of the projected growth in greenhouse gas emissions over the next 100 years is from developing countries. Hence, developing countries will have to limit their emissions of greenhouse gases, but industrialized countries should take the lead, as agreed in Kyoto.

Protection of the climate system will require substantial reductions in greenhouse gas emissions; hence, the Kyoto Protocol is recognized to be only the first step on a long journey to protect the climate system. However, unless the United States agrees to meaningful reductions in greenhouse gas emissions, it is highly unlikely that major developing countries will agree to limit their emissions or that industrialized countries will agree to further reductions beyond those already agreed in Kyoto.

One very positive development is that about half of the U.S. states have enacted some climate protection measures, and there are a number of initiatives in the U.S. Congress that would reduce greenhouse gas emissions. Although the McCain-Lieberman Climate Stewardship Act failed to pass in the Senate, 43 senators did vote for it, demonstrating an increasing recognition by members of Congress that there is an urgent need to deal with the climate issue. In addition, more than 40 multinational companies have voluntarily agreed to reduce their emissions of greenhouse gases and to improve the energy efficiency of their products. Several of these companies have already met or exceeded their initial targets and have saved money in doing so.

Technologies exist or can be developed to cost-effectively limit the atmospheric concentration of carbon dioxide to between 450 and 550 parts per million (ppm), but it will take political will, enhanced research and development activities, public-private partnerships, and supporting policies to overcome barriers to the diffusion of these technologies into the marketplace. A number of countries, including the United States, have committed themselves to developing climate-friendly technologies, but the level of investment must be substantially increased. The Kyoto Protocol needs to be ratified, and the United States needs to take meaningful actions to reduce its greenhouse gas concentrations. Governments should then consider setting a long-term target based either on a greenhouse gas stabilization level (between 450 and 550 ppm) or on limits for both the absolute magnitude of global temperature change (less than 2 to 3°C) and the rate of temperature change (less than 0.2°C per decade). A series of intermediate targets can then be developed to involve developing countries in an equitable manner. The need to reduce greenhouse gas emissions offers a unique opportunity to modernize energy systems and enhance competitiveness in a globalized world.

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VIEWPOINT

Tales from a Troubled Marriage: Science and Law in Environmental Policy

Oliver Houck

Early environmental policy depended on science, with mixed results. Newer approaches continue to rely on science to identify problems and solve them, but use other mechanisms to set standards and legal obligations. Given the important role that science continues to play, however, several cautionary tales are in order concerning "scientific management," "good science," the lure of money, and the tension between objectivity and involvement in important issues of our time.

"The scientific debate remains open. Voters believe that there is *no consensus* about global warming within the scientific community. Should the public come to believe that the scientific issues are settled, their views about global warming will change accordingly. Therefore, you need to continue to make the lack of scientific certainty the primary issue in the debate. . ." [Frank Luntz, political strategist, 2002 (*1*)].

This essay explores the relationship between science and law in environmental policy. The relationship has not been easy, nor has it achieved closure after more than 30 years of marriage. Two alpha partners are still trying to figure out who does what. Both agree on the importance of an environmental policy. The debate is about what it should be based on and how it should be carried out.

Back in the pre-dawn of public environmental statutes, there were private remedies for environmental harms, in tort and nuisance. If someone contaminated your apple orchard, or your child, you could seek damages and even an injunction against the activity. These remedies proved insufficient for at least two reasons. The first is that a civil law response to harm already done is small solace for someone who has lost her livelihood or the health of her child. The second is illustrated by the real-life saga described in *A Civil Action*, involving the contamination of drinking water from, in all probability, industrial waste sites (*2*). Children died, others were rendered vegetables for life, and their parents suffered a grief that is impossible to describe. But their legal case failed, as many others did, over the requirements of proof and causation. Which chemical, of the many toxins in the waste sites, caused these strange infirmities and through exactly what exposure pathways? Which waste sites were responsible: this one, operated by a company with lawyers on tap and a war chest of money available for its defense; or that one, now abandoned, once owned by a corporation long dissolved? Civil law failed because the science could not make the proof.

First-Generation Environmental Law: Science Embraced

Beginning in the 1960s, Congress surmounted these difficulties with new public environmental statutes, each based on standards of performance. The standards would operate by preventing rather than compensating for harm. They would, further, bypass the rigors of causation and proof: Once a standard was set, one had only to see whether or not it was met. The question remained, however: Who would set the standard? The answer seemed apparent. Scientists would, on the basis of scientific analysis. After all, it was the scientists, such as Rachel Carson, Jacques Cousteau, and Yuri Timoshenko, who had sounded the alarm; they were the ones to put out the fire.

