

# THE TERRAFORMING

As planetary-scale computation enables us to measure the inner dynamics of Earth, calculating its past, present, and future, we see the dissolving of the outside/inside mythos—the “out there” is actually “in here.” What we call “terraforming” is the hypothetical process of deliberately modifying a planet’s atmosphere, temperature, surface topography, or ecology to make it viable for Earth-like life. But what if we thought of the Anthropocene as a headless terraforming gone wrong, and researched better ways to terraform Earth and its ecologies? This text-only survey—an introduction and four essays edited in partnership with the Strelka Institute in Moscow—dares to suggest that the response to anthropogenic disaster will need to be equally artificial, and invokes creative solutions encompassing scenario planning, quantum physics, and cosmoplanetarity.

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It has been said that planetary-scale computation caused “the disappearance of the outside”: an act of *spatiocide* resulting in a monocultural globalism from which there is no escape. But perhaps instead it revealed that there never was an outside to begin with.

More specifically, it undermined a particular idea of the outside as the mysterious Nature on the other side of the border from the domesticated Culture. That border could be a fence, a wall or a door, but each similarly reinforced a notion of separation, with culture on the inside while nature remained “out there.” No more. We’ve come to realize that exteriority was a matter of perspective, and sometimes an illusion. A world made up of linear borders and horizons can be deceiving.

The dissolving of this particular outside/inside mythos has come from how the planet now senses itself, measuring its dynamics from the surface, underwater, in low-earth orbit and on the skins of things that populate it. How the world is perceived changes how we see what the world is. Just as the microscope forever changed how we see surfaces, and telescopes forever bent the horizon into the arc of a long curve, the development of a planet capable of sensing itself, sensing its own environment, calculating its past, present, and future, has and will continue to change how we (and it) understand *planetaryity*, which is a very different thing than “nature.”

This planetaryity has everything to do with climate change. In fact, the very idea of “climate change”—as in the calculation of a statistically significant shift in geochemistry and median temperature—is itself a direct accomplishment of planetary-scale computation. Without a big sensing and calculation apparatus through which the planet monitors itself, the current concept of “climate change” does not exist. In truth, the most important implications of planetary-scale computation may be epistemological and philosophical, not just technical. It changes not just how we think, but how the planet thinks through us.

The “question concerning technology” posed by the world, we are

The “question concerning technology” posed by the world-weary Heidegger held that an authentic relationship between “world” and “Earth” could only come from resisting the frame of technology. We see it the other way around: it is *only* through the precious, mind-bending technical alienation from naturalistic intuition that the reality of a planet might come into view. Any “authenticity” comes from alienation. It is by getting outside of ourselves and our singular bipedal phenomenology that we can see what’s happening. For us, that is the real outside—but for the planet looking back at us, everything is happening in the great big indoors. No matter where you go, you are inside the little skins of clothing, buildings, cities, and ecological niches and atmospheres. In this sense, they are all “artificial”; we can—and do remake them. Put differently, what is so provocative about directing our design attention “out there,” is that it is all actually “in here.” In this, there is both clarity and an invitation.

The research of The Terraforming think tank at Strelka Institute begins with this presumed planetarity, which becomes not just a frame of analysis, but also the basis for design. The terraforming we speak of is not the terraforming of other planets to make them viable for Earth-like life, but rather of ensuring that Earth will be viable for Earth-like life. It considers what is called the “Anthropocene” as a headless terraforming gone wrong. We are living in the structured debris of that terraforming. We recognize that whatever happens next, human culture will continue to terraform Earth and its ecologies. It’s not a matter of if, but of how. For us, “how” means, a reorientation to planetary thinking that is in contrast with those predicated on pre-Copernican hangover concepts of nature, ground, identity, and place. This is decisively different than “the global,” for which the planet is a static object for gridded overview. The planetary, by contrast, is multi-scalar and multi-temporal; it moves from atomic to atmospheric scales and back again without privileging the human-scale as the normative in-between point.

