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To Know or Not to Know? A Note on Ignorance as a Rhetorical Resource in Geoengineering Debates

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About the Author

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To Know or Not to Know? A Note on Ignorance as a Rhetorical Resource in Geoengineering Debates

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"The stakes are simply too high for us to think that ignorance is a good policy" (Caldeira & Keith 2010)

Climate scientists, policy analysts and activists are divided over whether it is a good idea even to conduct research into the feasibility and likely outcomes of adding sulphate aerosols to the stratosphere as a means of counteracting global warming. Both sides agree that the field of solar geoengineering is characterized by profound ignorance. However, they are divided by opposing views of how to proceed in the face of such ignorance. Should we seek to reduce it through research or should we respect it as a warning not to even begin to go down such a path? I don't seek to resolve the issue of the desirability of solar geoengineering research one way or the other. Rather, my purpose is to explore the implications of this disagreement for the sociological study of ignorance and for some of theories and models current in the field.

Climate Geoengineering is defined by Britain's Royal Society as "the deliberate large-scale manipulation of the planet's environment to counteract climate change" (Shepherd et al. 2009). During the past half-decade the topic has been hotly debated among scientists, social scientists and a small but attentive community of NGOs and policy

makers. Scientists and climate activists remain divided over the practicality and wisdom of such interventions. There are few gung-ho enthusiasts. Proponents are mostly cautious, even reluctant, while opponents are often appalled at the very idea.

The idea itself is not new. A 1965 report of the US President's Science Advisory Committee on the topic of climate change only considered what we would today call geoengineering approaches to the topic: climate adaptation and greenhouse gas mitigation measures are nowhere to be found within its covers. The idea of injecting aerosols into the stratosphere to manage solar radiation was explored in principle throughout the 1970s to 1990s (Budyko 1977, 1982; Marchetti 1977; US National Academy of Sciences 1992).

Yet geoengineering has not yet progressed much further than the stage of an idea. As was the case for many years with climate adaptation, geoengineering has been a taboo topic. Hence, the concepts largely remain what social scientists term socio-technical "imaginaries" (Jasanoff & Kim 2009) embodying a wide range of conflicting assumptions about their physical and social characteristics, important aspects of which remain largely unexamined. While there are extant bits of "kit" that could potentially form part of one geoengineering system or another, none of the geoengineering concepts is even close to the stage where it could be deployed with any degree of confidence as to its efficacy in achieving desired results without unacceptable side effects or opportunity costs (Shepherd et al. 2009).

Geoengineering proposals are conventionally described as falling into two broad types: those that extract carbon dioxide from ambient air and sequester it, for example, in the ocean or under the ground, and those that reflect some of the sun's energy away from the earth. Following the terminology of the Royal Society, the first of these is referred to as carbon-dioxide removal or CDR and the second as solar radiation management, or SRM. There are interesting asymmetries between these two classes of technology. While CDR addresses the underlying problem of climate change – carbon dioxide emissions – SRM only treats one of the symptoms – temperature rise. CDR would take many decades to implement at sufficient scale to remove gigatons of carbon per annum, while SRM promises to be very fast acting. Most, although not all, CDR

measures would not seem to raise any fundamentally new issues of governance or regulation, while the most widely discussed of the SRM proposals – stratospheric aerosols – raises the prospect of increasing international tensions unless implemented under some kind of international agreement.

Some CDR proposals, such as mechanical air capture of carbon (sometimes called artificial trees), are well-bounded, closed systems. Others involve releasing chemical agents into the ambient environment. Any geoengineering method involving the introduction of such deliberate “pollutants” into the oceans, the air, or on land is likely to prove controversial regardless of whether it is designed to reflect sunlight or remove carbon. For example, experiments designed to demonstrate CDR by adding iron to the ocean to encourage carbon-fixing plankton blooms have met with vociferous opposition (ETC 2010, 2012). Experimental geoengineering in the ocean is covered by the London Convention and Protocols ¹, which were originally designed to eliminate dumping waste at sea. However, there is no comparable international regime governing the atmosphere. Generally speaking the subset of SRM technologies that involve the introduction of sulphate aerosols into the stratosphere have attracted the most attention and been the principal focus of opposition.

