Junk Science and Environmental Policy: Obscuring Public Debate with Misleading Discourse

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The term "junk science" has become a fixture of popular and journalistic parlance, with media accounts leaving the impression that junk science is pervasive and far-reaching. News stories and OpEds suggest that junk science is especially troublesome in the arena of environmental policy. We are told that an "*epidemic* of junk science is afflicting the courts," that "scientific fraud is *endemic*," that "federal agencies [are] *running amok* with junk science," and that "the core of real science [has been] *overwhelmed* by a flurry of junk science." One newspaper editorial asserted that "[t]here is a battle taking place in America today between real science and junk science. . . ."

Many in the environmental science and policy communities might dismiss such claims as journalistic exuberance. While it is well known that the quality of environmental research in the U.S. varies, with plenty of room for improvement, there is little reason to accept the existence of any sort of crisis. The National Science Board's Task Force on the Environment recently completed an exhaustive review of the state of environmental science in the United States. The Task Force conducted hearings and town meetings, solicited commentary from scientists, government agencies, and the private sector, and reviewed hundreds of reports and documents relating to environmental research and assessments. While this effort resulted in numerous suggestions and recommendations, nothing in the report suggests an epidemic of junk science. Recent reviews of the Environmental Protection Agency support the same conclusion, as do current annual reports and leadership messages from the National Academy of Sciences, American Association for the Advancement of Science, and the National Council for Science and the Environment.

However, widespread media claims about the prevalence of junk science should be taken seriously. For most people, the news media are the most important sources of information about environmental issues. Studies show that public attitudes about the environment tend to mirror the content and emphasis of media stories. While one can find debates over the merit and desirability of environmental and public health policies in such venues as the courts, legislative proceedings, public meetings, hearings, protests and other events, the media play a central role in these debates by providing forums for public discourse through OpEd pieces, letters to the editor, and so on; and by reporting on debates occurring in other forums.

Even more importantly, examination of media accounts of junk science helps reveal how the public is asked to view environmental science. According to syndicated columnist, Ellen Goodman, "[We] need the scientific community to help separate the science from the fiction, [we] need to call on scientists the way [we] call on tech services to load in some new software." Goodman's analogy between science and "tech services" should ring alarm bells with anyone concerned about the role of science in American society. Loading software is a rote, menu-driven activity, while science-based assessments of environmental issues are frequently hyper-complex, multi-disciplinary, multi-study activities that combine and attempt to integrate numerous approaches and methodologies: mathematical modeling, long-term monitoring, theoretical and mechanistic research, and others as well. The suggestion that integrated assessments of science-based policy issues are even remotely similar to installing the latest version of Microsoft Word rests on serious misunderstandings of the scientific process and the role that it plays in the formulation and implementation of environmental policy.

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What Is Junk Science?

In a recent interview in *Science*, (then Governor) George W. Bush repeatedly responded to questions about environmental policy by insisting that regulations must be based on "sound" science. While he did not explicitly refer to "junk science," "sound science" is its most frequently used antonym. Also, in the media junk science often is contrasted with "real," "logical," or even "truthful" science.

The Union of Concerned Scientists (UCS) defines "junk science" as "work presented as valid science that falls outside the rigors of the scientific method and the peer review process. It can take the form of presentation of selective results, politically motivated distortions of scientifically sound papers, or the publishing of quasi-scientific non-reviewed journals." Building on the UCS definition, we identified five practices typically associated with questionable or unacceptable scientific activity:

- **Lack of Appropriate Credentials:** Scientific findings are inadequate or suspect because the investigator or user of the information lacks appropriate background or training.
- **Lack of Peer Review:** Scientific data or findings are inadequate or suspect because they have not been subjected to peer review or were found lacking during the peer review process.
- **Lack of Publication:** Specific data or findings should be treated with caution because they have not been published in a recognized journal or presented in an appropriate venue.
- **Weak Bibliographic Lineage:** Data or findings should be dismissed or treated with caution because they are not based upon or derived from a corpus of preceding research.
- **Outright Fraud:** Data or findings should be dismissed because researchers manipulated their approach or falsified findings.