We accept the artificiality of terraforming and presume that the necessary response to anthropogenic climate change will need to be equally anthropogenic. We embrace our Three A’s—astronomy, artificiality, and automation—but define all three in idiosyncratic ways. Most of all, we recognize the need for a *plan*. As the post-’68 critique of verticality morphed into the post-’89 celebration of horizontality, individuality, and decentralization, we turn our attention to necessary alternatives—not simply the inverse of these (i.e., verticality, deindividuation, and centralization), but to different variables altogether.

We look at the shambolic response to COVID-19 as evidence of what not to do. Falling back on post-colonial citizenship as default mechanism to re-sort, re-divide, and encircle naturally mobile population swarms shows just how under-matched our geopolitical traditions are by the epidemiological reality of our shared biological circumstance. That rich countries would purchase vaccine supplies, that countries would be reduced to hacking one another for life-saving research data, and that waves of political populism would dissolve into 5G hydroxychloroquine conspiracy theories is so predictable as to defy humor. It is anarchy in the worst sense of term, and shows how the evangelically horizontal planlessness of the neoliberal era has failed. *Ad-hoc community care networks* are nice, and market-discovered vaccines will be going in my bloodstream as soon as the Illuminati decree it, but neither is a sufficient replacement for a viable and ubiquitous planetary-scale healthcare regime.

We realize that our initiative is swimming cross-current with the moment. We realize that intellectual habits will all-but-deliberately misconstrue what we say, no matter how clearly we say it. It is also why the work matters. The spectrum of design runs from terraforming, defined as the transformation of the planet according to plan, to what program faculty Helen Hester calls *anthropoforming*, the transformation of the human organism according to the planet. Each implies similar but not identical relations to what is “out there.” Both see the wide exterior as another interior in which (for which) we can design. Both see *Homo Sapiens* as a fundamentally migratory species. Our anatomy evolved in relation to our mobility and our relation to our tools. It is more relevant that you have opposable thumbs because your ancestors gripped tools than it is that they gripped tools because they had opposable thumbs. The body is the result of its engagement with technology, and humans have thus developed technologies for the body and for the environment in ways that leapfrogged the slow speed of natural selection. You already possess many custom exoskeletons: the fur coat, the ski boot, the scuba mask—all are artificial evolution in action. For architectural and urban-scale design, this process makes furniture, or individual rooms, or groups of rooms, or building envelopes, or urban amenities, interfaces, and infrastructures. They are all ways of accommodating the Great Indoors under the thin atmosphere.

Four of the thirteen group and individual projects from the first year of The Terraforming think tank at Strelka Institute are presented below by the researchers who developed them.

***Bury the Sky*** draws on our discussion and debates of “geoengineering” as a planetary design and policy framework. The term is in quotes because for it to be useful, it must refer to more than a portfolio of strange cloud manipulation tricks.

For our program, geoengineering refers to a *scale of design effect*, one which includes both proactive and passive forms. The project addresses the pressing need not only to cut carbon emissions dramatically, but also to actively subtract existing carbon from the atmosphere. Direct carbon capture is one form of Negative Emission Technology (NET) that requires much more attention. Working back carefully from metrics that require billions of tons of CO2 removal to be successful, the project shows how to put existing extraction infrastructure in reverse, burying the carbon spewed into the sky back underground.

***Black Almanac*** draws the history of food—from early agricultural settlements to molecular gastronomy—as a history of artificiality itself. The almanac is an early form of database-driven agriculture, an open record of past and predicted climatic events, best practices and benchmarks. The almanac proposed by this project sets an agenda for the coming decades of food production as a terraforming process by which we make the matter that we ingest (and which thus becomes us). Instead of the skeuomorphic faux-traditionalism of today’s kitsch cuisine, the artificiality of food is posited as the necessary means to a just and intensely heterogeneous planetary food culture.