Stratospheric aerosols have the potential to be relatively cheap, fast-acting, and are said to be close to being deployable. Therefore, it is argued that they merit serious consideration alongside conventional mitigation and adaptation as a tool to help deal with climate change (Keith 2013). Opponents fear that the same characteristics render stratospheric aerosols potentially catastrophic, inevitably inequitable, and ultimately ungovernable, so that even conducting research on them is, at best, a waste of resources or, at worst, the first step on a “slippery slope” towards an unacceptable outcome (Hulme 2014). Indeed, critics argue that even conducting research to explore the potential of solar geoengineering to deflect sunlight using stratospheric aerosols ought to be considered beyond the pale.

¹ This is the common vernacular for the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, in force since 1975. In 1996, the “London Protocol” was established to further develop the Convention. Forty-four states are party to the Protocol; eighty-seven states to the London Convention

Both supporters and opponents of research agree that there are huge uncertainties and presently much that is simply unknown about the potential deployment of stratospheric aerosols. Under these conditions, the call for more research to understand the technologies, their intended and unintended consequences, and the conditions under which they might be deployed, if at all, may seem modest and rational. The Royal Society working group called for research expenditure of £10million a year for 10 years to characterize the full range of geoengineering technologies. Caldeira & Keith (2010) suggested that the US should initiate a phased research programme at US\$5million, gradually increasing to \$30million. These hardly represent major opportunity costs relative to the overall size of the UK and US national research budgets or to current expenditures on alternative energy or climate adaptation. Yet even the idea of conducting research on the potential of stratospheric aerosols to cool the earth has been highly controversial, suggesting that concerns go much deeper than the issue of the opportunity costs of such research.

Various arguments are deployed on either side of the issue. For example, opponents of research worry about what insurers call "moral hazard". They fear that even doing research might send a signal to people and policy makers that they can let up on efforts to reduce their greenhouse gas emissions in the erroneous belief that solar geoengineering will save the day. Some advocates of research have expressed concern that a future "climatic emergency" (where there is a strong likelihood of reaching a disastrous tipping point or runaway climate change) might lead to the implementation of solar geoengineering without adequate understanding of its behavior: an argument that critics have described as "arming the future" (Gardiner 2010). However, one factor emerges strongly on both sides of the argument and is invoked both to justify and to oppose research into stratospheric aerosols. That factor is ignorance.

Both sides agree that humanity currently lacks the knowledge that would be necessary to deploy stratospheric aerosols on any scale. However, they are dramatically divided by their response to such ignorance. The arguments are well represented in two little books aimed at general audiences, which eloquently summarise the cases for and against respectively. The case for research is made by a North American engineer

(Keith 2013) and that against is authored by a British geographer (Hulme 2014). Both have an extensive background and expertise in climate change policy issues.

Research advocates argue for improved computer modeling accompanied by complementary small-scale experiments gradually and cautiously scaled up over time. They see this as a pathway to deliver robust knowledge to inform decisions regarding full-scale implementation while avoiding any irreversible negative consequences (Caldeira & Keith 2010, Keith 2013).

However, opponents of such research argue that while computer models are reasonably good at predicting global temperature in relation to greenhouse gas concentrations, they remain poor in relation to other important climatic factors, such as precipitation. They argue that the complexity and uncertainties inherent in the climate and ecosystems responses are so massive that even if they were better understood they could not properly be represented in any conceivable computer modeling of stratospheric aerosol deployment in the foreseeable future (Hulme 2014). Attempts to model the impacts of the climate and ecosystems responses on human activity seem only to compound the uncertainties of the climate models.

A review of the modelling of geoengineering and its impacts (Hansson forthcoming) concludes that adding complexity to the models does not increase their accuracy. This echoes the earlier finding of Repetto & Austin (1997) that adding bells and whistles to integrated assessment models of climate change may make them appear more credible, but do not actually add to their accuracy or precision. Furthermore, including more complexity may make models more difficult for policy makers to interpret. While Smithson (1993:148) has argued that "decision makers are better off with an accurate picture of how extensive their [the scientists] ignorance is than a false precise assessment," Bellamy et al. (2013) point out that revealing the complexities and uncertainties may make geoengineering science inscrutable to non-specialists.

