SCIENCE AND SOCIETY

Testing Time for Climate Science

Climate science needs better ways of accounting for itself to the jury of the world.

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On 31 March 2010, a British parliamentary committee exonerated Philip D. Jones, director of the Climatic Research Unit (CRU) at the University of East Anglia, of personal wrongdoing in his conduct and management of research. Climate science fared less well. The Science and Technology Committee concluded in its report that the focus on a single individual had been misplaced: "we consider that Professor Jones's actions were in line with common practice in the climate science community" (*1*). Those practices included routine refusals to share raw data and computer codes. The committee judged that this had to change and that all future raw data and methodological work should be publicly disclosed.

In early 2009, few would have predicted that climate science was headed for a public trial or public embarrassment. The Intergovernmental Panel on Climate Change (IPCC), the world's chief provider of scientific knowledge about the climate, enjoyed a pristine reputation. With nearly two decades of work and four assessment reports to its name, the IPCC seemed to have quelled the doubts of many skeptics. A growing scientific consensus accepted the anthropogenic causes of climate change (*2*). Added validation came when the IPCC shared the 2007 Nobel Peace Prize with former Vice President Al Gore. President Barack Obama earned worldwide commendation when he signaled that America was at last willing to act on the IPCC's painstakingly assembled knowledge.

The ground shifted dramatically in November 2009 with the event that became known as "climategate" (*3*). A hacker entered the CRU's computer system and disclosed some 1000 private e-mails and 3000 documents. Some showed climate scientists apparently fudging data to exaggerate the effects of warming. Words like "trick" and "hide," referring to modelers' techniques of representing data, were seized upon as signs that CRU was purposefully distorting results to support its claims. Other messages suggested that scientists were reluctant to make raw data available to known critics and had tried to keep unfriendly papers from publication in peer-reviewed journals. In the ensuing uproar, the credibility of climate science suffered. A poll conducted in February 2010, found a 30% drop over 1 year in the percentage of British adults who believe climate change is "definitely" real (*4*).

In a time when global policy increasingly depends on scientific knowledge, the CRU's plight is not good news for science or society. What can be done to guard against such setbacks and to rebuild public faith in the credibility of climate science? A half-century of scientific advising holds some lessons.

From Integrity to Accountability

Scientific progress has always depended on credibility and trust. To build new knowledge, scientists have to be able to take each other's findings at face value. If every claim needed to be verified before others could act on it, research would grind to a halt. English experimental scientists in the 17th century set out to perfect, not only their methods of inquiry, but also the techniques of communication that would enhance credibility. For example, the adoption of an impersonal writing style increased the appearance of objectivity (*5*). As in the law, fact-finding in science also called on witnesses to validate new claims. The sociologist R. K. Merton attributed the rise of peer review, a form of "organized skepticism," to scientists' need for results that could be trusted (*6*).

Climate coalition protest rally, Brussels, 2009.

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In earlier times, it was enough to build trust within a researcher's community of scientific peers. Disciplines were small and methodologically coherent. Research neither drew heavily on public funds nor profoundly affected public decisions. Today, the circle of stakeholders in science has grown incomparably larger. Much public money is invested in science and, as science becomes more enmeshed with policy, significant economic and social consequences hang on getting the science right. Correspondingly, interest in the validity of scientific claims has expanded to substantially wider audiences. It is not only the technical integrity of science that matters today but also its public accountability.

In the United States, an elaborate legal framework for holding policy-relevant science accountable has been in the making since just after World War II. The 1946 Administrative Procedure Act (Public Law 79-404) required federal agencies to consult with the public before enacting new regulations; at minimum, providing notice and an opportunity to comment. A later milestone was the 1969 National Environmental Policy Act (NEPA) (Public Law 91-190), which called for extensive public inputs. Scoping exercises and hearings designed to solicit information from the public and to explain agency findings became recognized elements of the NEPA process. Many environmental and consumer protection laws now mandate public involvement beyond the requirements of notice and comment. Moreover, administrative decisions can be overturned if an agency does not have adequate scientific and technical evidence or has failed to act reasonably on the basis of available knowledge (*7*). Under the Federal Advisory Committee Act (FACA) (Public Law 92–463), scientific advisory committees must be fairly balanced and, in the absence of special circumstances, committee meetings and records are presumed to be open to the public.

The rising importance of public accountability is also reflected in growing concern with ethics in science and the proliferation of ethics oversight bodies. Once limited largely

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to concern for the welfare of human and animal subjects, today, ethics covers a wide array of issues across many emerging areas of science and technology, including stem cell research, nanotechnology, computer science, and the neurosciences. It is no longer enough to establish what counts as good science; it is equally important to address what science is good for and whom it benefits.

A 1983 and a 1996 report of the National Research Council bookended the turn from integrity to accountability. The first (*8*) recommended that the largely scientific exercise of risk assessment should be separated as far as possible from the political and value-laden task of risk management. The chief purpose was to protect science against possible biases. The second (*9*) concluded that risk analysis should be seen as an intertwined analytic-deliberative process, requiring repeated public consultation even in the production and assessment of scientific knowledge. Here, there was recognition that public consultation improves the quality and acceptability of expert judgments.

Science today has to meet a series of public expectations, not only about its products but also about its processes and purposes. The credibility of climate science has to be evaluated in this context of heightened demand for accountability. Accountability can be seen as a three-body problem, with each interacting component posing special problems for climate science.