***Cosmoplanetarity*** places each of us in the figure of the astronaut/ cosmonaut, encased in their life-support apparatuses, entangled with their ship, all given unfamiliar form by reduced gravitational pressure. The research braids *anthropoforming* into terraforming

directly and tests the transformations of the creature (who is us) in relation to those limits. The protagonist in the larger story is the gravitational force that not only holds form in place, but that also gives form as things evolve to suit its weight, on- or off-planet. That is, even as those creatures are “freed” from gravity and liberated from form, that form had been given in the first place by the gravity that now squeezes them. On stage is the “creatureliness” of the astronaut and their craft as the two remake each other under conditions of extreme interdependence. The lesson of the work is that the experiment up there clarifies what is already at work down here, terraforming and *anthropoforming* making and remaking one another.

In the original Cassandra myth, the daughter of the last king of Troy was less a futurist than someone uniquely sensitive to the implications of faint signals. Our namesake project, *Cassandra*, challenges the official futurism of the Intergovernmental Panel on Climate Change’s scenarios of what may happen next, suggesting that they’ve overlooked key variables and important ways of articulating their implications. The very idea of “climate change” extends the past into the future in ways that are extremely difficult to come to terms with; in that its significance is understood in relation to its future effects, it also extends the future back into the present. This gives power to the model and weight to the scenario as genres of governmental media. This project demonstrates new ways and new voices through which they can and must be articulated. An informal motto of The New Normal, our previous program at Strelka Institute, was “the future has not been cancelled”—a rejoinder to Mark Fisher (one that he approved of) and a nod to Russian Futurism. But in the early 20th century, the future was something to be achieved; in 2020, the future as we know it is something to be *prevented*. One future must be rendered impossible so that another can be realized.

If the projects of The Terraforming speak to “speculative design,” then it is of a specific kind. It works with (and sometimes as) a cold realism that cuts through comfort zones, including our own. Rather than speculation that is whimsically creative in some pretend tabula rasa, it works so directly with the disenchanting constraints of the real that its outcomes seem obtuse or even alien. The research is hyperfunctional, and so seems outlandish and unlikely, which has the effect of making whatever is most likely appear absurd. The planet should be open, and the multiplication of species should continue. To be “outdoors” is not to be outside of the larger inside. Doors are only one kind of shelter. Our project is to remake the inside—and be remade by it—in ways befitting this, the only planet within light years capable of hosting complex biological intelligence.

Edited by Benjamin H. Bratton and Nicolay Boyadjiev

Benjamin H. Bratton is a design theorist whose work spans philosophy, art, design and computer science. He is the Program Director of The Terraforming at Strelka Institute. The Terraforming program will be running for at least two more years. Applications for year two will be accepted in Fall 2020 at [theterraforming.strelka.com](http://theterraforming.strelka.com), where Bratton’s book *The Terraforming* is available to download.

Nicolay Boyadjiev is an architect, designer and editor based in Montreal and Moscow. He is the Program Design & Education Tutor at Strelka Institute and a core faculty member of The Terraforming.

## PROLOGUE

In Caspar David Friedrich's notorious painting, *Wanderer above the Sea of Fog* (1818), a man stands on a cliff, high and tall with his back to the viewer. Beneath him, the barely perceptible landscape stretches towards the horizon, rendered into a blank canvas by the thick layer of fog. Deep in melancholic thought, he watches the clouds move through the far-off mountains, imagining the adventures his journey will bring, anticipating the potential it holds. As the wanderer reflects on his own position on top of the world, the future seems his for the taking: it is a space of infinite possibility, an answer to his search of self-fulfillment; the exact direction of his gaze cannot be confirmed, yet it doesn't matter. What the wanderer is really looking at is not the landscape at his feet, but rather the time ahead of him. He is looking into the great unknown of his future, the limitless "out there."

It's not so far-fetched to imagine that the next COP will take place in *Fortnite* as a performative statement aimed at cutting down emissions needed to fly all of its participants into a single location. In this post-pandemic world, we are left wondering: what will be the new aesthetics needed to represent institutional decision-making? And what will be the role of digital spaces?