It is also argued that science actually increases ignorance and uncertainty, or at least our awareness of them, by rendering unknown unknowns into known unknowns. Writing in the context of GMO

controversies, Boschen et al. (2006) argue that insights from science and technology studies show that “the sciences do not only generate knowledge but also increase ignorance concerning the possible side effects of scientific innovations and their technological application (Ravetz 1986, Funtowicz and Ravetz 2001, Wynne 1992, Nowotny et al. 2001)”.

Writing specifically on geoengineering, Winter (2011) describes the current situation as one of “conscious ignorance” in which it is possible to know, even before research is conducted, that sufficient knowledge to justify the risk of using stratospheric aerosols can never be gained; that ignorance can be known in advance of research to be “irreducible”.

Under these conditions, writes Mike Hulme:

To embark on this course of action would indeed be to conduct a giant experiment, to take a leap in the dark. It is not possible to know what the consequences of such engineering would be. However much we are attracted to machinic metaphors to describe the natural world—picturing systems that can be re-tuned or re-engineered according to human desire or need—I do not believe the human mind has the ability to fathom the intricacies of how the planet functions. The simulation models upon which aerosol injection technology would rely are like calculative cartoons when it comes to making long-term predictions. There are limits to human knowledge; our species is a product of evolution, not its author or controller” (2014:112)

Opponents of solar geoengineering sometimes also express concerns about the potential misuse of the technology as a weapon (e.g., Robock 2008). This seems to sit rather uneasily alongside the assertion of irreducible ignorance and consequent uncontrollability of solar geoengineering, in that successful weaponization would seem to imply a high degree of control to focus damage on an enemy.

Against the view of irreducible ignorance, it can be argued that the perfect should not be the enemy of the good. The only way that we can learn more about what ignorance is reducible and what is irreducible is to conduct research. In marked contrast to Hulme, David Keith writes:

Our knowledge of the risks is not purely theoretical. Real-world experience gives confidence that those risks can be understood. To understand the risk of injecting a million tons of sulfur into the atmosphere, for example, we can study the 1991 eruption of Mt Pinatubo, which put eight million tons of sulfur into the stratosphere. And each year humans pump roughly fifty million tons of sulfur into the atmosphere as air pollution. This is not an argument that we should ignore the risk of putting one million tons of sulfur into the atmosphere for geoengineering, but it should give confidence that there is a strong empirical basis on which to assess these risks, and it is a reason to suppose that risks will be comparatively small (Keith 2013: 11-12).

And

"...were we faced with a one-time choice between making a total commitment to a geoengineering program to offset all warming and abandoning geoengineering forever, I would choose abandonment. But this is not the choice we face. Our choice is between the status quo – with almost no organized research on the subject – and commitment to a serious research program that will develop the capability to geoengineer, improve understanding of the technology's risks and benefits, and open up the research community to dilute the geo-clique. Given this choice, I choose research; and if the research supports geoengineering's early promises, I would then choose gradual deployment (op cit: 12-13)

For those of Keith's mind, not to do research is to remain ignorant of our ignorance. While research may not fully answer all of the questions that we would like, a well-designed programme of cautious research with clear stage gates and reviews is seen to have the potential to provide a better picture of the form and behavior of solar geoengineering technology. Perhaps such research would actually help to definitively clarify the case against deployment, taking the issue off the table once and for all.

How well does the sociology of ignorance help us to understand the conflict between supporters and opponents of solar geoengineering research, as exemplified in the arguments of Keith and Hulme? At least

three concepts would seem to be relevant here: “undone science”, “forbidden knowledge”, and “post normal science”.

There is a sense in which the situation appears to be an inversion of the idea of “undone science”, defined by Frickel et al. (2010) as “areas of research that are left unfunded, incomplete, or generally ignored but that social movements or civil society organizations often identify as worthy of more research”. Examples of such science include research into rare diseases and orphan drug development. But, the fit between the theory of undone science and the solar geoengineering case is only partial. Establishment organizations, such as the Royal Society, argue for, rather than against, research.

