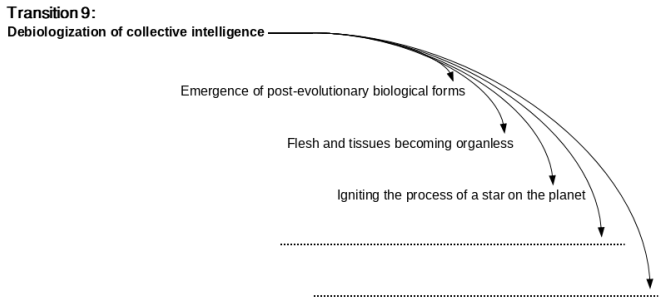


FIG. 29

What I just wanted to say was this: Our interest here is understanding what it looks like when natural history becomes interior to our biographies. But such 'interiority' cannot simply mean that we use our biographies as a timeline to visualize processes such as AI evolution. Because these processes don't just take place *inside* our biographies. They do not leave the unfolding of our biographies untouched, they change the temporal gestalt of our lives, so to say. They intervene in the course of our biographies, and they do so in ways and through mechanisms that did not even exist when these biographies started.

There is an element of this in the fears about AI potentially rewriting the work biographies of millions of people, no matter how far they have already come with their lives. Our biographies do not unfold under stable conditions, but under dynamic conditions of rapid natural-historical transformation. Their dynamics determine the course of our lives: possibilities that were not yet there suddenly open up, possibilities that were available dis-

appear along the way. And this is no different for individuals than it is for entire industries.

In the 2010s, I earned some money as a translator. In the 2020s, computing power and computer architectures have automated translation to a large extent, as you can read here – what now?

Well, academics fear that they will be cheated with term papers written by ChatGPT, although I think they should rather wonder what this tells us about their teaching. Look at what Steven Shaviro posted recently, wait a minute, I mean what he posted on Facebook on May 13: "The common fear among teachers is that AI is actually writing our essays for us, but that isn't what happens. You can hand ChatGPT a prompt and ask it for a finished product, but you'll probably get an essay with a very general claim, middle-school-level sentence structure, and half as many words as you wanted. The more effective, and increasingly popular, strategy is to have the AI walk you through the writing process step by step. You tell the algorithm what your topic is and ask for a central claim, then have it give you an outline to argue this claim. Depending on the topic, you might even be able to have it write each paragraph the outline calls for, one by one, then rewrite them yourself to make them flow better."[149] So once the students use AI that well, they really don't need us professors anymore. But then, poetry will still require you as translator.

The alleged untranslatability of poetry by machines is a romantic-nationalist article of faith – I really don't care about that.

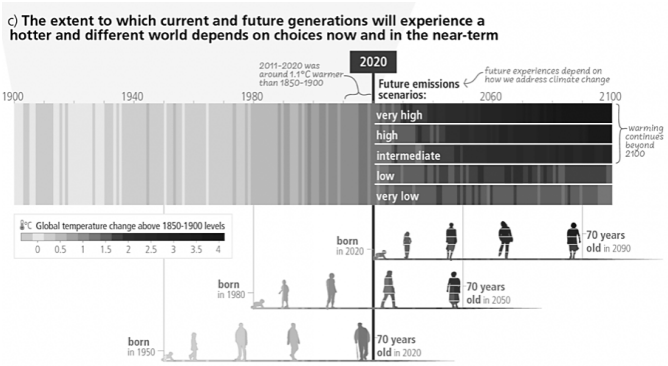


FIG. 30

Let's zoom out again instead.

The emergent 9th evolutionary transition triggers *Earth system changes* in our lifetime that are also dramatically internal to our biographies. Just think of the monthly increase in ppm CO_2, the world population growing by one billion every 12 years, or the flow of extracted materials and mineral resources that have been set in motion around the Earth since 1973/1977: these and associated processes intervene in the shape of our biographies and change the course of people's lives. Climate change, for example, which may not have been as pronounced when someone started their professional career, has 10 or 20 years later intensified to a degree that it destroys their industry. Or it destroys their livelihood, and forces them to emigrate. And all the more so the later they are born.[150]

The transformations of natural history bring disorder into biographical patterns.[151] We need to fully grasp this: planetarity –

the natural history of this planet and its drivers – does not take place on any other spatial or temporal scale! Planetarity is at work in our lives: our biographies are not a stable framework or a safe observation post of the natural history that takes place within them – they are reshaped by it.

Biographical processes are more and more overwritten by natural history. Which leads us to a different way of talking about ourselves. Until now, we expressed our biographies along the lines of: first I was a kindergarten child, then a schoolchild, then a student or trainee, then a professional, then a pensioner. But from now on, we can say:

My life pre- and post-iPhone.
Before and after GPT-4.
Before and after an mRNA vaccine.
Before and after Climate War X.
Etc.

This is how I have to think and talk about myself, since my biographical story has become a planetary story, a story of the Earth.

Yes, and that's how I think we get to the bottom of what I previously called 'disfigurement'. For my body and my life as an observer of this process feel strangely drawn out.

Imagine if I were present at the birth of a star. I'd have a presence for millions of years as an observer of this chunk of deep time. I would exist so long. As if taking on the bodily and perceptual form of interstellar dust.

Now say an equivalent process (like the technical evolution of fusion reactors) takes place within just a few decades and I am actually observing it – then, again, this somehow explodes my observer position: I feel as if I were becoming interstellar dust, so to speak.

A SmartDust[152] of a different kind.

The emergence of nervous systems or intelligence in biological matter is also an event that takes place in ultra-slow ('glacial') deep time. Today, however, we observe the emergence of intelligence in non-biological matter within just a few decades of our lives (on the same time scale as our own brains booting themselves). Again, my body sort of still thinks it is observing an ultra-slow process, shifting its observer's perspective into something that feels more prolonged than any Mount Everest or sea trench: this reshapes or deforms me, I feel shaky and unreal.

It also feels like: being an unlikely witness. Being an illegitimate observer who has been around for 500,000 years or so. It's as if the atmosphere had filled up with oxygen only over the short course of our lives. And the unbelievable thing is: Deep time actually happens in our lives. What we are experiencing *is* deep time. And it happens *in* our lives. It is deep time – not of the ultra-slow but of the ultra-rapid variety. That's the disturbance, the illegibility.

I'm just imagining that 300,000 years of transgenerational tool evolution in the Stone Age, all the way until its slow replacement by metallurgy, had instead taken place within 30 years, that is, within a single lifetime instead of across thousands of genera-

tions. And this is exactly the situation we are in today, where, for example, only 40 years or so have passed between the discovery of DNA and the complete sequencing of the human genome. The young researchers involved back in the day have not even reached the end of their careers.

I hardly feel like a human observer anymore *in the face of what I'm seeing...*

The hypothesis here is then: There is something traumatizing for us animals in seeing a major evolutionary transition unfolding before our eyes. And all around this traumatizing intrusion of ultra-rapid deep time, the individual swells up, as it were, and floats to the ceiling.

That's a way to put it...

But why do you think this is traumatizing?

Certainly, this is an operation on the open mind and the nature of intelligence itself is changing here ... On the other hand, this is no longer even an exceptional situation. Rather, from now on, and to some extent even retroactively, this is a regular experiential dimension of planetary life.

Maybe 'traumatizing' is the wrong word... But for sure it is in no way 'regular' yet. For me, this disfigurement is fraught with intensities that in my mind converge, for perhaps inexplicable reasons, in the notion of *redshift* (the effect whereby the light of astronomical objects moving away from us becomes longer-wavelength, i.e. redder).



FIG. 31

The fact that a life is now being flooded with natural history, that natural history now takes place within a life while, in earlier geological eras, it could only have been observed in the course of millions of years, somehow reminds me of the drifting apart of the universe and the redshift that comes with it. This is what I see in front of me when I speak of the swelling up of a life: the swelling 'space' of natural history 'drives apart' the 'space' of a human lifetime. Which calls into question the coherence of self-perception and biography:[153]

After going through a deep-time episode, how should you remember what you were at the beginning? Is it the same person who was there from start to finish? My puberty literally took place in the Cambrian. This is extremely dissociative. Life *is long*. Too long. Life is so insanely long, it's almost unbearable.

Too long – I'd have no problem with that, frankly! I'd just think of this as a deep life, a life widened by deep time.

And then, on the other hand, we should also note that there are spatial reterritorializations or retemporalizing effects and strategies that *counteract* or *restructure* this detemporalization of classical biographical time.

Think of the temporal mapping, the spatializing mapping of the graphs of hyper-anticipation that opened the door to this biographical discussion in the first place. But the diagrams also function as an optical parenthesis of these otherwise 'too long' and 'disfigured' lives. If natural history is what individuates us, then it makes sense that it should be the memory of "natural-historical events" which guarantees the continuity of continuous individuation.