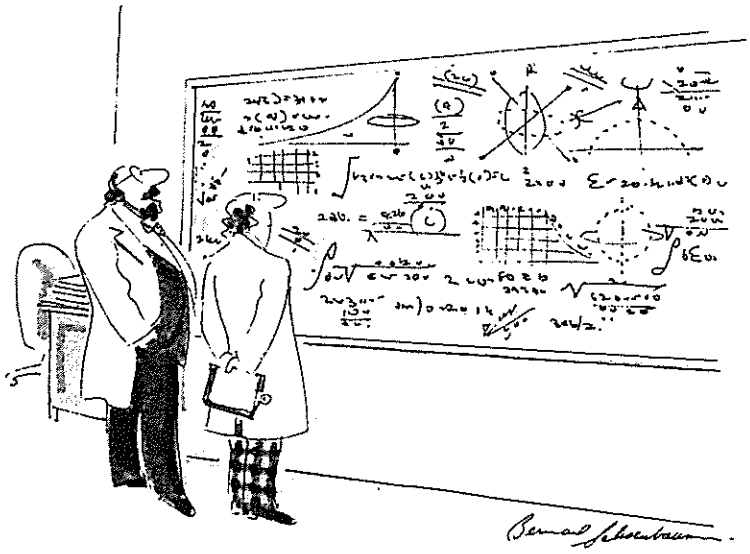
With these criteria in mind, we set out to explore the ways in which charges of junk science are leveled at a study or area of inquiry because the science on which it rests is associated with unacceptable standards concerning credentials, peer review, publication, bibliographic lineage, or because it contains fraudulent data.

Junk Science in the Popular Media: A Content Analysis

We conducted a content analysis of on-line news media text to assess the context and usage characteristics of the term "junk science." Data for this evaluation consisted of news media stories for the five-year period from 1995 to 2000. News stories were searched on the Lexus-Nexus database using the search command "junk science." The search yielded a total of 203 stories, 45 of which were evaluated. (We did not review articles dealing with subjects such as fad diets or UFOs.) All articles reviewed dealt with the use of scientific information in a policy or regulatory context. We reviewed and evaluated these articles according to the five attributes discussed above. Table 1 (see inset) summarizes the kinds of environmental and health

Table 1
Environmental and Health Issues Characterized as Junk Science in OpEds and News Stories

Global Warming	Endangered species	Ergonomic standards
Electro-magnetic flux from power lines	Dursban pesticides	Tobacco addiction
Pesticide use in schools	Trans fats and coronary disease	Second-hand tobacco smoke
Silicon breast implants	Exposure thresholds and effects of radiation	Sodium and high blood pressure
Air bag safety	Genetically modified corn	Endocrine disruptors and human reproductive effects
Air pollution in National Parks	Mad cow disease	Fen-phen and heart damage
Gender and clinical trials for new drugs	Oxygenated fuel and air pollution control	Evaluation of affirmative action programs
Mortality and health risks from air pollution	Dioxin clean-up at Times Beach, Missouri	Nitrogen oxide emissions in the Eastern United States
Sea level rise due to climatic change	Pollution control for SUVs	Wildlife management in National Parks



"Oh, if only it were so simple."

topics characterized as "junk science" in OpEds and news stories.

Notably, the articles we reviewed provided almost *no evidence of substantive or procedural inadequacies in the science* used to support environmental or public health policies. As indicated in Table 2 (Attribute Set 2A, see inset) less than ten percent of the articles we reviewed tied the charge of "junk science" to one or more of the criteria for failure of scientific credibility identified above. Only one of the articles attempted to support the charge of "junk science" by making at least some reference to scientific method. In most cases, authors seemed to take for granted that their readership already understands and is fully conversant with the notion of junk science.

In light of these findings, we again reviewed the articles in an effort to identify and summarize rationales that were provided to support or illustrate the charges of junk science. As Table 2 (Attribute Set 2B) summarizes, these articles focus on such issues as:

- **Failure to Consider Social and Economic Implications:** Many articles describe undesirable economic or social consequences anticipated from the proposed (or existing) regulations or policy regimes.
- **Inappropriate Weighting of Results:** Many articles claim that regulators or policy advocates excessively emphasize particular studies or approaches while ignoring or undervaluing other relevant data or information.
- **Failure to Cite Opposing Evidence:** Many articles mention or allude to studies that are claimed to support an opposing or alternative policy or regulatory perspective.
- **Assertions of Falsity:** Many articles make unsupported claims that the science used to support a particular policy or regulatory program is flawed or wrong.
- **Bias of Origin:** Many articles note that the science used to support a particular policy or regulatory position was conducted by an individual or institution with an expressed or implied interest in the outcome.

