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BOOK REVIEW

Climate Technology, Gender, and Justice: The Standpoint of the Vulnerable

Tina Sikka, E-Book: Springer, 2019 (ISBN 978-3-030-01147-5)

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Very often the philosophical theories of science we create are inert objects, submitted to our peers, and then dormant, invoked only in arguments that some phenomenon does or does not fit it, critiqued and counterexampled but rarely *used*. It is thus an exemplary feature of Tina Sikka's *Climate Technology, Gender, and Justice: The Standpoint of the Vulnerable* that it does not just invoke Helen Longino's *feminist contextual empiricism* (FCE) (in Longino 1990) for purposes of philosophical scorekeeping but employs it in a deep and principled way to think through issues surrounding climate geoengineering. This is particularly noteworthy, as many studies in feminist philosophy of science concentrate on the social and biological sciences, the case for the physical sciences often thought more difficult. It is a virtue of Sikka's book that it demonstrates that the physical sciences can also greatly benefit from feminist perspectives.

It has become increasingly and depressingly apparent that the political will to make the necessary cuts to our production of climate-changing emissions and large-scale changes to our lifestyles simply does not exist, especially among so called "first-world" nations. This being so, geoengineering, along with adaptability, are alternatives that, for good or ill, will likely become increasingly central to debates about climate change. Sikka's book is an extended examination of aspects of geoengineering from a distinctly feminist point of view, and it is a valuable contribution not just to feminist philosophy of science, but to academic discussions of climate change more generally. She concludes that, on feminist grounds, climate geoengineering has work to do to achieve objectivity.[1]

Geoengineering is an alternative response to climate catastrophe that requires less economic and behavioral change. Sikka's goal is to evaluate a specific kind of geoengineering—stratospheric sulphate geoengineering[2]—as a case with which to articulate the kinds of evaluation needed for an adequate feminist science. In particular, Sikka deploys Longino's FCE as the basis for an extended investigation and critique of geoengineering. A brief word on FCE will prove helpful. One of Longino's main claims is that, because of the logical necessity of background assumptions in empirical science, values play a fundamental role in connecting evidence to hypothesis and theory (see especially Longino 1990, 40–48, 66–76). In a series of papers, Longino and Kathleen Lennon formulated a set of core values for doing science in a feminist key, which Sikka adopts: empirical adequacy, ontological heterogeneity, novelty, mutuality of interaction, and attending to human needs (Longino and Lennon 1997a; 1997b; 1997c). Sikka's book is organized around each of these values, using them to evaluate models, assumptions,

and practices in order to "demonstrate that, with a few exceptions, the socio-technical strategy that has come to be known as geoengineering does not meet the feminist criteria set out by FCE" (7). However one appraises Sikka's conclusions, the method employed here demonstrates the utility of FCE as a means of both understanding and critiquing scientific practices. This is especially valuable since, in the final chapter, Sikka discusses how to amend FCE through the addition of elements from other kinds of feminist philosophy, in particular feminist standpoint theory (FST) and technofeminism (TF) (see 146–52).

Climate Technology, Gender, and Justice is well organized. After an important introductory chapter where the core ideas of FCE and feminist philosophy of science are discussed, the second chapter introduces the key ideas of geoengineering. In particular, Sikka spends some time introducing the specific stratospheric sulphate model that is evaluated in the book. The third chapter is the longest, and perhaps most scientifically challenging chapter, which concerns the value of empirical adequacy (EA), a core virtue for almost all science, feminist or otherwise. This was, for me, one of the most interesting chapters, so I'd like to take some space discussing it.