Here we go. So these are some of the potential effects of the fusion of deep time and biographical time.

Can we find a term for this?

Perhaps, biographical deep time?

Splendid. So let's call biographical deep time the fact that natural-historical deep time becomes *interior* to the biography, and our experience of it ...

... which is, precisely, the experience of a disfigurement. So basically, we suffer from the effects of biographical deep time.

And we take pleasure in it.

Of course.

On the other hand, however, I think we have to turn things around completely.

Because after all, what is deep time? Deep time and big history have only been developing here since the 18th century and the terms only came up during our lifetimes: "Deep time" dates back

to 1981, when I was in kindergarten, "Big History" is added in 1989 when you graduate.[154]

And I say 'here' deliberately. For the universe 'out there' floats in a state of eternal presence, in which no passing of time is recorded. In this sense, there is no 'time' out there at all – neither deep nor otherwise.

Rather, it requires planet-based intelligent civilizations as time constructors. It is they who respond to the universe's deep-time desire to be perceived – only then is there historicity and, ultimately, deep time, as a reality on Earth and in our present.

I am not sure such a "desire" exists.

It does – it's a Lacanian desire, just as it is a Lacanian pleasure, so that is by no means an ambivalence-free pleasure or anything.

This is slightly too – how shall I put it – psycho-planetary for my liking. I think the important point we're getting at here is rather the following: Looking at things from an epistemic angle, our life takes place not so much 'in' geological deep time, rather, geological deep time in many respects only emerges 'in' our lives: it is only during our lifetimes, as we live on, that an increasingly high-resolution image of deep time has emerged.

This can be easily seen in the timeline of its exploration (1977–2067 and 1973–2068 respectively). It is true that the age of the Earth was already known when I was born – whereas only 300 years earlier it had been estimated at a few thousand years ...[155] The image of geological time at the beginning of the 1970s, however, still contained no Cambrian explosion, no comet impact from Chicxulub, no mass extinctions, no Snowball Earth events,

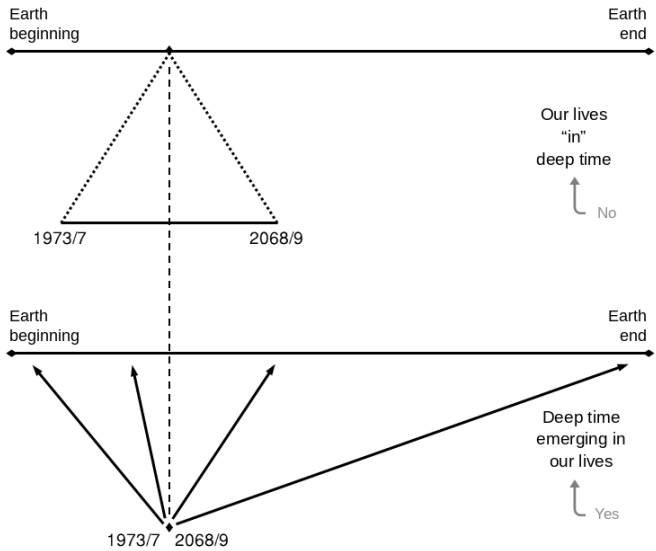


FIG. 32

no Great Oxidation Event (process of the late formation of the oxygen atmosphere), no deep-time climate fluctuations linked to CO_2 levels, and so much more.

Deep time had much less inventory.

Correct. But with every school year, the history of the Earth fills up with newly discovered fundamental events: In the 1970s in Italy, the physicist Luis W. Alvarez and his son discovered the geological signal of the comet impact which ended the time of the dinosaurs 66 million years ago – published in 1980.[156]

Two years later, David M. Raup and Jack Sepkoski published an article in *Science* on prehistoric extinction rates in marine fauna, which forms the basis for the now widely accepted observation of five major mass extinction events in the last 500 million years since the Cambrian explosion.[157]

The Cambrian explosion, for its part, also came into the world in the late 1970s with the fossil research of paleontologist Harry B. Whittington in the Canadian Burgess Shale (*The Burgess Shale*, 1985) and was consolidated as a phenomenon and popularized in the early 1990s by Stephen J. Gould and others.[158]

The correlation between climate and CO_2 in deep time, too, has only been known since the mid-1980s.[159] I could go on.

In addition to your list, there is also the fundamental fact that the first living beings did not draw their energy from sunlight or photosynthesis, something we only became aware of in the 1980s: "[T]he proposition that the deep history and biochemical diversity of life are carried by biota that grow from geochemistry rather than from surface exposure to sunlight is supported by a wide variety of chemical, biomolecular, cellular, and ecological observations, most of which have been systematically accumulated only within the past 40 years."[160]

This includes the fact that the Earth's early atmosphere did not contain oxygen – and how could it, there was no photosynthesis yet!? The fact that the oxygen atmosphere had to come into being, and that this was fatal for most of the life forms that had existed until then, is yet another thing we could not learn in

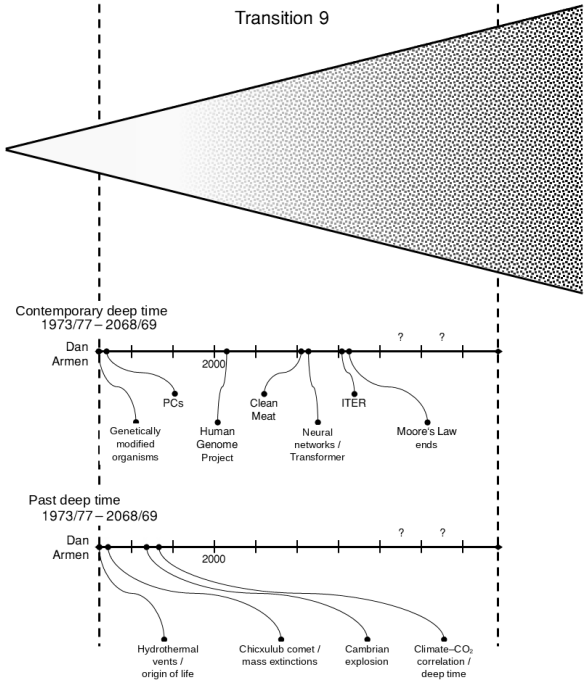


FIG. 33

school back then (in the fantasies of the good Mother Earth this is still ignored today).

Paleontologist Preston Cloud first formulated this hypothesis in 1972, and scientists such as Heinrich Holland subsequently elaborated on it.[161] A few years later, in 1976/77, the first hydrothermal vents ("smokers") were discovered on the ocean floor – since the early 1980s, therefore, people have theorized

that this could be the origin of terrestrial life over 4 billion years ago.[162]

It's puzzling that all of this emerges out of nowhere in the first two or three decades of our lives. Prior to that, it simply wasn't there in the thinking and inventory of the world.

Yes, and I think this is a connotation of the term biographical deep time that we must always be sensitive to from now on: While we experience our lives being infused with *contemporary deep time* – the 'live' unfolding of natural history – the emergence and ever higher resolution of the image of *past deep time* is also something happening in the course of our lives. And perhaps it is only against this background that we can recognize the former, the contemporary variety of deep time, as deep time at all.

Note that also in this new connotation of biographical deep time, the term describes a form of 'interiorization': more and more *past deep time* is being interiorized and engraved into our lives.

One could also say that in our lifetime we are growing a form of planetary memory.

And that's a novelty. Unlike Maurice Halbwachs – the historian who is always cited when it comes to a plurality of *collective memories* in which we participate in the course of our lives – we are interested in the emergence of a planetary memory, the emergence of which, however, will only have occurred retrospectively: by the time we could write our memoirs. But this follows on from – or in radical extension of – Halbwachs' intu-

ition that "[a]nother period of society might conceivably begin on the day after an event had disrupted, partially destroyed, and transformed its structure. But only later, when the new society had already engendered new resources and pushed on to other goals, would this fact be noticed. The historian cannot take these demarcations seriously. He cannot imagine them to have been noted by those who lived during the years so demarcated."[163]

But isn't our whole point that we're trying to note them now? Either way, the planetary dimension of memory – the deep-time space of memory – is ultimately beyond Halbwachs' horizon, don't you think?

Well, at least he relates the question of *a collective conception of time* to what he calls "the basic facts of astronomy and terrestrial physics."[164] ...

But otherwise sure, Halbwachs is interesting for us here mainly as a contrasting foil – to illustrate the difference between historiographical and natural-historical perspectives. I am also thinking here of his statement that "astronomical dates and divisions of time have been so overlaid by social demarcations as to gradually disappear, nature having increasingly left to society the job of organizing duration."[165] This fits so well because we are actually trying to describe exactly the opposite: how natural-historical time at work in contemporary societies revolutionizes them and imposes its beat on our biographies.

