

**When Is Science Valid?**

I read with interest Ken Baldwin's Viewpoint piece, titled "When Is Science Valid?" (OPN, April 2010). I found myself wholeheartedly agreeing with his initial thesis that "science over the centuries has honed a methodology accepted by society that maximizes the reliability of the information it produces." He is certainly correct. The scientific method is indeed one of the preeminent achievements of modern civilization.

However, I take issue in the strongest terms with his use of climate research as an example of the success of that method. The core of the debate over climate research is the very fact that a community of researchers attempted to conduct an end run around the scientific method, using dishonest and unethical tactics in order to manufacture a perceived "consensus" for political and financial gain. Evidence has been presented again and again that these researchers interfered directly with the peer-review process, manufactured results, and conspired to keep dissenting views out of the scientific literature and the public eye. In this sense, they created the illusion of satisfying Baldwin's "checklist for non-experts" while committing what amounts to scientific fraud.

Baldwin states that the "minority" that do not support the "mainstream scientific majority on human-induced climate change" have yet to

publish their ideas; this is patently untrue. Independent research over the past decade has called into question the "certainty" of the anthropogenic global warming hypothesis, pointing out large discrepancies between global circulation model predictions and direct observations (Douglass et al. *Int. J. Climatol.* **28**[13], 2008, 1693-1701).



Other research has highlighted the largest uncertainty in climate models—cloud feedback—that can easily offset any increase in radiative forcing due to carbon dioxide (Soden and Held, *J. Climate*, **19**[14] 2006, 3354-60). This and plenty of other credible research exists in the peer-reviewed literature that embodies the scientific method. However, it is often unacknowledged by the media.

If we are to conclude anything from the recent climate change controversy, it is that the scientific method is not perfect. Indeed, it is only as robust as the intellectual honesty of those who implement it. Perhaps it is in need of an update. For example, we could create a double-blind review process that eliminates the authors' reputations from the process and simply lets their work stand on its own merits. Or perhaps the controversy should motivate science educators to implement substantive ethics training as part of the graduate curriculum, similar to what is done in the medical and legal professions.

Overall, however, the all-but-dead climate change debate is certainly *not* an example of the success of the scientific method. Rather, it is a black eye for the scientific community as a whole, and it would behoove us all to do some serious introspection about how we can prevent similar breaches of scientific integrity in the future.

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**THE AUTHOR RESPONDS:**

I welcome my fellow Public Policy Committee member Daniel Rogers' commentary on my opinion piece "When Is Science Valid?"

Daniel and I are speaking off the same page when it comes to calling for vigilance in maintaining the integrity of the scientific process, and his suggestion of double-blind reviewing has some merits. I particularly endorse his idea that science educators should include ethics training as part of the graduate curriculum. Such measures address the obligations on scientists that are essential to ensuring that science can continue to be an effective contributor to our society.

However, I did not, as he claims, hold up climate science as an example of the success of the scientific process. Indeed, I used the recent criticisms of the IPCC as an example of how "human idiosyncracies will always contribute a (hopefully small) degree of error amongst a large body of truth."

The fact that these claims have eventually been investigated and addressed shows that the system is robust.

The real question is: Do such issues arise in climate science more than in other disciplines, or is it simply that climate science is more in the public spotlight?

Moreover, these episodes have not changed the overall conclusion that anthropogenic climate change still explains the great majority of data currently available. I am not an expert on climate science, but, like most scientists, I understand and endorse the way the scientific process works. It is for that reason that I believe in the overall robustness of the scientific system, and that thousands of independent colleagues who are expert in climate science have pursued the same standards of excellence as other scientists in order to arrive at this conclusion.

If scientists are to continue to contribute to society in a meaningful way, we must not only all practice the same high standards; we must also make it clear to the wider community that this is the case, so as to provide society with the confidence to enjoy the benefits that science creates.

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**Laser Light Shows**

I enjoyed Patricia Daukantas's recent article, titled "A Short History of Laser Light Shows." It is an excellent account of how the first generation of laser shows was developed and gives due credit to the medium's early pioneers, especially Mr. Dryer. Thank you for the fine narrative.

I'd like to make one point, though. Based on some comments, readers may get the

impression that the best days of laser shows are behind us, or that a resurgence of the laser show medium awaits some unrealized technological breakthrough. Nothing could be further from the truth. The laser show medium is in the midst of a renaissance, thanks to a new generation of laser companies that have brought renewed vigor to a fading industry. These second generation laserists are revolutionizing laser show technology and its applications: The last three years have seen more innovation than the previous three decades.

Some noteworthy examples are: 1) the development of highly efficient RGB laser projection systems that operate solely on battery power,

2) the debut of the first high-fidelity stereoscopic 3-D laser projection system, and 3) the success of a series of exciting K-12 outreach laser shows that are presently reaching about 1,000 schools per year. In short, the future of laser shows is a bright one.

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#### A Profile of Hermann von Helmholtz

I enjoyed reading the biographical article on Helmholtz by Barry R. Masters (OPN, March 2010). The article was very informative. I would like to share some of my own knowledge about this optical pioneer.

For most of us, the name of Helmholtz is synonymous with the equation named after him:  $\nabla^2\psi + k^2\psi = 0$ . While in Berlin, Helmholtz also became interested in electromagnetism. He tried to derive Maxwell's electromagnetic field equations from the least action principle. In 1879, he suggested that his student, Heinrich Rudolf Hertz, test experimentally the assumptions underlying James Clerk Maxwell's theory of electromagnetism.

In 1888, Hertz became famous as the first to demonstrate electromagnetic waves. Other students and research associates of Helmholtz at Berlin included Max Planck, Heinrich Kayser, Eugen Goldstein, Wilhelm Wien, Arthur

König, Henry Augustus Rowland, A.A. Michelson, and Michael Pupin. A Google search leads to 169,000 results for the Helmholtz equation. There is even a topic by the name "Helmholtz optics." In fact, I contributed an article on wavelength-dependent modifications in Helmholtz optics in the January 2005 *International Journal of Theoretical Physics*.

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