



COMMENTARY

“Gaps” in Climate Change Knowledge: Do They Exist? Can They Be Filled?

MIKE HULME

Department of Geography, University of Cambridge, UK

Gaps in Knowledge

There are many different ways of thinking about gaps in knowledge. Engraved on the copper face of the Lenox Globe circa 1500, one of the oldest known terrestrial globes, are the evocative words: “Here be dragons.”¹ This was used by cartographers to signify dangerous or unexplored territories and drew on a long history from classical times when lack of knowledge equated to danger. This danger was illustrated visually by filling blank areas of maps with fierce-looking sea serpents, dragons, or mythological creatures to warn travelers of the risks they might face. For any user of the map, understanding where the boundaries of knowledge lay was almost as important as knowledge itself. Illusory knowledge was the greatest danger of all.

In our contemporary understanding of climate change, where be dragons? Although dragons are today conspicuous by their absence, it is increasingly clear that they lie all around: at the interstices of academic disciplines, beyond the boundaries of falsifiable scientific knowledge, in the sheer indeterminacy of complex systems, and in the limited powers of human agency. Today’s dragons often go unrecognized and unnamed due to the unwelcome challenges they represent to our desire for order, certainty, and control.

If dragons no longer help us recognize gaps in knowledge, how do we then talk about gaps? Here are a few examples in the context of climate change. In 1990, the Intergovernmental Panel on Climate Change (IPCC) First Assessment Report (AR1)²

1. Elahi, “Here Be Dragons.”

2. McBean and McCarthy, “Narrowing the Uncertainties.”

framed knowledge gaps in terms of "narrowing the uncertainties." These uncertainties were concerned primarily with predicting the Earth's climate system, and "significant progress in knowledge" was deemed to be at least a decade-long venture. A decade later, the IPCC AR3 reconsidered the matter and framed the task of reducing knowledge gaps differently, this time in terms of "advancing our understanding." By this was meant a portfolio of activities related to, among other things: more comprehensive data; expanded process studies; testing Earth system models; developing probabilistic predictions; understanding nonlinear behaviour.³ In 2007, the IPCC's AR4 framed gaps in knowledge in terms of "key uncertainties" and listed eighteen of them across all three working groups; for example: attribution and detection at smaller than continental scales; future changes in ice sheet mass balances; the effects of non-climate policies on future emissions. But unlike in 1990, no timescale was placed on when these key uncertainties would be reduced.⁴

We also can look at declarations from some of the world's international global change programs. The 2001 Amsterdam Declaration on Global Change called for integration "across disciplines, environment and development issues and the natural and social sciences." In Beijing in 2006, the Earth System Science Partnership affirmed it "will take responsibility to mobilise knowledge for action" and provide society with the needed scientific information. And then at Planet under Pressure 2012, which led to the creation of Future Earth, the declaration called for research to "integrate across existing research programmes and disciplines, across all domains of research as well as local knowledge systems, across the North and South, and must be co-designed and implemented with input from governments, civil society, research funders and the private sector."⁵

These various statements from global change assessments and programs reveal a number of recurring themes about the framing of knowledge gaps: a concern with narrowing uncertainties, especially with regard to prediction; a desire to integrate knowledge across disciplines and across all knowledges, scales, and actors; and a link between knowledge and action—the latter, it seems, meaning decision making and solution forming. The sentiment is summarized well in a *Nature* editorial: "Future sustainability research, no matter how interdisciplinary, should build on the [mountain of data from previous programs] and focus on finding and closing knowledge gaps [which would] provide an invaluable service to society."⁶

3. Moore et al., "Advancing Our Understanding."

4. Pauchauri and Reisinger, *Climate Change 2007*, 71. IPCC AR4 WG3 also had a section labeled "Gaps in Knowledge," which claimed, "There are still relevant gaps in currently available knowledge regarding some aspects of mitigation of climate change, especially in developing countries. Additional research addressing those gaps would further reduce uncertainties and thus facilitate decision-making related to mitigation of climate change" (22).

5. IGBP, "Amsterdam Declaration"; ESSP "The Statement"; IGBP "The State of the Planet."

6. "Future Present," 8.