Frickel et al. recognize that “in some contrast to the role that social movement organizations and lay experts/citizen scientists play in exposing undone science and encouraging knowledge creation ... the same actors can also play a powerful role in determining which knowledge is not produced” (op cit p463). They cite the case where supporters of the disease theory of alcoholism, as propounded by Alcoholics Anonymous, blocked NIH funding of research into controlled drinking therapies, which might call into question AA’s core insistence on total abstinence. But in the case of geoengineering, the civil society organizations are divided. Environmental Defense actually co-sponsored with the Royal Society and Third World Academy of Science, a Solar Radiation Management Governance Initiative (SRMGI) to explore the conditions under which such research should proceed. On the other hand, the ETC group and Greenpeace have opposed such research, citing irreducible ignorance.

The concept of “undone science” seems to tell some of the story, but not all of it. It usefully highlights the fact that ignorance is mobilized as a resource in the institutional politics behind research funding, but Frickel et al. acknowledge that “more research is needed to understand the circumstances under which researchers decide to self-censor in response to pressure from outside groups” (op cit p463). Their account takes the starting positions in such cases for granted, implicitly rooting them in a fairly straightforward understanding of the self-interest of protagonists to control research funding or as a response to perceived professional or

even personal threats. But self-interest of individuals or institutions does not seem to lie behind opposition to solar geoengineering which seems to be motivated primarily by concerns about physical and moral harm.

Kempner et al. (2005, 2011) also set out to explore decisions by scientists to self-censor their research through the idea of “forbidden knowledge” (Shattuck 1997), which they define as “a term that refers to knowledge considered too sensitive, dangerous, or taboo to produce” (2011:476). Rather than focusing on the self-restraint of scientists responding to outside pressure, their focus is on the choices of scientists not to enter into certain kinds of inquiry because of ethical concerns about how the resulting knowledge might be misused or because the means of obtaining it would potentially cause harm. Forbidden knowledge is that which is prohibited by religious, moral or secular authority, such as human cloning; can only be obtained through unacceptable means, such as human experiments conducted by the Nazis; that undermines social norms, such as certain types of research on substance abuse; or is believed to be unacceptably dangerous, such as biological or chemical weapons (Kempner et al. 2005).

Sometimes individual decisions to self-censor research find institutional expression. For example, this was the case with the moratorium on recombinant DNA research arising from the 1975 Asilomar Conference (Berg et al. 1975).

However, the demand for a moratorium, or even outright prohibition, of solar geoengineering research, doesn't quite fit this model either. It is not so much the exercise of self-restraint on the part of scientists, as it is polarized disagreement between those advocating research and other scientists, ethicists, and activists who oppose the very idea. Where issues are highly polarized, it is common for scientists and activists on both sides to call for more scientific research to resolve disputed or poorly understood facts, whether the issue is acid rain, mad cow disease or badger culling. It is unusual for one side to call for a ban on research altogether. Notwithstanding the concern in some quarters about weaponization of stratospheric aerosols, most opponents of research are not concerned that it might reveal knowledge that could maliciously be

put to harmful use. Their concern seems to be that research is likely to fail to reveal potential inadvertent harms, perhaps leading to a sense of false security that the technology is safe enough to be implemented.

Research opponents offer a preemptive ethical argument against research and in favour of remaining ignorant of the potential technical capabilities of solar geoengineering even if it were possible to do so. For example, Hulme (2014:92-93) writes, "Aerosol injection is not simply about stabilising or restoring the global climate. It is an intervention that has profound repercussions for what we think it is to be human. It would forever alter our sense of moral duty and ethical responsibility" and "I make my position clear: I do not wish to live in this brave new climate-controlled world" (op cit Pxii).

In summary, the rhetorical deployment of ignorance in the case *for* solar geonengineering seems quite straightforward: conducting some research is the *only* way to reduce ignorance about the technology. However, the case *against* solar geoengineering research seems to be two-fold. Ignorance is a binding constraint – "we simply cannot know" – and ignorance is a source of virtue – "it saves us from folly".