2. LIFE EXPECTANCIES

But we have not yet gone far enough in our analysis of the interiorization of deep time. Because the possibility of our lives as such, i.e., as something that has emerged in this world, depends on the recent natural history of the Earth, which only created the demographic conditions of possibility for our lives to come about in the first place (as part of the escalation of habitability). We are often not even aware of how much our demographic situation is a historically young product, a natural-historical pop-up effect, if you will. We are, in a concrete and existential way, products of this technosphere, this Earth-spanning infrastructure of intelligent civilization. The vast majority of us would not have been born without it. It brings about modern population growth, without which we would not exist – not in these numbers and not with the life expectancy we now have. Without the technosphere, there would be no 8 billion people with an average life expectancy of 73 years. I always imagine this short clip: Where just a moment ago there were empty plains – steppe – there are now cities with millions of inhabitants.

Originally, this growth effect was mainly achieved by lowering child mortality in the first five years of life, which basically did not happen before the 19th century … Previously, child mortality was 40–50% practically everywhere, whereas now it is only 4%.[166]

Yes, but that's only one aspect. In addition, deaths have shifted more and more from the middle years of life to the old and oldest ages.[167] This too was different before, when the probability of death in adulthood was always about the same; today it is low in the middle decades and only rises sharply in older years.

Meanwhile, the absolute biological lifespan as such (of 120 years at most) has not changed much at all.[168] What has changed, as you say, is that more and more people are enjoying a complete life cycle from birth to a purely age-related death (the so-called 'natural' death). The dispersion of the times of death is increasingly giving way to their contraction in the highest age region.[169]

This is an artistry of removal: Reaching this region is the sum effect of a series of measures that *continuously keep preventing earlier death*, which could otherwise strike at any time, because of illness, accidents, etc. Such factors and events have to be actively removed – taken away, put aside – time and again, so that the body can ultimately arrive in the region of the age-related death.

There would be a whole history to tell of the discovery and implementation of vaccination – think of the eradication of smallpox – urban sewage systems and chlorination of drinking water, pasteurization of milk, hand washing, antibiotics, the Green Revolution, public health systems and medical technology, radiation and chemotherapy, antiretroviral therapy, etc.

Exactly, and the multiplicity and diversity of these elements should not deceive us: put together, here again we are confronted with a precise morphological process, a process

of natural-historical change undergone by the human habitat. Science journalist Steven Johnson puts this very nicely:

"In a sense, human beings have been increasingly protected by an invisible shield, one that has been built, piece by piece, over the last few centuries, keeping us ever safer and further from death. It protects us through countless interventions, big and small ..."[170]

This "invisible shield" forms a protective envelope around our lives.

Its growth and shape are based on the precise criterion *of providing a purely age-related death for ever greater parts of the population.*

Indeed. And the process is still ongoing – the escalation of habitability continues: life expectancy continues to rise, and (while still being scandalously unequal) it rises worldwide, not only in the places where the two of us have the undeserved privilege of living.

And I would argue this process marks the point where the interiorization of natural history into our lives reaches its highest, most existential intensity.

How's that?

Because the buildout of that "invisible shield" is a dimension of natural history that not only affects and reorganizes lives and biographical patterns *within given lifetimes* – as in all the cases we have discussed before – but also affects and expands the sheer length of our biography as such.

Can you explain this again with your biography?

OK, then I'll start again at the beginning. My heartbeat begins in the embryo after about 5 weeks, on a day in the spring of 1977. The heartbeat – and the fact that it could stop at any time – shows that mere survival is a fragile, constantly vulnerable process. Something could always come in between – between the present and a later age region. Life as an obstacle course through the age regions; heartbeat after heartbeat.

The territory of the next decades of the planet can only be entered through the continued heartbeat – through the continuation of a life process.

Gosh, that's kind of touching no matter how insanely trivial it is...

But then something gets in the way. 2017. One of my internal organs becomes inflamed – life-threatening ...

... Oh, I didn't know.

Yes, but before that, something else has come into the world – something that didn't yet exist when I was born. In 1985 – I am 7 years old and obviously have no idea what will happen later – a doctor in the German town of Böblingen develops a particular surgical procedure. With this procedure, my bad organ is removed 32 years later at the hospital Am Urban in Berlin – I'm 39 at the time. Otherwise I might not have reached the year 2018 and would not have been registered as 'present' in this year of 2023, in which we are having this conversation.

I wouldn't have shown up for work, so to speak.

I wouldn't have 'registered' in the 'countinghouse' of the 2020s decade at all.

This book would not exist – nor would the discovery of biographical deep time.

No, seriously, it is only during the course of my life that this technique has grown to salvage my vulnerability when it was required: when I was born, the world was still void of it. It arose within my life, *in time* before the onset of the illness. Now it allows me to sit opposite you.

Frightening.

Well, I'd say it is delicate timing – an existential juggling – that has in this case cleared away the obstacle and thus cleared a few years or decades to be accessed by me, unlocking more years of life: allowing the heart to keep beating.

Paradigmatic for what you just described is the scenario in which a person suffering from an incurable disease establishes a foundation for research into this disease and possible medications, or participates in ongoing tests of new treatment methods. Let's say these will take effect in the future. But the person has only years, or months, or weeks to live. Two timelines are intersecting: Does the drug's efficacy come *just in time* before death to unlock a package of some more years of life for the person? Or does he or she miss this development by days, weeks, months, years?

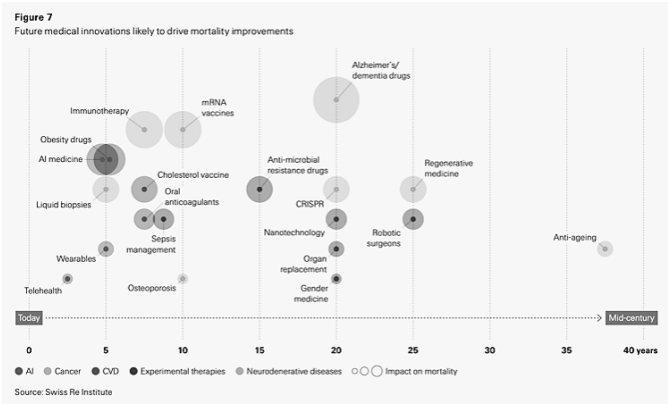


FIG. 34

This is where everything comes together: this is self-bootstrapping – pulling oneself out of the swamp by one's own hair, like Baron Munchausen – in the register of mere continued existence. It's a kind of magic trick.

Yes, and as contrived as it may sound, this scenario is not a macabre special case. Look, I've found a – hypothetical but not implausible – diagram issued by the reinsurer Swiss Re[171] that plots the future of innovations in pharmaceutical and medical technology on a timeline of the next few years and decades (calculated from 2023). Very pretty:

For people whose continued existence depends on these techniques, which will only become real in the future, it is a matter of 'just making it' into this respective future in order to be able to unlock further years of life there.

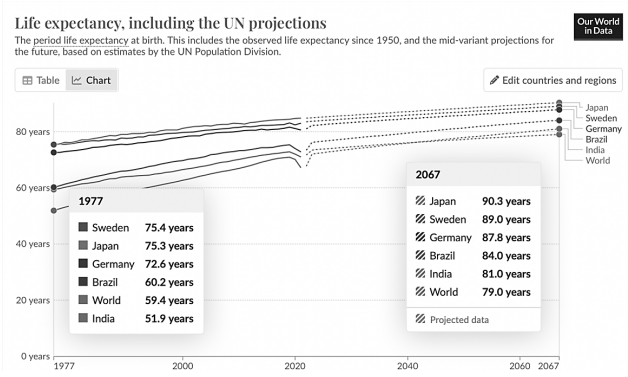


FIG. 35

All of this, too, is testament to the escalation of habitability as it happens. The history of medicine and pharmacy since our births in 1973/77 is full of such cases, isn't it? And because that protective envelope is becoming more refined in the course of our lives, our life expectancy increases a little with every year that we continue to live – and I mean it increases substantially, i.e. beyond the purely statistical effect that the higher the age already reached, the higher the future life expectancy. Now I'll give you a diagram:

If I apply this gain of 15 years of life expectancy between 1977 and 2067 (in Germany) to my own life, the following applies: for every 12 months I live, I gain two extra months of life. That's quite something. Especially since there is a strangely tautological element in looking at this graphic: it is the thing that I'm looking at here which determines how long I'll be able to look at it. At

the same time, this is simply a process that continues the modern increase in life expectancy.

The escalation of human life expectancy is a major product of recent natural history that is still far too rarely acknowledged. Philosophically, i.e. beyond a descriptive sociology of modernity, its significance is still not understood.