The digital space (the realm in which algorithms also exist and operate) already blends the boundaries between present, past, and future. These are spaces that exist outside of space-as-we-know-it, temporalities that exist outside of time-as-we-know-it. There is a potential for more and more institutional scenario planning and decision-making to begin taking place in the digital realm because it is a space believed to be devoid of friction. The "outside" is still seen as dangerous: the fictional idea of primeval nature that appears in the survivalist gear and hiking equipment marketing and feeds into the video game rhetoric, promising the experience of a "staged" adventure. It provides a conditional experience of the "outside" as a space of possibility, delivering a hero's journey into the comfort of your home.

But most importantly, the dangerous, physical "outside" is where a protest takes place, a non-staged encounter with the Other which many institutional decision-makers and stakeholders wish to avoid as much as possible. So how can you avoid being bombarded by protesters on your way to a boardroom meeting? How can you avoid having the legitimacy of your institutional authority undermined by the crowd that questions your protocols outside the building? It's simple: stage it in *Fortnite* and reduce flight emissions.

The Romantic notion that nature is the ultimate exterior, the "outside" to human subjectivity, didn't die off with the tradition of 19th-century landscape painting. Romanticism is alive and well. Friedrich's painting conveys the familiar aesthetic of the hero's journey, the solitary quest to tame nature and fate, which has served as a model for narrative-building in fields beyond fiction and which continues to haunt cultural imaginations of the world to this day, through cinema, fashion, video games, and car commercials. More than a representation of the surrounding world, it speaks of how humans conceive their own position within it. In mainstream cinema, the most dystopian narratives often end with the victorious hero, even when success is dramatically challenged by his journey. (Think of the feel-good family comedy set in space of *Ad Astra* for one.) These cultural representations of "the outside" frame the spatial condition of human existence as much as they frame the temporal one, transforming the future into a product of the experience economy—an imaginary space in which uncertainty is transformed into possibility, anxiety into excitement. The conceptual paradigm propelling those narratives also extends to other kinds of fictions. It legitimizes a certain genre of stories about the future of "nature," where the two are hermetic categories separated from the cultural present by the agency of the human.

## PLANNING

In the 1990s, the neuroscientist David Ingvar became known for coining the term "memories of the future." In his essay from 1985, published by the journal *Human Neurobiology*, he states that one's experience of the past is not limited to the functions of the temporal lobe, but is linked to the regions of the brain responsible for more general organization of behavior and cognition—namely, the frontal and prefrontal cortex, the same regions responsible for projection, or plans for future behavior. Those parts of the brain not only process serial information, but can also extract causality from "the enormous, mainly non-serial, random, sensory noise to which the brain is constantly exposed." In his opinion, it is their ability to do so that forms the basis for anticipation and expectation, as well as for the short and long-term planning of a goal-directed behavior. In other words, the brain prepares for the future based upon its experiences of past events and the awareness of a "Now-situation," each of which are continuously rehearsed and optimized. Without an expectation, or a *memory of the future*, the extraction of causality cannot take place. Dysfunctions of the frontal and prefrontal cortex, he adds, give rise to states characterized by a "loss of future," with consequent indifference, inactivity, lack of ambition, and inability to foresee the consequences of one's behaviors.

In relation to climate change, this paralyzing anxiety provoked by the uncertain future of the planet's biochemical makeup has by now transcended the level of personal unease and turned into a collective malaise, aggravated by the abrupt "suspension" of the future caused by the ongoing COVID-19 global outbreak.