In this essay I analyze these calls for the filling of gaps in climate change knowledge by asking three specific questions: What sorts of knowledge are we dealing with? How are gaps in knowledge framed? Why do we think more knowledge matters anyway?

What Sorts of Knowledge Are We Dealing With?

C. P. Snow famously introduced the idea of two knowledge cultures in his 1959 University of Cambridge Rede Lecture.⁷ Snow lamented the widening gulf he saw developing between the sciences and humanities, even while he argued strongly that it was the sciences that held out the greatest prospect of benefiting humanity. Yet despite his valorization of science, Snow would certainly have resisted the claims of “scientism”—that is, the claim that scientific knowledge is the only valid and necessary form of knowledge.⁸

To Snow’s two cultures must now be added a third in the form of the social sciences, a grouping of disciplines that Snow ignored completely but that Harvard psychologist Jerome Kagan helpfully juxtaposes with the sciences and humanities in his 2009 book *The Three Cultures*.⁹ One of the motivations for Kagan’s book was his recognition of the danger to society when the ideological hand of a dominant perspective becomes too heavy. For Kagan, this ideological danger was the dominance of scientism. This typology can be pushed further by calling on Matthew Nisbet’s argument, made with ecological colleagues, in which they recognized *four* knowledge cultures, with the creative arts and professions sitting alongside philosophy and religion. To do justice to the human experience of reality, they argued, we need “to bridge the great wellsprings of human understanding—the natural and social sciences, philosophy, religion and the creative arts—to ‘re-imagine’ how we live on Earth.”¹⁰

If this is so, then in recognizing the different sorts of knowledge that matter with respect to climate change, I would lay out (at least) these four knowledge categories:

- Scientific and social scientific knowledge: method-centered (mobile)
- ‘Local’ (or indigenous) knowledge: place-centered (holistic)
- Tacit knowledge: implicit (hard to transfer)
- Self-knowledge: reflective (inner)

I include self-knowledge here specifically because it may be seen as one of the goals of reflection and learning promoted by the humanities disciplines. There is no inherent hierarchy in this map of human knowledge making.¹¹ Rather than think about

7. Snow, “Two Cultures and the Scientific Revolution.”

8. Scruton, “Scientism in the Arts and Humanities.”

9. Kagan, *Three Cultures*.

10. Nisbet et al., “Four Cultures,” 331.

11. John Robinson’s “Being Undisciplined,” for example, argues for epistemological pluralism, suspicion of grand theory, and the importance of allowing meaning to emerge from the interplay of all forms of knowledge.

the sciences as superior and predominant, we would do better to adopt the German term *Wissenschaft*. *Wissenschaft* embraces what in English we might term, separately, "science," "learning," "knowledge," and "scholarship." It is an expression of knowledge that emphasizes its essential unity.

But then there are two additional categories of knowledge that are somewhat more problematic: actionable knowledge and beliefs. Into what category of knowledge would we place beliefs, whether these be individual or cultural? For now, I would say merely that the humanities can contribute much to our understanding about how beliefs connect knowledge with action. The crucial insight here—which Melissa Lane develops in her book on applying Plato to our ecological anxieties¹²—is that in the human state of being in the world, knowing and acting are one: to know is to act; to act is to know.

What Sorts of Gaps?

So what, then, if there are gaps in knowledge? After all, most scientists and scholars have the ambition and aspiration to research, argue, and discover something new. And if it is "new," does this not imply that previously there had been a gap, a void, some interstice or deficiency in the matrix of knowledge? But how do we (or how should we) think about and define gaps in knowledge? Let me suggest four different frameworks that are used to think about knowledge gaps.

The first framework sees knowledge as progressing in *linear* fashion. This heuristic emerges from a particular view of science and is epitomized by the IPCC's desire to "reduce the uncertainties in predictions." Knowledge here is progressive, ignorance is finite, and *discovery* leads to ever more complete understanding. Interestingly, this view parallels the "God of the gaps" critique of theology: as humans know more about the physical world, there is less need, so the argument goes, for any causal agency for God, until eventually this Being is discredited altogether. It is a heuristic that religious apologists have worked hard to dislodge. It assumes a particular view of God, just as in science this linear view assumes a particular view of knowledge.