It is easy to overlook the fact that these demographic effects are directly linked to the question of autobiographical self-description.

Indeed, according to sociologists like Martin Kohli, the demographic expulsion of death from people's childhood and middle years, and them being able to 'bank' on a certain length of life, is a prerequisite for the emergence of the life course – a particular life course – as a social "institution,"[172] i.e. as a relatively standardized social reality we are accustomed to since the 19th century. This is a new social fact that in many respects is also underpinned by normative force. Linked to this was the emergence of self-techniques such as diary writing and literary forms such as the autobiography – whose later descendant, autofiction, we still find everywhere today. Thinking further along these lines, we realize that the demographic situation we discussed is still and all the more presupposed if we now talk about planetarity as a mode of subjectification via the time bars brought to us by hyper-anticipation.

You mean because we constantly take it for granted to reach, say, the 2050s, 2060s? Because we can realistically assume it?

Yes, when we look at climate forecasts and insert the mark of our death on the time bar – as we did at the beginning – there is already a kind of basic trust at work: that our time of death will fall in the region of our life expectancy.

The life expectancy ticker is constantly running as we live on (also in the diagrams we discussed): it counts and it counts down, registers the number of days we have lived and projects the number of days we have left. As you know, we are in a better position to inform ourselves about the number of days ahead than any generation before us. And we do this all the time.

Also, if this were not the case, no temporal 'space' would open up before us in the first place. Without the basic trust I just mentioned, looking at the diagrams would generate no 'spaciousness'-effect with regard to the coming decades whatsoever – nothing could be mapped or made transparent. The future would not have the 'territorial' quality that it now has for us. The material reality of survival and planetarity as a form of subjectification are thus related.

So beyond the heroic gesture of 'running ahead' in the Heideggerian sense and the corresponding 'wholeness' of a life, the assumption of a certain *normal biography* is at play here, on which one can and does rely.

Normal biography Global North.

Yes, and it is easy to forget that this normal biography is itself a *special* form. It is temporally specific – a product of modernity and Great Acceleration. And it is geographically and socially spe-

cific – i.e. not given to all 8 billion contemporaries in the same way.

And the fact that this special form 'Normal biography Global North' is not a given for everyone is not just yet another scandal or political injustice among others.

No, from a planetary point of view, it's the core political problem. For planetarity is, as we have established, a temporal concept. To inhabit a planet is to inhabit the territory of its coming decades. It is therefore in this territory that all respective political issues and conflicts take place and play out. We already touched upon this in the context of hyper-anticipation as governmentality when asking: who models the scenarios, and which of the modeled scenarios are we (collectively) steering towards, and who benefits from this, or is harmed by it, and how? But in order to be affected by such questions, first of all *you have to be at all (still) present in these coming decades*, right?

Presence, however, is regulated by life expectancy.

The world map of life expectancies ... It's not so easy not to look at it in a flat way, as a spatial configuration. But, after all, this is a world map of the temporal horizons of current generations of the world's population, i.e., a gestalt that is at least as temporal as it is spatial.

I'd say: The temporal shape that corresponds to this topology of inequality is the morphology of the biographies produced by it. In a sense, more significant than the place itself – for example, Jakarta, or Jaba in South Sudan, or Zurich, where we are sitting

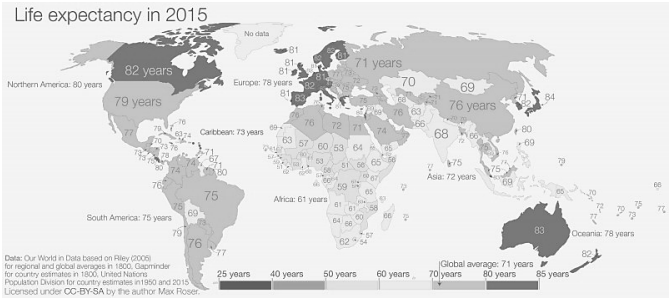


FIG. 36

together right now – is the temporal gestalt that emerges from it. By which I mean the morphologies of the biographies that keep unfolding there – with their patterns, phases, turns, etc.

Biographical morphologies that take on radically different shapes.

And varying lengths: as indicated in the map, 30 years separate countries with the lowest and those with the highest life expectancy. In addition, one would of course have to also include life expectancy differences within the individual countries, which are mostly related to forms of social immobility (class society) and structural racism.

This is so extreme. The most existential register of all questions of (in-)justice is determined by the issue of *mere continued existence*. Therefore, inequality in life expectancy should no longer be tolerated – all the economic, political and climate-

related factors that perpetuate it are ethically and politically reprehensible.

Indeed. According to UN data, life expectancy is increasing for all regions and the difference is narrowing – but it is far from closing.

And that's not even taking into account the way in which global warming is already interfering with these trends. It is astonishing how little research is being done on the life expectancy effects of global warming, as far as I can see. There is a lot on its general health effects – see, for example, the flagship project "The Lancet Countdown: Tracking Progress on Health and Climate Change"[173] – and there is occasional research on life expectancy in warmer vs. cooler climates (excluding other factors).[174]

But I have found little on the predictable scenario that global warming will mostly reduce the life expectancy of those who have contributed the least to it.[175]

Basically, unequal life expectancy is not just an under-researched, but also a massively under-theorized form of inequality. Maybe because it's so unfamiliar? Unfamiliar first because it takes place in the medium of time. It temporalizes the political nomoi. Above all, however, it drags the question of inequality into the metaphysical realm – life expectancy inequality does not play out purely within the physical world (as perceived by us), but precisely touches on the question of who still exists in the physical world and who doesn't.

This is a highly exotic variant of the issue of equal access.

Then again, maybe it's not *that* exotic. As the name suggests, we think of age regions as *territories*. But then the following applies: Some people get access (via continued heartbeat) to the higher or more distant regions, some do not. Some are given access to a 'land' to which others are denied access. All familiar – except that we're talking about the most existential 'land', the land of mere continued existence.

The land of still being around (in a certain age bracket, i.e. in a particular future).

The 'land' as a particular future of the Earth.

Yes, it's about access (or not) to the planet's natural-historical futures.

3. *REDSHIFT*: OLDEST AGE = HIGHEST FUTURITY

Perhaps we can now go back to the beginning, where we said: The graph of hyper-anticipation contains our time of death; we are absolutely linked to the scenario on display there, and more generally to the natural history of the Earth (especially of the next few decades). Because after all, the 'wholeness' of our biographies that becomes tangible in the graph – if we mentally run ahead to the end – was only a first indication of the existential zero mobility *vis-à-vis* the diagram, which we can now better qualify.

OK, what have we got? First – and setting the scene of our lives, so to speak – zero mobility is implicit in the recognition that the possibility of our existence is inextricably linked to the demographic situation of modernity. We could never have been born into a world where we *do not* see population growth and fossil capitalism, climate change, etc.

This is the so-called Anthropic Principle.[176]

Yes, and secondly, zero mobility is based on the fact that this natural history does not just spit us out into the world and then take a break. Instead, we said, it obviously continues its work inside our biographies, dominates their course, restructures them and even influences how long we continue to live.

Existential zero mobility then means:

We belong to a certain state of the Earth – completely and unreservedly.

The Earth is the underlying entity, the sub-ject to which we belong.

Instead of maximally standing out from the background and heroically separating ourselves from it – as the Heideggerians would like it – the perspective of biographical wholeness resulting from hyper-anticipation inscribes us entirely into the planetary background and its movement.

Perhaps, from here, we could approach a third connotation of the term biographical deep time – namely, deep time *as biographical in the sense of individuating*. Biographical deep time would therefore mean: The way in which our biographies are 'nailed' onto their spot in natural-historical deep time, and the way in which deep time takes place inside them – this is what individuates us, this is what makes our biographies what they are and constitutes their ownmost quality.

Individuation through natural history.

Through Transition 9. Exactly.

OK, let's investigate.

If we are being individuated by natural history, then we are, and always will be, *the ones* who witnessed the process of the incipient debiologization of intelligence – or the growth of the first generation of fusion reactors. We were there and have lived in its presence. At least this would be the claim of the term bio-

graphical deep time now, to say: *This* is our ownmost and most intimate individuating feature. There is nothing deeper to say about us.

A rather externalist conception of individuation: that individuation should not take place from within, through self-formation, self-determined biographical development, but from the outside, through witnessing, basically through pure *being-at-*...

Yes, it seems strange, but it is not without precedent at all. As a mode of self-description, the externalist model of biographical deep time is reminiscent of the beginnings of (auto)biographical thinking and writing as a self-practice.

What do you mean?

