



Holly Jean Buck, *After Geoengineering: Climate Tragedy, Repair, and Restoration*, New York: Verso, 2019. ISBN: 9781788730365 (cloth); ISBN: 9781788730389 (ebook)

After Geoengineering: Climate Tragedy, Repair, and Restoration is the culmination and synthesis of Holly Jean Buck’s published research on climate, democracy, and geoengineering but with a creative flair. With *After Geoengineering*, Buck takes a deep dig into what is possible in the wake of climate tragedy. More utopian efforts like this book that aim to positively shape climate futures are a welcome change from the hellish, apocalyptic writings that dominate the topic. “[W]hat’s clear”, writes Buck, “is that we need a social imagination to match our technological imagination” (p.161), which, unfortunately, is itself limited. Buck possesses a measured hope about the likelihood of this matching. Regardless, engaging these imaginations, and the powerful potential of the geographical imagination, too, is more critical now than it ever has been, and Buck’s book is a strong contribution to this effort to envision and to enact livable climate futures.

Part speculative fiction, part investigative journalism and explanatory scientific writing, *After Geoengineering* bridges mitigation and restoration visions, theories, and practices while also critically parsing them. Buck homes in on the potential for coming up with new technologies and for augmenting natural processes toward decarbonization. Meaningful implementation of these is of primary import in the book, but so too are the contingent problematics of environmental governance. To many humans, a “good” Anthropocene and a less precarious future looks “green” and biological. With *After Geoengineering*, Buck interjects: what about the chemical and the geological? Can we simultaneously encourage life while also disposing of pollutants, protecting our safety, and sequestering what can potentially hurt us and other living and non-living things? Attending to “the alchemy of the nonliving” (p.122), Buck argues that the very capacity for transformations in the Earth system will depend upon the participation and

enrollment of all earthlings, even if it is produced and directed by humans. Buck investigates what would motivate and incentivize the creation of new social movements for climate justice, climate repair, and the creation of new industries for carbon removal. Going further, Buck probes whether a society can be built on removing carbon and go so far as to transform the nature of work itself so that it too becomes more purposeful, including the growth of green jobs.

After Geoengineering is told from a perspective at once present and future-gazing. Buck examines where and when the global community must start to remove carbon from the atmosphere and the oceans given environmental and sociocultural actualities. From there, the author seeks to understand the extent to which geoengineering, particularly solar geoengineering, is a necessary component of this commencement. More importantly, Buck asks: how might geoengineering come about, and how long will it take? In other words, is geoengineering a temporary conservation fix, or something more? Buck raises more questions and offers the beginnings of responses, while also leaving the space for possibility with the reader. Buck writes: “What could make the most difference, and really give these approaches wings, are changes in our politics, economics, and culture” (p.152). This book breaks ground toward that aim, and, in this sense, we find the author sticking to their own prescription toward socioecological repair.

Following an ambitious and lengthy introduction, Buck reveals to us during the course of storytelling that, despite the chatter, much of the research and development around climate geoengineering has not yet occurred. This is, in part, due to the fears and uncertainties surrounding such an extreme human intervention into the Earth system. As a researcher of the natural and social scientific aspects of restoration with a focus on human-environment relationships, I was drawn to read and review this book to grasp how I could research and teach on the linkages between restoration, global climate change, and geoengineering. Screening Pierre Smith Khanna’s film *Fairytales of Growth* (2020) in class recently, I was surprised to learn – and Buck confirms this – that bioenergy with carbon capture and sequestration (BECCS), while often

cited as a panacea to carbon overloading, is not yet fully imagined nor developed. In fact, the lack of research and design on geoengineering and its effects, both within and without academic institutions, is a key motivation for the author. Buck argues that we cannot begin to imagine alternative futures and life after geoengineering if we do not first have public discussions and debate about the mechanics and applications of the technology and, even more importantly, if we do not have the technology. *After Geoengineering*, then, reads as a tool to inspire and to jump-start these kinds of conversations and actions.