A second view conceives knowledge gaps as the result of *poor connectivity*. What is needed is better *integration* of existing knowledge. Integrating different knowledges is a form of gap filling, as ever more comprehensive and faithful replicas of reality are built in our minds or in our models. The 2012 Planet under Pressure Declaration placed huge faith in this form of gap filling, desiring to "integrate across all domains and regions."¹³

A third view of knowledge gaps is that they are *socially contingent*. That is, knowledge is *constructed* as a result of social norms and processes. As these processes change over time, so too does the credibility of what is known and the definition of (and urgency of finding) what is not known. Rather than progressing in a straight line—ever

12. Lane, *Eco-Republic*.

13. IGBP, "State of the Planet."

onward, inward, or upward—the processes and products of knowledge generation are often convoluted and entangled.

A final approach to gaps in knowledge is to see them as places of *brittleness* or *weakness*. This heuristic requires knowledge to be *thickened*: adding layers of meaning and significance to our experience and understanding of reality. The humanities are not on a search to discover new knowledge per se or even to connect or integrate existing knowledge. Rather, the humanities draw attention to relevant ideas that will never admit a technical solution: ideas like justice, equity, goodness, humility, and democracy. These disciplines frequently pose normative questions that, rather than being resolved, can only be better or more deeply understood. Here, knowledge is deepened rather than “progressing”; or, as philosopher Nicholas Davey puts it: “[Knowledge] does not progress by overcoming the problems of previous generations, but rather thickens and extends an understanding of the issues involved.”¹⁴

So not only are there multiple sorts of knowledge that have a bearing on our understanding of climate change, there are also multiple ways of conceiving of deficiencies in these knowledges. I have suggested that the conceptions dominant in the IPCC and Future Earth are about either linear processes of discovery—“narrowing uncertainties,” for example—or connecting (*all!*) disciplines together: universal integration for a “knowledge of everything.” But knowledge gaps, I suggest, might more usefully be thought of in terms of blind spots that are socially constructed or else defined as sites where understanding needs thickening by deploying value-heavy concepts.

Why Do We Think More Knowledge Matters?

But we then need to ask, for what purposes are knowledge gaps to be filled? To put this more broadly: is the problem of responding to climate change that there is a deficiency in knowledge in toto (the linear view) or that knowledge is insufficiently connected (the integrationist view)? Or rather, as I suggest, is the problem that the difficult normative dimensions of the relationship between knowledge, values, and action have not been sufficiently attended to? Of course, many of the calls for knowledge making I considered above have alluded to this relationship. But too infrequently is there any direct questioning of how knowledge does and should relate to action. Instead, the implicit assumption too often still seems to be that: knowledge leads to action; *more certain* knowledge leads to *more definite* action; and *more integrated* knowledge leads to *more joined-up* action.

This thinking is perfectly captured in a 2007 front page headline from the *Guardian* newspaper in the United Kingdom following the publication of the IPCC AR4 Working Group I report: “UN’s Vast Report Will End the Scientific Argument. Now Will the World Act”.¹⁵ The linear model of knowledge for policy asserts that if researchers could fill

14. Davey. “Philosophy and the Quest for the Unpredictable,” 305.

15. “UN’s Vast Report.”

knowledge gaps, decision making and policy enactment would be an easier thing to do—and the world would be a better and more sustainable place. Kathleen O'Reilly puts this claim succinctly, in the context of knowledge for development: "If we knew just a bit more, success would be imminent . . . there will come a point when we will know enough and then development interventions will deliver on their promised positive outcomes."¹⁶ The linear model also opens an opportunity for strategic scepticism,¹⁷ for casting doubt on knowledge not because doubt is warranted but because under the assumptions of the linear model such doubt undermines the need for action in the world.¹⁸

But empirical reality does not bear out the simple optimism of the linear model.¹⁹ The challenge of responding to climate change is to turn our gaze away from making firmer, newer, or more integrated scientific knowledge and instead to ask why enacting directed change is so hard to accomplish.²⁰ It is less about asserting firmer facts about the world or constructing less uncertain projections of the future. Rather, it is more about cultivating appropriate public spheres of contestation and deliberation about multiple and diverging worldviews, beliefs, and value systems.²¹ In a democracy, this step cannot be overpowered through an overwhelming display of knowledge. So when the call goes out—"Integrated science at the international level is certainly the way to go. This is urgent: the planet calls for action now,"²² or "Inaction is inexcusable"²³—what forms of (in)action are being foreseen? Action by whom, for what ends, by what means, and with what legitimacy? The problems of making an adequate response to climate change are less to do with knowledge gaps or disconnects that can be filled or integrated. The problems are more procedural and deliberative: *how* to decide about what to do when ontologies and value systems clash, whatever thematic knowledge may be possessed at any given moment.