Well, look, here is this somewhat technically worded text by Martin Kohli – but I found this paragraph very insightful exactly for our purpose. He writes: "in the present context one structural change stands out [in the early 18th century – AA, DF], namely, the change from an 'annalistic' conception in which life is structured by the sequence of external historical or seasonal events to a developmental conception, organized around and by the self. In temporal terms, this implies a change from historical, or natural, time as the axis for the life that is being narrated to the time of the individual life course itself. In the first case, the individuals are put into a sequence of events that are connected by a supraindividual logic; in the second case, they constitute a sequential program of their own logic."[177] Biographical deep

time then marks precisely a reappearance of "natural time as the axis for the life that is being narrated" – only that this natural time is now not so much cyclical (seasonal) but ecstatically drills itself into the Earth's possibilityspace, so to speak. And it is the resulting "supraindividual" morphological trajectories that individuate us – simply by witnessing them.

This idea of witnessing I find really apt; same goes for the sense of being individuated purely by *being-at-*... For me, this is like witnessing the growth of a plant or the construction of pyramids. I stare at the thing in its morphological process. At the intelligent 'crust' growing around the globe, which is the technosphere. It individuates me – like a spell: I can't turn away – even if it is a terrible thing (like the climate crisis and many other disasters we stare spellbound at). I look at it because I *need* to see the growth of this edifice – natural history is a kind of distinguished edifice that defines what the present is, and that gives me my name.

I am *the person* who saw *that*.

Yes, and I can no longer forget it, or make it unseen. It defines me.

Instead of Psyche, we have Earth in our heads. Its history is what is most intimate to us: *autobiography = planetography*.

This is the becoming-planet of the autobiography, as we would have said earlier with Deleuze/Guattari.

A radical externalism...

... and it also individuates us as philosophers or researchers, who do not simply write about planetary time in the abstract. Instead we are historically situated in a specific time of growth of various radically new technologies and astrobiological findings, which we want, or must, or can witness philosophically. I'm not sure which modal verb fits best, but this is a genuinely philosophical desire to witness the emergence of the planetary. No planetary thinking without witnessing our planetary lifetime.

Yes, this is a philosophical and spiritual activity.

No – or at least let's delete the latter thing, the thing with the spiritual ... I mean, already before we started drifting off a bit I fear...

I don't see it that way. Witnessing the unfolding of the being which is a planet, for me that's the highest dignity of a philosophical life. And if this dignity blends into the spiritual, then why not. Planets are inhuman spherical deities – feel free to let this stand under my name once this goes into print!

We'll delete the names anyway, plus you've already answered yourself twice... OK, so planets are inhuman spherical deities, you say – in the Spinozist sense of *deus sive planetus*?[178]

Yes, what else could be more worthwhile to look at in the universe than the self-unfolding of these deities? Nowhere is there more happening to matter, nowhere are there more wonderful structures growing, nothing in the universe is more animated. And this is not limited to the one Gaia but constitutes a veritable

planetary polytheism. Gaia is a plural – there are many Earths and not just one Mother Earth in the post-oedipal universe.

Witnessing them astrobiologically – planets from which we have emerged and into which we will soon sink back – constitutes a spiritual dimension that is strangely absent from contemporary atheist philosophy (just think of Martin Hägglund's much-discussed *This Life*[179]).

Witnessing planets – as we age.

Yes, exactly, that's crucial. For implied in this witnessing position is a time span, a temporality that involves the entirety of a lifetime, a temporality that comes with an existential immobility vis-à-vis the thing that is being witnessed.

And again with zero mobility.

Absolutely. Philosophy has traditionally regarded cognition, thinking, as the 'highest' human capacity. But this is something else than just accumulating knowledge about this and that in the course of a lifetime: as if what is to be known would be optional, as if one could move freely amongst random stacks of knowledge. It's not like using Google all day or jumping back and forth between different book projects. A better comparison might be researchers who study generational or intergenerational processes in a society and thus follow their human objects of investigation *throughout their entire lives*, such that in the meantime the researcher's life is also used up entirely. Every research process extends to the end of the researcher's life as well as of that of the

object. There cannot be any mobility here – you've got *one* shot. The commitment is always that of an entire researcher's life.

Philosophically, this is the crucial operation: Witnessing the unfolding of the Earth's natural history 'live' – now that natural history is taking place inside our lives and the Earth is in this sense 'closer' to us than ever before.

Hyper-anticipation and the Earth's futures it lays out are absolutely decisive but only a starting point in this regard. After all, we are *living into* the anticipated world, aren't we? And then, as the years go by, we witness how the series of possible future Earths presented to us (by the models of hyper-anticipation) individuates itself into the *one* path it ultimately will have taken through the possibilityspace.

Welcome here and now!

And I would go even further and say that our mere continued existence into a year or decade (as an effect of the natural-historical development of medicine) is in itself already a form of witnessing.

Still-being-there is already a form of witnessing – witnessing consists in nothing but still-being-there as a witness or observer (the observer testifies to her own existence *through* her still being there). And the mere continued existence into a year, an upcoming spring, is already the circumstance that is being witnessed (by being given).

This sounds somewhat esoteric, doesn't it? But I am reminded of a passage in Jeremy Sherman, *Neither Ghost nor Ma-*

chine, where he says: "[T]he highest moral aim is keeping selves self-regenerating. As far as we know, life doesn't mean anything to the universe. ... make the meaning, and if we were to make a meaning that most of us could agree on, it might be that the meaning of life is not to end it."[180] Whatever "meaning of life" comes to signify here ...

What is certain is that the older we get, the more we see of the Earth's path through its possibilityspace. From today's point of view, therefore, the older we become, the more future natural history of the Earth we can include in our testimony.

Also from this point of view, then, we must insist on the marking of the political crime, the metaphysical injustice that inequality in life expectancy always represents.

After all, the *planetary right to the highest ages*, i.e., to a purely age-related death, is the right to be individuated by what takes place in these highest ages.

Without reaching the highest age in that sense, I cannot fully 'redeem' my individuation on this Earth.

We say: To be in the presence of a natural-historical event, to be a witness to it, is what individuates us. Now let's say such an event takes place in the 2040s. Then not experiencing it even though one *could have* done so – as evidenced by others from that same generation who enjoy a higher life expectancy – constitutes a violation of the right to be individuated by that event.

Yes, because in this scenario, I remain cut off from my natural-historical potential, as it were. It's literally like being denied access to a land in which you could find your own name.

It's as if you could not go pick up your own name.

It's as if you're forced to leave your individuality at the cloakroom.

The biography can't continue writing itself ...

Hence the demand: Equal rights to participate in planetary dignity for all members of a cohort! Equal rights of access to the highest degrees of futurity (through life expectancy) that are possible within a cohort!

I imagine Kant asking today what it means to orient oneself in thinking, i.e. in thinking the planetary and thus in planetary time ... He probably would call this a world citizenship *in time* – and Marx would call it a planetary communism with equal participation for all in the planet unfolding into the future.

This also means equal participation in aging.

This is a transverse position – a counterintuitive crossover – that is perceived much too rarely: The increasing futurity of the Earth, its escalating futurity, is associated with the process of our aging, the increasing retreat into fragility: The old body is visibly tortured by the junk of cell replications accumulating in it, by the copying errors that take away more and more specificity from the body's cells ... But this is the transverse position: The wrinkles, the hunched gait, the weakness and the forgetfulness are *signs of futurity.*

This way our aging becomes a sign of the deepened, intensified futurity of the Earth. And it is a sign of the intensified redshift of our biographies – as we called it above: in the later years, so much natural history has already forced its way into our biography and continues doing so more and more.

Of course, in old and oldest age it becomes increasingly unlikely to reach the next year, the next month, the next week. At the same time, with every year, month, and week *we do reach*, we arrive in an increasingly distant future. This is especially true with exponential natural-historical processes (such as, to a certain degree, Transition 9): The span of a later month takes us deeper into the Earth's possibilityspace than the span of an earlier month.[181]

Just as aging itself is an exponential phenomenon (we age faster and faster as we age), aging into an exponential situation means that I witness a much more rapid natural-historical dynamic in a month of my 80th year than in a month of my 8th or 28th year.

The redshift is at work in our lives from the very beginning, which shows that we have been living in deep time since birth. But old age is particularly dynamic, particularly dissociative, in this respect. As it draws to a close, a life is flooded with ever greater amounts of deep time, whereby the bio-planetographical space – the architecture of the last years and months of our lives – is 'driven apart' even more violently.

The late phases of a life drift away faster and faster from the earlier phases and its beginning, whose 'light' hardly penetrates

across into those late stages any more. Age has drifted away, becoming more and more futuristic.

For each and every individual life, the phenomenology of highest futurity is the phenomenology of the highest age, the greatest frailty of a body.

The weaker you already are, the more you drift away, the higher the degree of futurity, the more powerful the non-biological intelligence that touches you in your later days – in the form of advanced medical technology that now surrounds or even becomes part of your body more and more frequently.