Divided into four parts (“Cultivation”; “Burial”; “The After-Zero Society”; and “Buying Time”), the book’s more ethnographic, journalistic chapters are interspersed with fictional sketches, which push the work beyond mere academic theorizing and into the realm of what I call “imagination politics”. With its unique style and sci-fi elements, *After Geoengineering* does work not unlike those creative innovators and disruptors, whom Buck valorizes and is counting on to make eco-social change. The author is in effect “[r]olling up their sleeves and playing around and doing, rather than theorizing” (p.169). This not only makes for a good story, but the so-called “moral of the story” might also be good for the science, as Buck points out. It also makes for interesting academic work that allows for “critical” geography to entail both critiquing *and* envisioning.

In the ten chapters of *After Geoengineering*, Buck inventories climate change science and technology on our ocean planet, taking to task human actions and, more significantly, inactions. Part I (“Cultivation”) examines the possibilities for biofuels without capitalism, ocean food and energy sources, and land-based climate solutions, including regenerative agriculture/carbon farming, afforestation, biochar, and blue carbon. Buck demonstrates how these “natural” carbon sequestration approaches fall short in the face of the magnitude of carbon emissions, while admittedly being exciting and seemingly do-able. We would be delusional, the author contends, to think that these could be the only responses to climate challenges. Buck does not reach the

endpoint of hope and, instead, pushes the reader to expand the purview of their thinking about conceivable solutions and futures. Part II (“Burial”) of *After Geoengineering* looks at the science and technology of carbon capture. According to Buck, “Level 1” carbon capture results in avoided emissions. This differs from large-scale “Level 2” carbon removal, which could draw down greenhouse gas concentrations and actually affect the climate significantly. In this chapter the author also plays with the potential of enhanced weathering, or “rocks-for-crops”, which attempts to speed-up time in order to turn deadly gas into stone.

Part III (“The After-Zero Society”) takes a dedicated moment for utopian exploration and speculates on how a society committed to carbon removal might take shape. Asking what it would be like to live in a society that has brought greenhouse gas emissions into negative territory, Buck’s informed musings on working, learning, and co-opting in a carbon-removal-society require anticipatory politico-legal engagement. The most compelling aspect of Part III is the author’s thought experiment, an outline of ten “key capacities” that might make the actualization of decarbonization more possible: critical design skills; cross-cultural and multi-species empathy; decolonial practices; experiential knowledge of the natural world; numeracy and an understanding of scale; critical algorithmic literacy; interdisciplinary systems thinking; dialogue; imagination; and emotional self-knowledge (p.193-196). While I employ many of these capacities in my own work and agree to their importance, I would also add “placedness” to the list. As scholars such as Eve Tuck and Marcia McKenzie (2015) show, critical place inquiry is central to decolonial practice and to the establishment of more just relationships with each other and with nature. Furthermore, being grounded in place gives us the vantage point from which to carefully observe and to experience interacting patterns and processes as they take place across various spatio-temporal scales.

Part IV (“Buying Time”), though it ends rather abruptly, ponders best- and worst-case scenarios for climate futures involving solar geoengineering with its stratospheric aerosol

injections. That I found myself wanting more from this story stands as testament, perhaps, to the richness of the content, to the dearth of this material elsewhere, and to Buck's prowess in telling and detailing her and others' ideas here. Given the captivating structure and very readable style of the book, *After Geoengineering* could be a worthwhile addition to an undergraduate or graduate class in human or physical geography or, even, in a hybrid course that explores the experimental and policy implications of geoengineering, carbon mitigation, and/or ecological restoration. While not sufficiently robust to be a primary text, the book would be a good supplement to other readings in such courses. The author does present and explain several basic definitions and concepts foundational to the study of the *geo*, including the solar constant, carbon capture and storage (CCS), weathering, and chemurgy, to name a few. Importantly, Buck opens the book by reminding us that we have already reached 1 degree Celsius of warming. Although a central fact to this scholarly tale – one that should be posted on highway billboards! – this met threshold is not fully understood by the public.