These two aspects of the argument are strongly redolent of the orthogonal dimensions of "ignorance and uncertainty" and "decision stakes" used by Funtowicz and Ravetz (1985) to introduce the idea of "post-normal science". Ignorance and uncertainty includes the elements of inexactness, uncertainty and ignorance surrounding the precision of estimates and measurements, adequacy of methods and appropriateness of concepts involved in technical studies. Decision stakes contains not only the technical assessments of benefits and costs but judgments about what is fair and even the societal determination of what is valued (Figure 1).

Where both ignorance and stakes are low, decision-making is characterized by routine procedures and applications of formal decision rules to well-known data. Where either ignorance or stakes rise, decision-making relies much more heavily on the interpretive and anticipatory craft skills of scientific and political practitioners. Where either dimension is high, decision-making is dominated by the competing worldviews of the people involved and is likely to be conducted in an adversarial mode that

Funtowicz and Ravetz situate within the post-normal paradigm. Solar geoengineering is clearly high on both dimensions. The very absence of information about a technology that does not presently exist places it far from the origin on the dimension of ignorance. The competing rhetorics of “arming the future” versus “a brave new climate-controlled world” emphasise that the decision stakes in this discourse are not confined merely to concerns about possible side-effects of the technology, but embody fundamentally different world views about what it means to be human and our relationship with nature.

The explicit objective of research advocates is to move solar geoengineering down the ignorance scale. Their hope is that it will also clarify the decision stakes in terms of the potential impact on climate and any side effects. But, Funtowicz and Ravetz’s framework suggests that merely increasing technical knowledge of the characteristics of solar geoengineering cannot attenuate the kinds of concerns expressed by Hulme and like-minded critics and may even exacerbate them. The decision stakes for research opponents include questions about the kind of world we want to live in that are broader than simply its climate. Those who see solar geoengineering as incompatible in principle with the values inherent in their worldviews are likely to continue to resist research precisely because ignorance in this case is a virtue that preserves us from folly. Contrary to the claim of Caldeira and Keith (2010:62) that “The stakes are simply too high for us to think that ignorance is a good policy”, for research opponents it is precisely because the stakes are so high that ignorance is seen as a good policy. To subvert the common aphorism, in this case, ignorance is power.

But while Funtowicz and Ravetz provide a useful map to describe the dynamics of the dispute, their framework does not explain why the various protagonists take such different views of the same “facts”, or rather lack of them. To cast some light on this question, I turn to the related ideas of institutional and epistemic culture. The theory of institutional culture originated by Mary Douglas (1970, 1986) proposes that hierarchical, competitive and egalitarian ways of organizing each sustain and are sustained by characteristic argumentative frameworks, appeals to different sources of authoritative knowledge, and procedures for dealing with uncertainty and ignorance.

Hierarchical cultures tend to favour carefully designed, staged procedures with well-defined decision rules. As such they often attract the soubriquet "technocratic". Competitive cultures place a strong emphasis on individual expert judgements, craft skills and "the right stuff". Egalitarian cultures generally place a strong emphasis on extensive discussion and debate involving a wide cross-section of actors, often seeking to amplify the voices of the weak and powerless (Rayner 1992).

Applying this perspective to the Funtowicz and Ravetz framework, we expect that members of hierarchical cultures are likely to try and locate as much of a problem as close to the origin of the diagram as possible, and will view ignorance as susceptible to domestication, while egalitarian cultures will seek to frame the same issue far away from the origin, requiring extended discourse, and resistant to settlement by appeal to technical resolution.

The related concept of epistemic cultures specifically explores the operation of comparable epistemic "preferences" in the sciences with regard to how they generate both knowledge (Knorr-Cetina 1999) and non-knowledge (Boschen et al. 2006) In particular, Boschen et al (2010: 790) identify a "control-oriented scientific culture of nonknowledge", characterized by an epistemic focus on the control of the experimental conditions and the avoidance of disruptive factors; a "single case-based experience... which shows a tendency to define non-knowledge as a problem of the individual expert"; and a "complexity-oriented culture... characterized by a high degree of openness toward unanticipated events as well as uncontrollable and context-sensitive settings".