The future grows towards the aging body: this can be the new medication – wrested from the extreme redshift and unlocking some further months or weeks for you – or it can be the robotic machines carefully 'bending over you' in your last days and minutes, surrounding your body like a fragile place of worship.

The desire for the future and futurity is the desire for old age.
Redshift:
Oldest age = highest futurity.

That's a good equation.
Here's another one:
Highest futurity = highest truth.
Because as melancholic as this could make us:
The later Earth is the truer Earth.

The truth of the Earth resides in the future, not the past; not in a past nature, not in childhood, not in any origin or anything else that preceded us.

No, we encounter its greatest truth in what it reveals at the latest moment of our lives.

You mean, the truth *about* the Earth (and what it can do) that is only gradually coming to light?

Yes. After all, the ultimate question of astrobiology is not: Are there other planets like Earth in the universe?

But rather: What can a planet do?

What events, morphologies or structures can planets form out of themselves in this universe?

The question is already implicit in the general planetary model, as its apotheosis: *What is the ultimate thing that a planet can do?* What is its ultimate possibility?

Obviously, it is true that I can know more about this at the end of my life than I could at the beginning. But what is possible here is also possible in the infinite series of exoplanets. This is the ultimate consequence of the Copernican principle – the astrobiological serialization of the Earth.

This reminds me of the well-known quote from Deleuze, where he states with Spinoza: "[W]e do not even know what a body can do."[182]

On our last day – at the point of our highest futurity – do we know what our body could do?

Look, the day of our death is now marked in the diagram (Fig. 26): we will be cast aside with it soon.

The planet continues on the path to its truth – and the truth of all planets.

We don't know what it can do.

Planetary thinking is not a normative requirement, in the same way as politically shaping the emergent dispositif of hyper-anticipation (which could and should guide our future actions) is not a categorical imperative drawn from 'pure reason.' Instead, the radical transformation of philosophical thought associated with the notion of planetarity is the fulfillment of a desire that is, strictly speaking, as old as philosophy (and thus natural philosophy) itself. For this is what this book is all about: elaborating the contours of a philosophy of nature that is up to speed with astrobiology's understanding of planets. In order to get a better sense of what this could mean, let us turn to two neuralgic points.

(1) The first is the fundamental natural-philosophical problem of the separation of subject and object in the knowledge of nature. Traditionally, the question is not only *how* we think about nature, but also *who* does the thinking. The phrase that gives this book its title, *Thinking Planets*, can be read at once as *genitivus subjectivus* and *genitivus objectivus* and thus dissolves the modernist distinction between subject and object. Thinking planets takes place on this planet; it escapes the distinction between our own thinking of the planet on the one hand and the planet's thinking on the other. Such desires for separation, which are still anchored in a naïve modernity, cease in the discourse on the planetary. "[T]he planetary emerges as the feeling that there is a clash between the global – basically moderniza-

tion – and the planet,"[183] as Bruno Latour put it in an interview. This opens up the invaluable opportunity "to rethink the ontological infrastructure of modernity, with its sharp distinction between human things, natural things and technical things."[184]

Equipped with the astonishing astrobiological revelations of the past decades, a rethinking of the ontological infrastructure for us meant recognizing knowledge processes and infrastructures as new natural properties of the planet and crucial operators of its further natural-historical development. In turning to contemporary natural history, thought takes itself as its object in a new way. For knowledge shapes the planet, and knowledge infrastructures (sensors, satellites, artificial intelligence for the evaluation of climate data, etc.) can and must therefore be linked to thinking the planetary in a deeper sense. The two sides can no longer be separated.

Obviously this doesn't imply that these infrastructures are necessarily aware of their own natural-historical positionality, or that they are particularly suitable for navigating the storm of natural-historical events unfolding before our eyes. Neither is the case. Following Jürgen Renn, more "knowledge about the dynamics of the Earth system and the consequences of human intervention in these dynamics" could only be generated under conditions of a *flexible technology of knowledge representation*, i.e. only after "overcoming the current compartmentalization of scientific insights."[185] The latter is based on institutional divisions that are not simply a side effect of a narrow understanding of science, but are symptoms of a separation that characterizes modernity as a whole: the separation not only of culture and nature but also of cultural studies and the natural sciences. This results

in a set of equally enduring and problematic consequences. For we are far removed from sufficiently understanding the evolutionary effects of such *planetary sociotechnical systems* in terms of their potentialities – which would be particularly relevant with regard to continuing and navigating the potential paths of Transition 9. These systems highlight what Renn has called the *co-evolution of social and mental structures*, or as Sheila Jasanoff puts it: "Knowledge and its material embodiments are at once products of social work and constitutive of forms of social life; society cannot function without knowledge any more than knowledge can exist without appropriate social supports."[186]

(2) Another neuralgic point of philosophy of nature concerns the question of teleology, i.e. the potential purposefulness and purposiveness of the natural process. A commonplace of the history of science and philosophy sees this question at the heart of the modern separation of empirical natural science and speculative (natural) philosophy:

> In the divorce settlement three hundred years ago, when natural philosophy separated from philosophy, taking the name natural science, philosophy got to keep the mystery of purpose. Natural scientists expected that science would get along just fine without having a solution to it.[187]

In reality, however, the historical constellation is much more complex than any linear history of science might want to acknowledge (cf. "serious misunderstandings of the history of science"[188]) and the teleology question keeps reappearing today in astrobiological debates and elsewhere. This testifies to the tenacity with which the supposedly long-abandoned major

themes of natural philosophy continue to impose themselves on scientists in general and on everyone dealing with the origin of life or extraterrestrial life forms in particular.[189] And it is not only in popular representations of science that teleology (however refurbished or under different conceptual disguises) celebrates a comeback wherever a deeper understanding of planetary evolution is at issue. "It is the teleological nature of the universe that creates a cosmic context that instills life with meaning and purpose, and that purpose is to suffuse the cosmos with intelligence and experience by thriving, multiplying, and expanding"[190] – which is why a newly gained or increased self-awareness of planetary intelligence should turn us into an ontological imperative on a cosmic scale: "You are not a cosmic accident. You are a cosmic imperative."[191]

Symptomatic of the astonishing survival and afterlife of teleology are not least the failed attempts to draw new conceptual distinctions while somehow keeping the new conceptual confusions caused by them under control: this concerns the attempted separation of teleology, as hypostatized by classical philosophy of nature, from teleonomy, which claims to be in accord with modern science ("teleonomy means the impression of purpose resulting solely from the laws of nature"[192]) or follow-up distinctions such as that between directed and self-directed processes that would follow their own purposes, etc.

□ DIRECTIONALITY AND INTIMACY

Both strands of discussion and their aporias confirm the need for a new natural philosophy in the spirit of astrobiology. And we firmly believe that today, after all naïve assumptions about a stable, original, and balanced nature have been debunked by the theory of major evolutionary transitions, a serious natural philosophy is possible once more – a confident philosophy of nature instead of repeating the submissive gesture of (natural) philosophy from *ancilla theologiae* to *ancilla scientiae* into all of eternity. This is possible not through recollecting any peculiarities of a *philosophia perennis*, but, on the contrary, by opening up to new scientifically informed perspectives. These allow philosophy to take part in the overcoming of disciplinary boundaries and to fulfill its long-suppressed desire: by means of an unreserved and consistent temporalization of its main operators, methods, and objects – as exemplified by the pluralization and serialization of its core object, the planet.

Planetarity is in at least two respects the preferred subject of natural-philosophical reflection today. Benjamin Bratton appropriately writes of a "planetarity that is, first, revealed as the precondition of any philosophy and, second, the name of the project before us as we contemplate how to preserve, curate and extend complex life."[193] The two aspects are inseparable. In addition, we pointed out in the introduction that numerous theoretical or philosophical approaches in the planetarity discourse have so far suffered from ignoring a scientific or, more precisely, astrobiological understanding of planets. This omission can now be clarified and generalized: What they missed was and is a philosophy of

nature abreast of current insights into (the evolution of) life and its planetary process. But it is precisely this temporalized nature that is at the heart of Natural Philosophy 4.0, which takes an astrobiologically grounded approach to key natural-philosophical tropes like 'infinity,' 'plurality of worlds,' 'life on other planets,' etc. – tropes that have not only been present in all stages of natural philosophy but have worked as their driver or catalyst.