The audience for this book seems, at first, to be just as broad and as global as the subject matter. However, the author makes mention several times in the book to a “we” that is more specific. For example, in Chapter 8, Buck says, “If there’s no progressive vision about how to use CCS, including a clear set of demands about how we want to use this technology, the oil companies can essentially take us hostage” (p.203). Perhaps Buck’s audience is not the general public or even only the hackers, entrepreneurs, or technicians interviewed and referenced throughout, but is rather a more change-oriented readership made up of those who care. Through the mix of eyewitness journalism and fiction, the author speaks to an educated audience (though the book’s tone has a dense, academic vibe) comprised of those who want to make a difference in the global climate catastrophe and who are looking to get the lay of the landscape with all its contours. The “we” here is interested in making a cultural shift just as much as a technical one. With that said, this book could still appeal to a wide audience, and it also contains plenty of

insights portrayed creatively – which touch on design, entrepreneurship and eco-startups, algorithms, and even blockchains – that would, or should, certainly capture the attention of business people, engineers, and IT folks.

With *After Geoengineering*, Buck draws on and contributes to multiple fields, most notably for this review to ecoliterature and geography as they interconnect with each other, with the climate crisis, and with studies of the future. Several key theories relevant to both human and physical geographers, and maybe to critical physical geographers as well (see Lane 2019), guide the argumentation of *After Geoengineering*. Of note are ideas put forth by scholars in geography Rebecca Lave, Neera Singh, and Joel Wainwright and Geoff Mann. Lave’s term “free range science”, described in the 2015 article, “The Future of Environmental Expertise”, is a method of doing science differently that Buck’s futures depends upon. Describing it as a “hybrid of conventional and unconventional, or professional and amateur practices” (p.167), Buck takes us through an application of “free range science” and geoengineering in the case study of an island and its inhabitants off the coast of what is now called British Columbia. In 2012, the Haida people of the Old Masset band did their own research and defined their own scientific standards, enlisted their own technicians, and actively pursued environmental intervention. Without advanced (university) training, without grants, the Haida orchestrated ocean fertilization and added iron-based material into the Pacific as part of a salmon restoration pursuit. Despite the condemnations of the effort by Environment Canada and the scientific “community”, the Haida and their collaborators, Buck exclaims, made “striking” cognitive linkages (p.166) and – geoengineering project or not – actually studied and experimented with a process (ocean iron fertilization) that could have potential for carbon sequestration in ocean environments. If we are to change the future, Buck contends, we will need to change our relationship to Enlightenment science.

Singh's (2013) work on affective labor and the "gift" paradigm gives Buck the theoretical fulcrum necessary for articulating the possibilities of an after-carbon, after-geoengineering economy:

Affective labor, in contrast to alienated labor, writes Singh, involves self-expression; its ideal is a craftsman or artist, who expresses their inner self and gives to society as a whole. It can't be separated from the person doing it. The relationship between the person and the object of labor is important. (p.171)

The future economy Buck wants to see, replete with care and meaning, is most fundamentally an economy of relationships. If work is to transform the environment and to maintain the habitability of the Earth for humans and non-humans, then vocation ought to be reconsidered with a post-carbon thinking cap. Feeling "good" about ourselves and our relationships to the natural world might very well be a pivotal point in a new economy as well as in the policy and legislature that structure it. Gift giving or the paradigm of the gift is another way, offered by Singh, to conceptualize future work (p.171-172). As Singh states and Buck relays, policy makers should consider value beyond profit so that bequeathing a livable future to coming generations becomes part of the equation on how and why we labor. Because a livable future requires the involvement of the entire Earth system, regulating our laws and technologies becomes a question of global environmental governance. Here, we might start by weighing the risks and benefits of something like a "planetary sovereign" (p.205). To envision a livable future, Buck utilizes theories by Wainwright and Mann presented in *Climate Leviathan* (2018). Future livability, the author finds, is as much about with what and why we work as it is about what governs us and how.