EA asks about whether and how a science proves itself responsible to empirical evidence, not just in terms of models, but also how those models are used and discussed in public. Sikka discusses five important modes by which geoengineering meets or fails to meet this standard. First, she discusses geoengineering in terms of the first boundary objects and baselines. In particular, she has chosen a particular baseline concentration of CO2 of 280ppm to avoid climate change, one based on "pre-industrial" times.[3] Sikka labels this baseline a boundary object, used to mediate between experts and the public, and the discussion here focuses especially on the ways that this particular object assumes that CO2 is the primary driver of climate change, ignoring methane or NO2, as well as other activities such as deforestation and livestock-rearing (53–54). This is important since this object is essential for "extrapolating collected experimental data to the reached conclusion that sulphate climate engineering is a reasonable option" (53). Sikka then goes on to discuss these models in terms of idealization and parameterization, in particular the way in which the modeling community prefers highly complex models with large numbers of parameters, and the way in which these parameters might depend on various kinds of assumptions (57). Next is a fascinating discussion of visualizations used in certain geoengineering papers, in particular the various maps used to encode various ideas of both globalism and eurocentrism (59–60). Following this is my favorite part of this work: an analysis of the use of "natural analogues" in sulphate geoengineering. The idea is that volcanic eruptions and their consequences can be used to reinforce confidence in the outcomes of geoengineering models and are thus a powerful rhetorical resource in arguing for these techniques (61). Sikka points to numerous ways in which these analogues can be misleading, adding to the argument the way in which geoengineering is rhetorically positioned, for instance, by the substitution of "climate remediation" for "engineering" or "modification" (62). Sikka ends this chapter with a discussion of trust, truth, and consensus-formation, focusing especially on how these discussions are effectively siloed from one another, with discrete conversations between social scientists and physical scientists, with little cross pollination, in addition to being carried out primarily by white, male researchers. On the basis of these discussions, Sikka concludes that much more work needs to be done to establish the empirical adequacy of geoengineering models (64–65).

The rest of the book is organized around the aforementioned FCE values. Chapter 4 deals with ontological heterogeneity, in particular arguing that in order to embrace this

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value, these models need to abandon monocausal accounts (like favoring CO2 as the primary driver of climate disruption)[4]in favor of multicausal accounts that allow for various kinds of factors to play a role in the mechanisms of geoengineering models (72). This chapter has an interesting discussion of the ways in which the value of ontological heterogeneity can improve the science of geoengineering in ways that are already appreciated in some modeling communities (72 and 76).

Chapter 5 discusses the role of novelty, in particular arguing that though geoengineering enjoys a great degree of novelty in terms of its basic technical approach to solving climate change, these models do not exhibit the kind of radical novelty that might require rethinking and reinterpreting various aspects of their approach (90). Of particular interest here in Sikka's expansive notion of novelty is her discussion of the lack of consideration in climate engineering for the novel *aesthetic* consequences that might result from sulphate geoengineering, such as the possibility of changing our skies from blue to gray because of levels of particulate matter (96).

Chapter 6 deals with mutuality of interaction, the value that geoengineering comes close to truly fulfilling, with its use of nonlinear models and large multifaceted systems, although it is argued that it ultimately falls short of this initial promise (101). Sikka notes that a truly reflexive consideration of this value would extend beyond these features to consider the contexts in which these models are produced, including (among other things) consideration of unequal power relations in the geoengineering community (108). Chapter 6 is the last chapter to deal with principally epistemic values, as the next two values are of a more pragmatic nature.

Chapter 7 evaluates geoengineering with respect to the diffusion of power. Sikka argues that this is not something widely discussed in the scientific literature. This is important because it means that geoengineering is in some ways structurally incapable of diffusing power, since these technologies "require institutions and a scientific culture that are hierarchically designed to limit risks and effectively act as a veritable thermostat through time and space" (118), making including other groups (including perhaps giving agency to the natural world itself) quite difficult. What is needed here is a suite of important changes. These changes would include a shift in inequalities related to who participates in geoengineering studies, not only expanding the participation and interaction between physical and social scientists, but among other stakeholders, including especially citizens and local communities and at-risk indigenous peoples (118). Other changes here would also include analyses of the effects that climate-manipulation techniques would have on future generations, governments and other polities, and the natural world itself (119–21).

Chapter 8, the last chapter before the conclusion, deals with the ways that geoengineering fails to meet and apply to human needs. This includes a discussion of the ways in which ethics plays a role in climate engineering, "as well as matters related to intergenerational justice, globalization, socially responsible science and conflicts of interest" (127). Sikka specifically compares geoengineering to caring sciences (like nursing) and the Gaia hypothesis, concluding that, unlike these endeavors, sulphate geoengineering fails to meet human needs in tangible and practical ways (129). Instead, Sikka finds that mere lip service is paid to these issues, with more or less throwaway lines about the need for additional research about, for example, the ways in which social and political conflicts would affect the implementation of such methods of climate engineering (129).

The conclusion, chapter 9, is noteworthy, although somewhat brief. Here Sikka notes that other feminist theories of science—particularly feminist standpoint theory and

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technofeminism—contain various ideas and resources that could be used to further the criticisms enabled by FCE. These theories offer more radical criticisms, including, for instance, going beyond merely incorporating diverse perspectives in creating and evaluating climate engineering to actually *undermining* hierarchical power structures. This might include challenging norms central to the science as it now stands, such as those of control over nature, the logics of costs and benefits, winners and losers, and so on (147).