This uncertainty, however, is not produced by a lack of “narratives” which provide a clear trajectory of where the planet could be heading—in fact, there are plenty. Instead, it stems from the cognitive dissonance between the various acknowledgements that the path from the present to the future could or should be mapped differently, and the lack of action to support those acknowledgments. In practice, the focus of planetary futures needs to shift from the act of imagination as an end in itself towards the strategic importance of planning. For this to happen, a more nuanced conceptualization of time will be necessary, but it won’t be enough—an institutional framework capable of actualizing the *practice* of planetary future will need to emerge as well. Imagination and planning are not polar opposites that cancel each other out, but should be seen instead as reciprocal processes.

On the surface of institutional discourse, the future is imagined as a vague social construct, while the process of getting there is seen as a linear trajectory of an abstract vector from the present towards somewhere beyond our familiar experiences. The future habitability of Earth is viewed by governing institutions as *terra nullius*, a place to which fantasies of success get constantly deferred.

## MODELING

The framework of scenario planning used by the Intergovernmental Panel on Climate Change (IPCC) maps the planetary future as five divergent alternatives, known as Shared Socioeconomic Pathways. It positions the present as a moment from which the forking paths can be seen, presuming that one of the five trajectories can be deliberately chosen. The pathways are based on predictions of how socioeconomic parameters might guide the concentration of greenhouse gases in the atmosphere for the next eighty years, and are extrapolated from mathematical projections that take into account a number of criteria. On the surface, these scenarios are grounded in scientific data and sound computational practice, although the criteria that are used to feed the projections together with the overall framing method fall short of fulfilling their ambitions, which, ultimately, are to ensure the survival of Earth-like life on the planet. By using global population, economic growth, and emissions as key variables in determining a possible “destiny” of the shared planetary space, these scenarios end up with generalized narratives that lack nuance and limit the scope of de facto measures and actionable policies aimed at managing climate change.

Social sciences and social determinism are seen as “driving forces” of these narratives, which at their core do not critically examine but rather perpetuate the economic and social paradigms that are leading humanity towards an ecological collapse in the first place. Climate change has become a mainstream issue in the public agenda on planetary scale, yet the scientific and political framing of the problem and the possible range of solutions have been limited by the cultural and ideological understanding of modern neoliberal economy. One of its main weaknesses has been identified in recent economic theory as the failure to account for the concept of “externalities,” consequences which exist outside of its theoretical and practical framework—including, for example, the cost of environmental damage. The scenarios also reinforce the all-or-nothing mindset, where the future is either an equally distributed utopia or similarly overarching dystopia, as well as discursively position certain strategies as implicitly antithetical to each other. This only reinforces anxiety and paralysis, where if “we” do not get something exactly right, there is no point in trying.

The reality is more fragmented than these narratives allow it to be. There is no overarching narrative that a single (even if collective) agency can fulfill. Instead, the shared environment of the planet is continuously and simultaneously being shaped by multiple, often conflicting agencies, and is influenced not only by the processes taking place in and for the present, but by the echoes of the future as well. That is, scenario planning can be and already is effective but only when practiced by organizations with the ability to enforce their strategies, and whose mode of decision-making is not centered around consensus-building. Hence why a situation arises where the withdrawal of the United States from the Paris agreements undermines the very possibility for these objectives to be achieved at all.

Humans have developed complex technologies, techniques, and devices for navigating and organizing the spatio-temporal conditions of their inhabitation, which do not exclusively rely on human vision or other senses for logistical tasks. However, that imaginary line of the horizon keeps looming in the background of the rhetoric that surrounds climate change and the futures of planetary inhabitation. While these conversations stay futile, the infrastructures of sensing, modeling, and simulation already have the ability to bring into effect physical transformations of the material reality, so far largely unplanned.

As pointed out by Lev Manovich in his essay “Automation of Sight from Photography to Computer Vision” from 1997, the discovery of linear perspective can be seen as a precursor of technologies of automation of sight. Where linear perspective allowed the visualization of a three-dimensional structure from a two-dimensional, simplified representation, it is now possible to measure depth and navigate space directly by employing various remote sensing technologies, such as Lidar, radar, AI-assisted 3D modeling, machine vision and so on, in combination with each other.