The different approaches taken by Keith and Hulme seem to indicate clear epistemological preferences. Keith's arguments reflect the hierarchical and control-oriented cultures that might seem to characterize the engineering disciplines and what Rayner and Malone (1998) describe as the more quantitative "descriptive" style of social and policy science. Hulme's arguments display the characteristics of the egalitarian and complexity-oriented cultures that we might expect from what Rayner and Malone describe as the more qualitative "interpretive" social sciences. Rayner and Malone also note the propensity of the descriptive approach to lead to an essentially utilitarian approach to decision making focused on maximizing the general welfare, while the interpretive approach leads

practitioners towards a more deontological rights-, duty- or virtue-based position, again as reflected in the differences between Keith and Hulme, as well as other protagonists on both sides of the geoengineering research debate.

Concluding thoughts

If, as I suggest, the arguments for and against geoengineering research are significantly informed by fundamentally different epistemological cultures, then where does that leave us? Rayner and Malone argue that policy is strengthened when descriptive and interpretive epistemologies are used to complement each other. But geoengineering seems to provide a limited opportunity for this as the opponents of research have little ground for compromise. If they allow “just a little” research or research under clear constraints, then they have already conceded their position that the use of stratospheric aerosols should be unthinkable. This is the crux of Hulme’s “slippery slope”.

I do not have a definitive answer to “Where does this leave us?” I can only offer my own perspective as an actor in the geoengineering field. In proposing the “Oxford Principles” for the governance of geoengineering research (Rayner 2013), I have already accepted, in principle, Keith’s argument for transparent research conducted explicitly in the public interest, although I reserve judgement on any eventual deployment. In contrast to Keith, passing a technical research stage gate should not automatically lead to an assumption of deployability, however gradual. This is because I find myself equally committed to Hulme’s position that the disagreement over stratospheric aerosol research is not merely a technical debate about the safety or efficacy of the proposed technology but is, at heart, a debate over the kind of society we want to live in. In his earlier work “Why we disagree about climate change” Hulme argues that we should not merely ask “What can we do about climate change?” but also “What can climate change do for us?” In that same spirit I would ask “What can the geoengineering research discourse do for us by way of stimulating discussion of the kind of world we wish to inhabit?”

It may be that the Geoengineering debate is at a point that is almost

never recognized in other techno-science debates until after the moment is passed. At the time of writing, the value differences are clear, and there are no strong science claims to hide behind in articulating those values (Sarewitz 2004). Quite the contrary, everyone seems to acknowledge that we currently know very little. Once research gets under way (if it does), then the debates will likely change, and explicitly begin to focus on what's being learned by the research, and what it tells us. And once that happens, debates over the science will displace the debate over the values. While in principle this doesn't have to happen, it always does, as we know. So we have, now, a moment of clarity. Capturing that clarity and making sure that it does not get corroded, camouflaged, or otherwise elided in the form of competing knowledge claims seems to be a worthy governance or policy goal.

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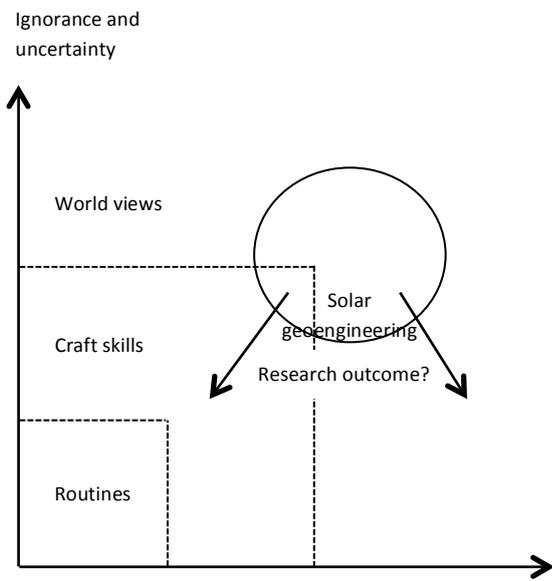
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Decision

Fig 1. The implications of reduced ignorance are different for supporters (left arrow) and opponents (right arrow) of research