Many of the charges of junk science leveled in these articles seem unsupportable. Nearly one-third of the articles founded their use of the term on either (a) unsupported assertions of falsity, or (b) a claim or sug-

gestion that the research was flawed because it was conducted by an individual or institution with a material stake in the issue at hand. Another third of the articles associated the charge of junk science with anticipated negative socioeconomic outcomes of a proposed policy or regulation.

Other charges of junk science are more substantive. Fifty-five percent of the articles based the assertion of junk science on the claim that investigators or policy advocates inappropriately emphasized some evidence over other relevant findings; and 42 percent of the articles cited or alluded to other publications or research that would support an alternative policy perspective.

Junk Science as a Contrarian Trope

Very few articles about junk science actually address questionable or unacceptable scientific activities. The most striking finding of our content analysis is that an overwhelming majority (84%) of the articles contained an anti-regulatory message or admonition, asserting that a particular policy or regulatory perspective or program should be reversed or opposed because it is based upon junk science. None of the articles reviewed used the term in conjunction with a pro-regulatory message.

We believe that, in many of these articles, the phrase "junk science" is being used as a *trope*. An expression is used as a trope when a writer or speaker uses a word or expression figuratively in order to give vividness or emphasis to an idea. Even when an expression is used figuratively instead of literally, it still tends to evoke the values, beliefs, and stereotypes associated with the original, or literal, use of the term. Thus, the strategic use of linguistic tropes can have powerful rhetorical and practical ramifications.

We suggest that our analysis of the articles surveyed reveals that *the phrase "junk science" is meaningful pri-*

Table 2
Content Analysis of Forty-five Articles Containing the Term "Junk Science"

Attribute Set (2A)	Number of Articles Displaying Attribute	Percentage of Articles Displaying Attribute
Lack of appropriate credentials	2	4%
Lack of peer review	4	8%
Lack of publication	1	2%
Weak bibliograghic lineage	2	4%
Outright fraud	2	4%
Attribute Set (2B)	**Number of Articles Displaying Attribute**	**Percentage of Articles Displaying Attribute**
Failure to consider social and economic implications	15	33%
Inappropriate weighting of results	25	55%
Failing to cite opposing evidence	19	42%
Assertion of falsity	15	33%
Bias of origin	15	33%
Anti-regulatory thesis or admonition	38	84%

marily from a politicized or ideological perspective. Although "junk science" appears to have little meaning if treated in a strictly descriptive manner, it plays a strategic role as part of a contrarian, anti-regulatory discourse. Almost none of the articles that we reviewed documented scientific analysis conducted in a way that is inadequate or inappropriate. Despite the use of the phrase, "junk science," most of the articles reviewed were critiques of environmental or public health policies based on *politics or values rather than on science.* In other words, the imprimatur of science is being smuggled into deliberations that actually deal with values and politics.

The Role of Environmental Science in Public Policy Assessment: Some Deeper Issues

Many of the articles we reviewed appear to rest on misunderstandings about the nature of scientific assessment in a policy context. These assessments typically address such complex phenomena as global warming, acid rain, or regional-scale ecosystem degradation. These phenomena cannot be adequately characterized by applying a single variable or metric of concern. Only rarely does a policy decision hinge on the truth or falsity of a single, discrete hypothesis or proposition. As a result, scientific assessments conducted to support environmental policy formulation are frequently large, multi-disciplinary, multi-year undertakings that involve dozens to hundreds of individual studies. These studies can all pass muster in terms of quality, but nevertheless provide only ambiguous guidance with respect to policy outcomes.