Now for some criticism. Although I enjoyed and learned a great deal from Sikka's work, I note, first, that some readers (including me) would have appreciated more technical detail at certain points, in particular in the chapter on empirical adequacy. For example, Sikka claims that "climate models do not simulate future climate but produce relative probabilities of potential future climate states," adding that these models do not use "direct empirical data" (56). A longer discussion of what is meant by simulation, and the ways in which these models fail to do that would have been most welcome. So far as I understand, there is in fact a huge debate in the climate-modeling community about how to interpret the outputs of climate models, specifically on the subject of how to understand conditional (and other sorts of) probabilities.[5] What is meant by "direct empirical data" is unclear and potentially misleading insofar as climate models are related to their empirical bases. That is, though they might not be verified for their predictions, the output is compared with historical data that could be interpreted as direct. A more thorough discussion of some of these issues of confirmation and prediction would have been quite useful.

Second, a few places show interpretive problems with respect to Longino's theory. In one passage (51), Sikka seems to equate incommensurability and underdetermination, which Longino, in fact, spends a great deal of time separating (see, for example, Longino 1990, 60, 182). The import of this is not clear, but more substantial is Sikka's occasional equivocation about the role and kinds of values in Longino's theory. Sikka claims (for example, 52) that social values *always* fill the gap between observation and data via background assumptions, when, in fact, Longino is careful to make a weaker claim, namely that "scientific inquiry is, thus, at least in principle, permeable by values and interests superficially external to it" (Longino 1990, 13). These are not severely damaging, but they do point to some potential problems, especially with regard to the last chapter. Although the analysis of how FCE might be extended with other feminist theories is interesting, it is not at all clear that this is possible within Longino's framework, or, if it is, how exactly such an integration could be consistently effected. A related discussion, which would have been a valuable addition, would have been one about the issue of value management: in general there is what has been called the "bias paradox," namely the idea that including different values might seem to necessitate including distinctly nonfeminist positions, and that leads to a seeming assumption by Longino and Sikka (and others) that representation of differing values can be achieved through the representation of differing groups of people (Intemann 2017).

Of course, these are somewhat beyond the scope of Sikka's book, but they do lead to a third and deeper problem, a pragmatic one. There is a sense in which Sikka's analysis speaks to those already converted, so to speak, that is, to those who already believe that this sort of feminist analysis is necessary and useful. In fact, Sikka's book might be used to help argue for this position, but there is a problem of buy-in: how do we move from the use of FCE as argued in the book to making actual changes? How do we ensure wide dispersion of feminist approaches? How do we overcome the very problem of inequality of power relations that is a core theme of the book? It is surely too much to ask Sikka to resolve these issues, but a direct discussion of some of them would have been

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appreciated. In particular, the historical background of geoengineering (18–19) could have been used as an opportunity to discuss these kinds of issues, in particular the fact that part of geoengineering's origin is in military projects and funding. Indeed, the issue of the funding of geoengineering research might have merited a longer and more analytical discussion, though, to be fair, Sikka does discuss independent billionaire funding, issues of governance, and related issues in her chapters on diffusion of power and on human capabilities and needs.[6]

In sum, however, this is a valuable and interesting contribution to feminist philosophy of science. I heartily recommend it for all scholars and graduate students working in climate science, philosophy of science, feminism, and science studies, although it is probably appropriate only for advanced undergraduate students.

Notes

1 Sikka uses *objectivity* in the sense that Longino discusses, as intersubjective convergence in communities that meet the requirements of FCE, which are discussed in the body of the review.

2 There are numerous kinds of geoengineering, but for convenience I shall use the broad term *geoengineering* to refer just to the specific stratospheric sulphate kind discussed in this work.

3 It's important to remember that though it may seem that these statements are overgeneralizations about climate research, Sikka is in fact careful to limit her pronouncements to a specific set of papers and models dealing with specific sulphate solar radiation models.

4 Dr. Marina Baldisarri has pointed out to me that, though a lot of the literature is centered on CO2, it doesn't necessarily follow that the models don't consider other kinds of greenhouse gases, as CO2 often means "CO2 equivalent." Skepticism about some of Sikka's claims might therefore be warranted.

5 For a good discussion of how general circulation models are understood, see Touzé-Peiffer, Barberousse, and Le Treut 2020.

6 For recent work on funding issues, see Overland and Sovacool 2020.

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