In addition to Buck's application of geographic theory to the climate tragedy on the geoengineering horizon, the author's approach to carbon capture as a waste management issue serves as a major contribution of *After Geoengineering*. When we think from a waste management model, Buck argues, "it makes it easy to connect the nascent direct air capture industry to environmental justice concerns" (p.131). Not only could this framing be of use to addressing regulatory questions, but it could also help to analyze crucial operational aspects of the process like safety concerns. Less explored in this work is also the question of why we are focusing on the geoengineering option, which the author views as both radical and high-risk from moral, ecological, technical, and administrative standpoints. Yet, as Buck nudges us throughout, climate engineering ideas can be understood as either "promising or terrible" depending on how they are implemented (p.149). Buck makes mention of environmental and social justice issues in both theories and examples – citing, for one, Indigenous scholar Kyle Whyte – but an inclusion of more marginalized viewpoints and worldviews and a sharper attention to intersectionality would also serve to enrich the text and its line of reasoning. While the fictional writing makes this text distinctive, I am also left feeling like maybe Buck could amplify their own theoretical work a bit more. Still, with *After Geoengineering*, Buck tackles a large-scale, life-or-death problem and does so *differently*, thus making numerous strides from potential toward prospect.

After Geoengineering: Climate Tragedy, Repair, and Restoration as a whole is a timely and inspiring contribution to the growing library of climate change theory and literature, comparable, yet distinct from, now-canonical works like *The Progress of This Storm* (Malm 2017), *The Uninhabitable Earth* (Wallace-Wells 2019), and *Field Notes from a Catastrophe* (Kolbert 2006), for example. Even with its prominent placement in the book's title of the term "restoration", Buck's treatment of restoration is precautionary; as Buck sees it, restoration ends up being limiting and backward-looking (to a past that may or may not have existed). Following

theorists Raj Patel and Jason Moore (2017), Buck attests that the tying of restoration and restorative activities to *recognition* and *reconciliation* and other *re-* words takes into better account the realities of capitalism and (settler) colonialism threaded through life. Buck's adoption of Patel and Moore's "reparations restoration" as "a way to see both history and future" (p.245) is on-point, and scholars of ecological restoration/restoration ecology would also do well to keep it in mind.

The most sobering take-away from this title is that any kind of future resilience means coming to terms with loss. This includes the possible loss of blue skies, laments Buck, but, because "[w]ild variability is the new normal" (p.1), the full extent of these losses is still to be determined. What are the personal and societal limits at which we might lose hope entirely, and where-oh-where are the turning points? Guided by Buck, we find there is no single answer to what an after-zero society will look and feel like. But, as Buck tells it, even mountainous feats cannot stop us from imagining these futures.

References

- Kolbert E (2006) *Field Notes from a Catastrophe: Man, Nature, and Climate Change*. New York: Bloomsbury
- Lane S N (2019) Critical physical geography. *Geography* 104(1):49-53
- Lave R (2015) The future of environmental expertise. *Annals of the Association of American Geographers* 105(2):244-252
- Malm A (2017) *The Progress of This Storm: Nature and Society in a Warming World*. New York: Verso
- Patel R and Moore J W (2017) *A History of the World in Seven Cheap Things: A Guide to Capitalism, Nature, and the Future of the Planet*. Oakland: University of California Press



- Singh N M (2013) The affective labor of growing forests and the becoming of environmental subjects: Rethinking environmentality in Odisha, India. *Geoforum* 47:189-198
- Tuck E and McKenzie M (2015) *Place in Research: Theory, Methodology, and Methods*. New York: Routledge
- Wainwright J and Mann G (2018). *Climate Leviathan: A Political Theory of Our Planetary Future*. New York: Verso
- Wallace-Wells D (2019) *The Uninhabitable Earth: Life After Warming*. London: Penguin

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