This is already exemplified by an Ancient Natural Philosophy 1.0, which Aristotle established in distinction from metaphysics and mathematics. In his natural-philosophical writings *On the Heavens* (*Peri ouranou*), *On Generation and Corruption* (*Peri geneseōs kai phthoras*), or the *Meteorology*, he discusses a broad spectrum of – in today's parlance – physical and astronomical topics.[194] Even after the departure from Aristotelian scholasticism in the early modern period, Modern Natural Philosophy 2.0 remains characterized by a speculative desire to recontour the relationship between mathematically influenced exact (laboratory) sciences and philosophical reflection on nature. No one has expressed this more clearly than Francis Bacon, the pioneer of empiricist natural science, according to whom a "pure" natural philosophy had yet to be developed: "We have as yet no natural philosophy that is pure; all is tainted and corrupted; in Aristotle's school by logic; in Plato's by natural theology," which is why "from a natural philosophy pure and unmixed, better things are to be expected."[195]

One should then not be deceived by the fact that the reciprocal affinity between natural philosophy and science has been dormant for a (long) time, especially in the modern scientific dispositif that was hegemonic in the 19th and 20th centuries.

This applies, above all, to the Modern Natural Philosophy 3.0 which developed in the course of the so-called Second Scientific Revolution around 1800. Not only did various new scientific disciplines (like biology or geology) establish themselves at that time, massively shifting the meaning of others (like chemistry or physics), but also the separation of natural sciences and natural philosophy came to its logical conclusion.[196] During this period, natural philosophy threatened to shrink (itself) into an academic philology or a mere auxiliary discipline: the analysis of different historical concepts of nature or of the conditions of the possibility of the only relevant natural *science*.

The time to end such self-degradation has now come. Natural Philosophy 4.0 is reconstituting itself – and not only by means of a *new recognition of the planetary and natural-historical positionality of thought* (see above). In addition, it is based on a new understanding of *directionality* (the term often used as an alternative to the historically discredited teleology) as a quantitative, optical effect of the immeasurable and profoundly counterintuitive size of the astrobiological series: what appears as directionality in a small sample of selected planets becomes recognizable as a mere concatenation of coincidences when considered in the entirety of the astrobiological series, and vice versa. Directionality yes or no: a classic pseudo-problem.

The same then holds for the question whether planetary evolution took place *to the end* of producing intelligent civilizations, whether our existence is *the purpose* of the formation of so many habitable planets in this universe, etc. Conversely, however, in an astrobiological understanding it is very clear that intelligent

civilizations – like that of *Homo sapiens*, to which we belong – are not ontological aberrations of the planets that bring them forth.

Instead, intelligent civilizations are, in the full sense of the word, *planetary* phenomena. This does not imply (or only in an accidental sense) that they are 'Earth-spanning' phenomena. To call something 'planetary' means: it is in the nature of planets to be able to produce such a thing. Even if it happens only *on a single one* in a series of billions of Earth-like planets; and after this one planet had to work its way through a natural history full of vicissitudes for billions of years before it could happen. It is in their nature – based on all the contingency in the series. It is part of the possibilityspace called a 'planet', which astrobiology's general planetary model has set out to describe. 'Planetary' means: belonging to planets and being proper to them. Our intelligent civilization belongs to this planet.

Natural Philosophy 4.0 also understands that natural-historical deep time – the proper time of planets – does not always have to be 'infinitely slow' as compared to the experiential time of members of intelligent civilizations. For the present of the Great Acceleration, which we interpret as indicative of a beginning 9th evolutionary transition, we instead observe an interlocking of planetary, natural-historical time and biographical time. This is paradigmatic for our age of rapid technological and scientific acceleration, while its ethical and political implications are still far from understood.

Planetarity is not an object that stands in front of us, but a force at work inside our lives as we construct our biographies. The astrobiological serialization and temporalization of the Earth therefore does not so much lead to the planet vanishing

into the distance of astronomical objects (as Bruno Latour assumed) or into the depths of time since its beginning (as Dipesh Chakrabarty suggested) but instead places us in a relationship of ontological familiarity, belonging, and biographical interiority with the planet – as individual living beings as well as civilization or species.

Planetarity is almost synonymous with intimacy.

□ THIS PLANET

Planetarity-as-intimacy puts the serialization of the Earth (as indicated above in chapter A.1) in sharp contrast to imaginaries of abandoning this planet: as if, for us, the Earth were an arbitrary specimen from the astrobiological series, as if we could easily exchange it for others.

Hence our strong opposition to projects that are as prominent as they are caricature-like, such as "Occupy Mars," in which billionaires rack their brains over how to construct space colonies for the emigration of a privileged few just in time before the Earth supposedly becomes uninhabitable. But not only will the Earth not become uninhabitable anytime soon, which is clear already in view of the recent escalation of habitability (even if the effects of climate change will be as drastic as is to be feared). Ultimately, even a critique of such emigration projects based on the sense that these space colonies will be nothing but future enclaves of the super-rich, is a form of ideological embellishment, a smokescreen. Because colonies of this kind will never be a reality (beyond model projects doomed to failure). However,

such fantasies are connected with what we perceive as the real problem, which is being covered up by that criticism: with the reality that such terraforming projects by and for the super-rich have existed for a long time – but down here on Earth. Think of all the bunkers in New Zealand, gated communities and private security services, tax havens, yachts and private jets: such quasi-extraterrestrial enclaves on Earth will become all the more frequent the more extreme global warming and its chaotic effects play out.

Just as we are politically repelled by this scenario, we are philosophically repelled by another, even more distant scenario of leaving the Earth, which starts with the idea of uploading our brains to computers. It is the idea that post-biological intelligent beings would one day 'colonize' the entire Milky Way galaxy or universe by sending in space probes to other planets in order to settle and replicate there, and from there to send out further probes, and so on and so forth to the bad infinity. However, nowhere in these projects or fantasies do we recognize a noteworthy – let alone natural-philosophically interesting – answer to the astrobiological question "What can a planet do?" Again, space colonization fantasies underestimate the expansion of the universe. All other problems aside, these probes would be traveling in empty space for many hundreds of thousands, even millions of years before having 'spread' even just rudimentarily in the Earth's cosmic environment. Throughout this time, the probes are 'frozen' – while the collective intelligence on Earth keeps developing. In view of this intelligence, with each passing decade and century, the probes that have been sent out will appear more and more like 'old-timers' or atavisms from the history of technology.

A museum of technology, disseminated into outer space, does not answer the astrobiological question. This can only be achieved by the planet itself. Within the actual limits of its habitability – i.e., until photosynthesis will cease and the oceans will evaporate in the deep future – planet Earth has plenty of time to spell out the consequences of Transition 9. It would also have enough time to go through all other possible evolutionary transitions (in the very unlikely but not impossible case that they will all be 'found'): until the physical possibilities of structure formation and information processing for a planet of this universe have been completely exhausted right here on Earth. This state of exhaustion of planetary possibilities – which is unimaginable for us and so far unexplorable due to the lack of exoplanetary examples – would be the (final) answer to the astrobiological question.

Maybe there will be an answer after our time.

Meanwhile our current question is whether and how the potentials Transition 9 has in store for human and non-human life on Earth might come true in some future. The answer to this can only be a collective one, and its implementation must be techno-political and not just technological. Ideas of a technological fix or an overly optimistic solutionism are not suitable for this. Only through political, cultural, civilizational – and thus, in our view, democratic – means will we be able to figure out how to steer the unfolding Transition 9 away from toxic pathways or even to prevent its interruption by major civilizational catastrophes. Following our analysis, it is now a matter of positioning the potentials of Transition 9 in such a way as to help us with its navigation. How debiologized intelligences could be integrated into more intelligent human action within the Earth system is something

we touched upon in chapter A.3, where we were dealing with the new dispositif of hyper-anticipation.

In the actually existing, both reduced and reductive form of that dispositif, transnational organizations circulate hyper-anticipatory climate and Earth system models, which remain ineffective in the absence of a planetary political constitution, while on the other hand, nation-states and corporations access tools of hyper-anticipation to very different degrees in order to gain a competitive advantage in their antagonism.

Conversely, hyper-anticipation could become collectivized and constitutionalized: The new temporal envelope that hyper-anticipation promises for our lives could become a protective envelope in the most comprehensive sense, where we find better tools for tackling the dangers and utilizing the possibilities that come our way through Transition 9.

And first of all, to provide equal life expectancy for all. Because the active and conscious inhabitation of the planet *as* planet – which would only become real in this way – corresponds to a more comprehensive desire.

A planetary desire.

This is not a desire for a certain natural-historical state of the planet. It is not about trying to live 'in tune' with some snapshot of the Earth in its process – its shape at the time of our birth, or in pre-industrial times, or whenever everything is supposed to have been intact...

No, what we are talking and thinking about is an unfulfillable, but therefore productive and always generative *desire for planetary evolution.* Our desire for the planet emerges from the planet (a desire in the Lacanian or Hegelian sense: desire of the other,

desire for the other – and this other is the future). Its goal will have been none other than the creation of the Earth.