Addressing these problems is a task of democratic theory and political philosophy. It asks difficult questions about how democracies should be ordered and, if not democracy, then about what other forms of political organization and decision making are desirable for the Anthropocene. And this takes us back to the thickening of knowledge, tasks which the humanities are well equipped to accomplish. The key questions then become such as these: How is the knowledge of "experts" balanced against the wishes of "the people"? How are different versions of "the good life" imagined and evaluated? When, and how, *should* cultural norms be deliberately changed? What is the right

16. O'Reilly et al., "Symposium," 2795.

17. Oreskes and Conway, *Merchants of Doubt*.

18. McGoey, *Strategic Unknowns*.

19. See, for example, Scoones, "Politics of Global Assessments."

20. Sarewitz. "How Science Makes Environmental Controversies Worse."

21. Mouffe. *On the Political*.

22. Artaxo. "Break Down Boundaries in Climate Research."

23. Copenhagen Climate Change Congress, "Key messages from the Congress," March 12, 2009, news.ku.dk/all_news/2009/congress_key_messages.

balance between voluntarism and coercion? What forms of democracy—representative, participatory, centralized—are most desirable?

The Planet under Pressure Declaration that established Future Earth called for one integrated knowledge system, serving one overarching goal, to be delivered by a unitary global governance system. But what conceptions of power, knowledge, and epistemic justice are being expressed in such a vision?²⁴ The danger in such a singular conception of “knowledge for policy” is well expressed in the words, again, of O’Reilly: “If the will to know is deployed to gain knowledge for controlling others, then the will to know is also a will to power. Although the will to power may be couched in terms of ‘doing good,’ it remains a desire to know the world in order to manipulate people’s behaviour.”²⁵

In the current unstable climate (both atmospheric and political, and of course the two are connected) it is becoming ever more important to engage directly with the politics of knowledge. The pursuit of knowledge is inevitably a political act, if only because the sorts of knowledge that one chooses to create and to endow with authority carry political ramifications.²⁶ Such confrontations cannot escape dealing with normative issues where, I have suggested, knowledge thickening, rather than gap filling, is the most that can be achieved. Reasoning together in public to make actionable knowledge must allow for the expression of contrasting value commitments, however inconvenient this may be.

MIKE HULME is professor of human geography at the University of Cambridge. His work sits at the intersection of climate, history, and culture, studying how knowledge about climate and its changes is made and represented and analyzing the numerous ways in which the idea of climate change is deployed in public discourse around the world. His latest book is *Weathered: Cultures of Climate* (2016).

Acknowledgments

The ideas in this essay were originally presented at a workshop of the PLS Alliance at King’s College London in May 2017, and the feedback from participants at that workshop is acknowledged, as are the suggestions of the editors of *Environmental Humanities*.

References

- Artaxo, Paulo. “Break Down Boundaries in Climate Research.” *Nature* 481 (2012): 239.
- Davey, Nicholas. “Philosophy and the Quest for the Unpredictable.” In *The Public Value of the Humanities*, edited by Jonathan Bate, 303–12. London: Bloomsbury, 2011.
- Education Science System Project (ESSP). 2006. “The Statement of the Conference on Global Environmental Change.” www.essp.org/integrated-regional-studies/open-science-conferences/beijing-2006/essp-osc-statement/ (accessed January 23, 2018).

24. See Maggs and Robinson, “Recalibrating the Anthropocene”; and Klenk et al., “Local Knowledge in Climate Adaptation Research.”