A Three-Body Problem

The individual scientist or expert. In any professional activity where truth-telling counts—whether in law, accounting, engineering, medicine, or science—practitioners must be held to high standards of honesty and integrity. In science, peer review partly serves this purpose, weeding out dishonesty and misrepresentation along with mistaken or inconclusive results. Of course, the scientific community has experienced many episodes of misconduct (*10*), but there is often broad agreement on what constitutes deviant behavior, and publics by and large have reason to trust science's self-correcting practices.

Scientific knowledge. This body is organized into disciplines or into well-defined, topically focused areas of inquiry. Reliable bodies of knowledge are built on theories and methods that have wide currency among practitioners. Again, peer review serves a crucial legitimating function by maintaining rigor, coherence, and integrity in the development of a field's research frontiers. Peer review also demarcates work that is considered acceptable from work that is not (*11*). In many areas of science, the ongoing work of peer criticism is enough to ensure a field's credibility to the outside world.

Committees that translate scientific findings into policy-relevant forms. This third body is increasingly important in modern democracies and frequently combines knowledge and skills from experts in different fields and contexts—for example, science and engineering, universities and industry, and bench and clinic. Their authority derives in part from individual members' impartiality and sound judgment and in part from the views they collectively represent, as required in the United States by FACA. Scientific advisory committees have dealt with the demand for accountability far longer than scientists who never did the work of translating science for policy. In most Western countries, expert advisers are required to explain their judgments to audiences outside, as well as within, their own research communities (*12*).

Implications for Climate Science

Standards of individual good behavior are especially difficult to identify and enforce in evolving scientific domains with underdeveloped histories of accounting to external audiences. Divergent national traditions of openness and confidentiality present additional hurdles for climate scientists (*13*), who are involved in international, as well as interdisciplinary, consensus-building. As the UK inquiry on the hacked CRU e-mails revealed, some data relied on by climate scientists had been obtained from national governments under nondisclosure agreements. The parliamentary committee conducted, in effect, a process of post hoc standard-setting when it concluded that the climate science community should have followed more open practices of publication and disclosure.

The sciences represented by IPCC Working Group I do not share common principles for such basic tasks as visualizing data, interpreting anomalies, representing uncertainty, data-sharing, or public disclosure. That such disparate communities have come to agree on the causes, size, and scope of the climate problem, through iterative rounds of assessment, may be taken as strong evidence of reliability. At the same time, the very fact that judgment has been integrated across many fields leaves climate science vulnerable to charges of groupthink and inappropriate concealment of uncertainties.

Though intergovernmental in name, the IPCC is subject to none of the legal or political requirements that constrain, but also legitimate, national expert committees. The IPCC has invented its own procedures, including extensive and sophisticated peer review. These methods are good enough to satisfy many scientists, but they rest on traditions of scientific, rather than public, accountability. Yet the IPCC performs a mix of functions—part scientific assessment, part policy advice, and part diplomacy—that demand external, as well as internal, accountability.

These problems suggest that it will not be enough for climate scientists to be still more scrupulous and transparent toward their peers. Adding more new forms of expertise may increase the credibility of the field (*14*), but it will not fully address the third component of accountability, which involves relations between science and its publics.

Creating accountability practices that work at a supranational level will be neither straightforward nor easy. Administrative procedures mostly operate within nation states, and there is no higher court where science can account for itself to the world. However, the IPCC has demonstrated that it can learn and change in its methods of representing science to scientists. That ingenuity should now be directed toward building relationships of trust and respect with the global citizens whose future climate science has undertaken to predict and reshape.

References and Notes

1. Science and Technology Committee, U.K. Parliament, "The disclosure of climate data from the Climatic Research Unit at the University of East Anglia," Eighth Report of Session 2009-10 (HC 387-I, Stationery Office, London, 2010), p. 3.
2. N. Oreskes, *Science* **306**, 1686 (2004).
3. A. C. Revkin, *New York Times*, 21 November 2009, p. A1.
4. J. Jowit, *Guardian*, 23 February 2010, p. 9.
5. S. Shapin, S. Schaffer, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life* (Princeton, NJ: Princeton Univ. Press, 1985).
6. R. K. Merton, *The Sociology of Science: Theoretical and Empirical Investigations* (Univ. of Chicago Press, Chicago, 1973), chap. 13.
7. For example, *Massachusetts* v. *EPA*, 549 U.S. 497 (2007), held that EPA had to give more persuasive reasons for its decision not to regulate greenhouse gases as air pollutants under the Clean Air Act.
8. National Research Council, *Risk Assessment in the Federal Government: Managing the Process* (National Academy Press, Washington, DC, 1983).
9. P. C. Stern, H. V. Fineberg, Eds., *Understanding Risk: Informing Decisions in a Democratic Society* (National Academ. Press, Washington, DC, 1996).
10. W. Broad, N. Wade, *Betrayers of the Truth: Fraud and Deceit in the Halls of Science* (Simon & Schuster, New York, 1983).
11. T. F. Gieryn, *Cultural Boundaries of Science: Credibility on the Line* (Univ. of Chicago Press, Chicago, 1999).
12. S. Jasanoff, *The Fifth Branch: Science Advisers as Policy-makers* (Harvard Univ. Press, Cambridge, MA, 1990).
13. R. Brickman, S. Jasanoff, T. Ilgen, *Controlling Chemicals: The Politics of Regulation in Europe and the United States* (Cornell Univ. Press, Ithaca, NY, 1985).
14. A. C. Revkin, "East Anglia's climate lessons," Dot Earth blog, *New York Times*, 14 April 2010.

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