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As we have argued elsewhere, such research can produce a banquet of high quality data and findings, but cannot determine which dishes should be considered by policy makers and which should weigh most heavily in the policy choice. The integration of scientific findings to support a particular policy or regulatory regime is a challenging and tricky proposition involving the development and application of numerical models, stipulation of scenarios, and the use of decision analytical tools. But most importantly, integration of individual studies involves *judgment.*

Apparent misunderstanding of the nature of science and policy assessments is not limited to those in the media; professional policy and regulatory analysts also seem confused. In the Policy Forum section of the journal *Science,* Linda Cohen and Robert Hahn asserted that too many environmental regulations are founded upon "false or misleading" research findings. One of their recommendations is that Congress should establish a new agency with the task of evaluating scientific findings that form the basis for those regulations which have an annual economic impact of $100 million or more. They argue that "government should be allowed to use [particular] research findings in developing regulations only after the [independent] agency has replicated the results or has certified that the results have been replicated." This proposal would have the practical effect of delaying the implementation of regulations that in many cases have taken years or even decades to develop. However, the more fundamental problem with this proposal is that major environmental policy positions or regulations are often based upon hundreds of (more or less) independent research activities. It is almost inconceivable to imagine that an independent agency could replicate (or certify the replication of) the findings of, say, the National Acid Precipitation Assessment Program (NAPAP), a 10-year, $850 million assemblage of hundreds of distinct research, monitoring, and modeling activities. Moreover, no single study could have unambiguously confirmed or denied the validity of the acid rain provisions of the Clean Air Act Amendments of 1990. Proposals such as those put forward by Cohen and Hahn gain their apparent plausibility by conflating science-based policy assessment with something akin to software installation.

Concluding Remarks

The junk science trope tends to shatter rather than inform civic dialogue, and it does little to enhance public understanding of environmental science and its social applications. To be sure, public understanding can be deepened—citizens should not only better understand science and scientific advances generally, but they can also be better educated about how science is used to help formulate and implement environmental policy. Science assessments, such as those related to the U.S. Global Climate Change Research Program, are fueled by scientific rigor, but ultimately are held together by something much more akin to creative judgment. Widespread and uncritical acceptance of the language of junk science serves—wittingly or not—to nourish a disabling belief about the conduct of science in support of environmental policy.

Although our review was not based on a formal, statistical design, we believe the results are suggestive. Rather than creating independent government agencies to police the application of science to environmental policy matters, we should take steps to assure that the popular media and policy advocates avoid the use

of tropes and figurative descriptions of complex scientific characterizations of environmental issues. "Junk science" is a punchy, dazzling, but highly misleading description of the use of science in environmental policy formulation.

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Sources: The initial quotes concerning "junk science" occur in: D. Byrne, *Chicago Sun-Times* (6 December, 1998); A. Chase, *The Denver Post* (19 June, 1998); S. Milloy, *Wall Street Journal* (10 August, 1999); P. Raeburn, *Business Week* (8 April, 1996), and R. Gots, *The Tampa Tribune* (17 March 1997). National Science Board, *Environmental Science and Engineering for the 21st Century* (National Science Board, 29 July 1999); National Research Council, *Strengthening Science at the Environmental Protection Agency: Research Management and Peer Review* (National Academy Press, 2000); M. Powell, *Science at EPA: Information in the Regulatory Process* (Resources for the Future, 2000); *The Nation's Environmental Information Needs Assessment*, (Westat study, commissioned by the Environmental Protection Agency, 30 December 1999); D. Bengston and D. Fann, *Evaluation Review*, vol. 23 (1999); W. Gamson and A. Modigliani, *American Journal of Sociology*, vol. 95 (1989); T. Atwater, M. Salwen, and R. Anderson, *Journalism Quarterly*, vol. 62 (1985); E. Goodman, *The Baltimore Sun* (24 February 1998); interview with George W. Bush in *Science*, vol. 290 (13 October, 2000); P. Hollingsworth, *American Scientist* (Jan/Feb 2000); *Stanford Encyclopedia of Philosophy*, available on-line at http://plato.stanford.edu/ (2000); on the topic of research and its ability to offer policy recommendations, see C. Herrick and D. Jamieson, "The Social Construction of Acid Rain: Some Implications for Science/Policy Assessment," *Global Environmental Change* 5 (1995); T. Stewart in *Prediction: Science, Decision Making and the Future of Nature*, edited by D. Sarewitz, R. Pielke, and R. Byerly (Island Press, 2000); L. Cohen and R. Hahn, "A Solution to Concerns Over Public Access to Scientific Data," *Science*, vol. 285 (23 July 1999); C. Herrick, "Predictive Modeling of Acid Rain: Obstacles to Generating Useful Information," in D. Sarewitz et al. volume. Copies of the articles reviewed in the content analysis are available from the authors.