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With the enhancement of such technologies, the single-POV perspective loses its privileged role, as space, objects, and phenomena can be measured and mapped through properties other than vision (the single-perspectival image being too ambiguous for computer vision systems). The implications of this epistemological paradigm shift manifest in the inadequacy of modern scenario planning in relation to climate change, where mutually exclusive representations of the future are outlined and juxtaposed against each other. The multiplicity and simultaneity of POVs, textures, and media enabled by constantly accelerating innovations in the field of non-human vision break apart the dynamic of reality and representations recursively shaping each other.

Scenario planning, as conceptual modeling of the future, is a navigational practice which needs to operate from within what Patricia Reed terms “horizonless perspectives.” The figure of the horizon as a marker for orientation, which exists in practices that position the future as a destination point, is “no longer an adequate vehicle for navigating [the] planetary scale condition,” she says in a talk given at Simon Fraser University in 2018. This brings back the imagery of the wanderer, embodying the centuries-old technology of the linear perspective, dependent on the unique advantage point of the viewer, which has deeply informed not only cultural representations and the aesthetics of mapping, but also the practice of futurology, science-fiction writing, and scenario planning to this day. When the horizon disappears, it is still possible to navigate the world sailing by sight, but only with a well-calibrated compass and the knowledge to interpret its oscillations—because, as Seneca summoned, “If a man knows not to which port he sails, no wind is favorable.”

The mutually constitutive relationship between the diagrammatic structure of the space and the situated, personalized experience of it opens up possibilities for how planetary futures could be navigated. Within the shared environment of the planet, however, “a broader array of types of knowledge is required to co-construct a diagram of [the] reality—a reality that is multi-situated across bodies, materials, geographies and knowledge practices, yet one that is still coherent nonetheless,” as Reed rightfully points out. The absence of the horizon within the labyrinthine complexity of this reality, made up of a meshwork of relations and agencies, shouldn’t dissuade anyone from trying to make sense of how to orient themselves within it; instead, it should be seen as a necessary precondition, especially when it enables the logistics of navigating time. Speculative practices which use imagination as a point of access into different futures, in this context, can be seen as potential navigation devices, specifically, because they do not attempt an account of the reality from the perspective of encyclopedic knowledge, but rather allow one to situate and orient oneself within the present configurations of systemic relationships as well as within the probability space of the future’s plurality. Such practices, like seeds, generate an array of coexisting narrative possibilities, as late science-fiction writer Ursula K. Le Guin proposes in the Carrier Bag Theory of Fiction, a radically different narrative device than that of the Hero’s Journey. Drawing its conceptual grounding from a variety of disciplines—from quantum physics to philosophy and literature—the Carrier Bag Theory invokes and operationalizes a plurality of worlds, mapped onto historical contexts, and poses questions about the incongruities that exist between imagination, abstraction, and orientation.

## EPILOGUE

Accelerating with the Age of Discovery, the exploration of planetary geography and the material conditions it produced—the legacies of which are still being grappled with to this day—transformed the world as a system of social relations and facilitated irreversible changes within the biochemical makeup of planetary ecosystems. These processes informed, and continue to inform, the very imaginations of “being” on this planet, modes of its inhabitation and worlding, and it is necessary to keep interrogating the mechanisms and ideologies through which they do so. Globalization is only a tip of the iceberg, but it is the prime paradigm that the concept of planetarity will need to overtake—the concept which, according to Bratton, “exceeds final perceptual closure in ways that the cartographic heritage of the Global does not.” And it remains to be seen what new emergent practices of planning and modeling which will serve as the basis for the new cartography of sound planetary navigation. But if we were to bet, it will be those that do not rely on linear perspectives, do not privilege the centrality of human senses and treat imagination as a creative and open ended process but not an end in itself.

Chiara Di Leone is a writer and design researcher based in London.

Laura Cugusi is an artist, researcher, writer and cultural producer.

Anastasiia Noga is a researcher, writer and curator based in Moscow.