What greater existential and intellectual exaltation can there be than witnessing the unfolding of a planet 'live'? What greater desire could we have than seeing, with our own eyes, as much of its future as we can?

But to do this, we need to age.

Age, with the planets.

Thinking planets.

NOTES

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2 humanities.wisc.edu/research/workshops/alien-earth.

3 Cf. www.digitalearth.art; www.e-flux.com/announcements/423809/the-terraforming-2022 (the Moscow-based program *The Terraforming* was cancelled after the start of the war in Ukraine); www.more-than-planet.eu/labs/more-than-planet-lab; antikythera.xyz.

4 www.zfl-berlin.org/media-center-detail/planetary-humanities-i-panel-with-dipesh-chakrabarty-rochona-majumdar-achille-mbembe-walter-mignolo-and-henning-trueper.html.

5 Cf. Dipesh Chakrabarty, *The Climate of History in a Planetary Age*, Chicago, London 2021, pp. 86ff.; Lukáš Likavčan, *Introduction to Comparative Planetology*, Moscow 2019, pp. 36ff.

6 Will Steffen et al., *Global Change and the Earth System: A Planet under Pressure*, Berlin, New York 2005, pp. 131ff.

7 Will Steffen, Paul J. Crutzen, John R. McNeill, "The Anthropocene: Are Humans Now Overwhelming the Great Forces of Nature?," *AMBIO: A Journal of the Human Environment* 36, no. 8 (December 2007), pp. 614–621, here p. 617. Update: Will Steffen et al., "The Trajectory of the Anthropocene: The Great Acceleration," *The Anthropocene Review* 2, no. 1 (1 April 2015), pp. 81–98.

8 Chakrabarty, *The Climate of History*, p. 84.

9 Ibid., p. 85.

10 Ibid., p. 15.

11 Ibid., pp. 87, 89.

12 Ibid., pp. 86, 89.

13 Ibid., pp. 86f.; cf. p. 90.

14 As early as the early 20th century, the concept of the planetary was in circulation – as a candidate for the description of Earth-spanning processes in real time (Schmitt, Jünger, Heidegger, etc.). Since the middle of the last century, however, these processes have been described primarily under the concepts of the global and globalization. The 'planetary' went out of fashion – until Spivak took it up again.

15 Gayatri Chakravorty Spivak, *Death of a Discipline*, New York 2003, p. 72.

16 "If we imagine ourselves as planetary subjects rather than global agents, planetary creatures rather than global entities, alterity remains underived from us; it is not our dialectical negation, it contains us as much as it flings us away." Ibid., p. 73.

17 Gayatri Chakravorty Spivak, Susanne M. Winterling, "The Imperative to Make the Imagination Flexible," planetarysensing.com/the-imperative-to-make-the-imagination-flexible.

18 "To encounter the planet in thought is to encounter something that is the condition of human existence and yet remains profoundly indifferent to that existence." Chakrabarty, *The Climate of History*, p. 70.

19 Likavčan, *Introduction to Comparative Planetology*, p. 19.

20 "[T]he great outdoors [of the planetary], which moves too, but only at the pace of tectonic plates." Ibid., p. 90. Cf. Lukáš Likavčan, "Introduction to Comparative Planetology" (lecture), 2020, www.youtube.com/watch?v=JwCd9WPvWAI, at 25:26.

21 Likavčan, *Introduction to Comparative Planetology*, p. 72. See also: "[F]rom an Earth-system perspective, it is true that the planet is really a system of magnificent forces, which at best temporarily uses or misuses us as mediators for its own purposes, and at worst does not need us at all." Ibid., p. 71.

22 Ibid., pp. 78f.

23 Likavčan, "Introduction to Comparative Planetology" (lecture), at 24:30.

24 Benjamin Bratton, "Planetary Sapience," *Noema*, 17 June 2021, www.noemamag.com/planetary-sapience.

25 Ibid.

26 Peter Ward, *The Medea Hypothesis: Is Life on Earth Ultimately Self-Destructive?*, Princeton 2009; Toby Tyrrell, *On Gaia: A Critical Investigation of the Relationship between Life and Earth*, Princeton 2013.

27 Timothy M. Lenton, Bruno Latour, "Gaia 2.0," *Science* 361, no. 6407 (14 September 2018), pp. 1066–1068, doi: 10.1126/science.aau0427.

28 Spivak, *Death of a Discipline*, p. 72.

29 Gayatri Chakravorty Spivak, "Imperative to Re-imagine the Planet," in: id., *An Aesthetic Education in the Era of Globalization*, Cambridge MA 2012, pp. 335–350, here p. 338.

30 "This total view of the planet suggests complete interconnectedness, but also forms of imperial control. It is the product of globality as well as universal science." Jennifer Gabrys, "Becoming Planetary," *e-flux Architecture*, October 2018, www.e-flux.com/architecture/accumulation/217051/becoming-planetary/.

31 Ibid.

32 Ibid. Bratton, for his part, takes aim at positions such as these when he remarks: "The present orthodoxy is that what is most essential – philosophically, ethically, politically – is the uncomputable. It is the uncontrollable, the indescribable, the unmeasurable, the unrepresentable. It is that which exceeds signification or representation – the ineffable. For much of the Continental tradition, calculation has been understood as a degraded, tertiary, alienated, violently stupid form of thought." Benjamin Bratton, "A New Philosophy of Planetary Computation," *Noema*, 5 October 2022, www.noemamag.com/a-new-philosophy-of-planetary-computation.

33 In her own academic-activist practice, Gabrys is less concerned with impossibility than with the diversification of representations of the Earth, which she analyzes and pursues in her work with and through so-called citizen sensing projects; see Jennifer Gabrys, *Program Earth: Environmental Sensing Technology and the Making of a Computational Planet*, Minneapolis 2016.

34 On "Rehearsing Planetary Thinking" and "Transition to the Planetary Culture" in Günther, cf. Cai Werntgen, *Kehren. Martin Heidegger und*

Gotthard Günther. Europäisches Denken zwischen Orient und Okzident, Paderborn, Munich 2006, esp. pp. 44–46.

35 Bronislaw Szerszynski, "Viewing the Technosphere in an Interplanetary Light," *The Anthropocene Review* 4, no. 2 (August 2017), pp. 92–102, here p. 100, doi: 10.1177/2053019616670676. Cf. Nigel Clark, Bronislaw Szerszynski, *Planetary Social Thought: The Anthropocene Challenge to the Social Sciences*, Cambridge, Medford MA 2021, pp. 79ff.

36 Benjamin Bratton, *The Terraforming*, Moscow 2019, p. 71.

37 Bruno Latour, *Down to Earth: Politics in the New Climatic Regime*, Cambridge 2018. Cf. Chakrabarty's conversation with Latour: "Postscript: The Global Reveals the Planetary: A Conversation with Bruno Latour," in: Chakrabarty, *The Climate of History*, pp. 205–218.

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39 Chakrabarty, *The Climate of History*, pp. 80f.

40 Achille Mbembe, "Climate, Sustainability & Inequality Seminar: Notes on Planetary Habitability," www.youtube.com/watch?v=d1AKvMN5ock; cf. David Wallace-Wells, *The Uninhabitable Earth: A Story of the Future*, London 2019.

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understands the Sputnik shock as a mandate to perform a 'soul turn' from a *terrestrial* to a *stellar consciousness*: "With satellites, the classical human gaze from the sphere of the earthly out into space is radically reversed: the Earth's surface itself enters the picture. The view of the globe from the outside, the 'reflexive self-encounter of the Earth,' means a collective borderline experience of humanity" [translation by the authors].

44 Charles H. Langmuir, Wally Broecker, *How to Build a Habitable Planet: The Story of Earth from the Big Bang to Humankind*, Princeton 2012, p. 645.

45 Cf. Bruno Latour, *Facing Gaia: Eight Lectures on the New Climatic Regime*, Cambridge 2017, Lecture 1 ("On the Instability of the (Notion of) Nature"). On the concept of the environment and its predecessor term 'nature,' which has been spreading abruptly since the 1970s, see also Joachim Radkau, *The Age of Ecology: A Global History*, Cambridge 2014.

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52 Smith, Morowitz, *The Origin and Nature of Life on Earth*, p. xvi.

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54 Iris Fry, "The Philosophy of Astrobiology: The Copernican and Darwinian Philosophical Presuppositions," in: Steven J. Dick (ed.), *The Impact of Discovering Life beyond Earth*, Cambridge 2015, pp. 23–27, here p. 24.

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56 Clark, Szerszynski, *Planetary Social Thought*, p. 79.

57 Oswald Spengler, *The Decline of the West*, vol. I: *Form and Actuality*, trans. Charles Francis Atkinson, New York 1926, chap. III, p. 112.

58 Fry, "The Philosophy of Astrobiology," pp. 24f.

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