25. O’Reilly et al., “Symposium,” 2795; emphasis added.

26. Jasanoff, *States of Knowledge*; Latour, *Pandora’s Hope*.

- Elahi, Shirin. "Here Be Dragons . . . Exploring the 'Unknown Unknowns.'" *Futures* no. 43 (2011): 196–210.
- "Future Present: A Young Global-Sustainability Platform Deserves Time to Find Its Feet." *Nature* 531, no. 7592 (2016): 7–8.
- International Geosphere-Biosphere Programme (IGBP). 2001. "2001 Amsterdam Declaration on Earth System Science." www.igbp.net/about/history/2001amsterdamdeclarationonearthsystemscience.4.1b8ae20512db692f2a680001312.html (accessed January 23, 2018).
- . "State of the Planet Declaration." 2012. www.igbp.net/publications/stateoftheplanetdeclaration.4.6b007aff13cb59eff6411baa.html (accessed January 23, 2018).
- Jasanoff, Sheila. *States of Knowledge: The Co-production of Science and the Social Order*. London: Routledge, 2004.
- Kagan, Jerome. *The Three Cultures: Natural Sciences, Social Sciences, and the Humanities in the Twenty-First Century*. Cambridge: Cambridge University Press, 2010.
- Klenk, Nicole, Anna Fiume, Katie Meehan, and Cerian Gibbes. "Local Knowledge in Climate Adaptation Research: Moving Knowledge Frameworks from Extraction to Co-production." *WIREs Climate Change*, 2017, 8:e475. doi: 10.1002/wcc.475.
- Lane, Melissa. *Eco-republic: Ancient Thinking for a Green Age*. Oxford: Lang, 2011.
- Latour, Bruno. *Pandora's Hope: Essays on the Reality of Science Studies*. Cambridge, MA: Harvard University Press, 1999.
- Maggs, David, and John Robinson. "Recalibrating the Anthropocene: Sustainability in an Imaginary World." *Environmental Philosophy* 13, no. 2, (2016): 175–94.
- McBean, Gordon, and Jim McCarthy. "Narrowing the Uncertainties." In *Climate Change: The IPCC Scientific Assessment*, edited by John Houghton, Geoff Jenkins, and Jim Ephraums, 311–28. Cambridge: Cambridge University Press, 1990.
- McGoey, Linsey. "Strategic Unknowns: Towards a Sociology of Ignorance." *Economy and Society* 41, no. 1 (2012): 1–16.
- Moore, Berrien III, Larry Gates, Luis Mata, A Underdal, Ron Stouffer, Bert Bolin, and A Ramirez Rojas. "Advancing Our Understanding." In *Climate Change 2001: The Scientific Assessment*, edited by John Houghton, Y. Ding, David Griggs, Maria Noguer, Paul van der Linden, X Dai, Kathy Maskell, and Cathy Johnson, 769–85. Cambridge: Cambridge University Press, 2001.
- Mouffe, Chantal. *On the Political*. Abingdon, UK: Routledge, 2005.
- Nisbet, Matthew, Mark Hixon, Dean Moore, and Michael Nelson. "Four Cultures: New Synergies for Engaging Society on Climate Change." *Frontiers in Ecology and Environment* 8, no. 6 (2010): 329–31.
- O'Reilly, Kathleen, David Simon, James Sidaway, Ian Yeboah, and Edward Carr. "Symposium: Geographers and/in Development." *Environment and Planning A*, no. 43 (2011): 2788–800.
- Oreskes, Naomi, and Eric Conway. *Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming*. London: Bloomsbury, 2010.
- Pachauri, Rajendra, and Andy Reisinger, eds. "Climate Change 2007. Synthesis Report." *Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, 2007.
- Robinson, John B. "Being Undisciplined: Transgressions and Intersections in Academia and Beyond." *Futures* 40, no. 1 (2008): 70–86.
- Sarewitz, Dan. "How Science Makes Environmental Controversies Worse." *Environmental Science and Policy*, no. 7 (2004): 385–403.
- Scoones, Ian. "The Politics of Global Assessments: The Case of the International Assessment of Agricultural Knowledge, Science, and Technology for Development." *Journal of Peasant Studies* 6, no. 3 (2009): 547–71.
- Scruton, Roger. "Scientism in the Arts and Humanities." *New Atlantis*, no. 40 (2013): 33–46.
- Snow, C. P. "The Two Cultures and the Scientific Revolution." Rede Lecture, University of Cambridge, May 7, 1959.
- "UN's Vast Report Will End the Scientific Argument." *Guardian*, January 27, 2007.