The first wave of environmental law, therefore, was science-based environmental policy in action. One of the first was the Water Quality Act of 1965 (*3*), which sought the attainment of water quality criteria. It was soon followed by the National Environmental Policy Act of 1969 (*4*) and the analysis of environmental impact. Then came the Clean Air Act in 1970 (*5*), focused on the attainment of national ambient air quality stan-

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dards, soon followed by the Resource Conservation and Recovery Act (RCRA) (waste disposal) (*6*), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (abandoned waste sites) (*7*), the Toxic Substances Control Act (TOSCA) (chemicals) (*8*), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (pesticides) (*9*), and the Safe Drinking Water Act (*10*), all with the same premise: Science would tell us what was safe and what was not. Scientists would draw the lines.

It didn't work. None of these laws worked well, and some, after enormous investment, failed utterly (*11*). We began to realize that science, although endlessly fascinating and constantly revelatory, is rarely dispositive. And in the world of environmental policy, that which is not dispositive is dead on arrival. The reason is political: Environmental policy faces a degree of resistance unique in public law. No one who has to comply with environmental law likes it, and many hate it outright. A conventional explanation is money, and that is certainly a factor; it takes more capital to install pollution controls or to raise the causeway on stilts. Environmental law is also intrusive: It involves other people, state bureaucrats for one, in the operation of your oil refinery, pig farm, or real estate portfolio. Worse, it puts the general public in there too, nosing around, asking questions, taking their complaints to the media. They interfere with your personal life as well: your commuter highway, your garbage, or the way your granddaddy ran cattle and you've always run cattle in your family. These are life choices; often life values. Read George Will (*12*), listen to Rush Limbaugh (*13*). For some, environmental policies seem to threaten their very soul.

Not far from the bottom of all of this resistance is one more element: the embarrassment factor. No one likes to be tagged with the responsibility for poisoning children with lead or destroying the Everglades, and a small industry of euphemisms has sprung up to mask the blame. Strip mining becomes "the removal of overburden," as if the soil, grass, and trees were somehow oppressing the land; dredgers in Louisiana leave "borrow pits," as if they were going to give the soil back someday. At the top of the 2002 domestic agenda are the "clear skies" and "forest health" initiatives (*14*), labels that at the least disguise the contents of these programs, if not belie them. This is embarrassment speaking.

The extraordinary degree of resistance to environmental policy brings at least two consequences. First: That which is not nailed down by law is not likely to happen. Second: Even requirements that are nailed down by law, such as the permit requirements of the Clean Water Act or the no-jeopardy standard of the Endangered Species Act (ESA), secure compliance rates of about 50% percent (*15*). A good rule of thumb is that no environmental law, no matter how stringently written, achieves more than half of what it set out to do.

With this understanding of the special challenges of environmental policy, it is easy to see why science-based approaches fare so poorly. One lesson in this regard can be drawn from the Federal Water Pollution Control Act, aimed at the attainment of water quality standards. Scientists would establish concentration limits for every pollutant, and when waters exceeded these limits, scientists would determine the cause and require abatement. But concentration limits for what use: swimming, drinking water, or fishing? If for fishing, would the target be catfish or trout, which have widely differing requirements for dissolved oxygen? And for the lower Mississippi River, which basically floats boats, why would one need fish at all? The first question in the standard-setting process, then, depended on identifying goals that were purely political and that, as Congress later found, led inexorably to a race to the bottom: States lowered their standards to attract industry, which then held them hostage under the threat of moving away (*16*).

The "scientific" part of the act was equally fluid. It involved extrapolating "acceptable" concentration limits from laboratory experiments to natural surroundings; from single pollutants to cocktails of multiple pollutants; and from rapid, observable, lethal effects to long-term, sublethal, and reproductive effects. Then came dilution factors, fate, and dispersion and mixing zones. Conclusions differed by factors of 10, scientist against scientist. When it came next to enforcement, someone had to prove who and what were causing the exceedance of the standards. If Lake Pontchartrain turned entropic, was it the cattle farming, the shoe tannery, the local sewage system, or Mother Nature? The higher the stakes, the more contested the science. The problem was not information, it was closure. We had returned to the difficulties of *A Civil Action*. Whether in tort law or public law, the proofs failed.

Environmental statutes addressing toxicity record the problem in a more acute form. In the early 1970s, a number of laws were enacted based on determinations of "unreasonable risk to human health in the environment" (*17*). The challenges to scientists here were even more demanding. How were they to determine risk to human health, except through experiments with rodents? But what was the dose-response relationship in a rat, and what was the relationship of a rat to a human, and were these relationships linear, curved, parabolic . . . who knew? Further, exactly which humans were they to consider: those living at the fence line, elderly asthmatics, kids sneaking in to play in the dirt, or fishermen downstream of the outfalls of pulp and paper mills who were eating residues of dioxin in their catch? Were they eating the bodies of the fish or the heads, and were they frying them or stewing them raw? What would scientists do, moreover, about toxins, including many carcinogens, for which they could establish no known threshold of safety? And finally, even if they could arrive at a scientific-looking determination of risk (*18*), what risk level was acceptable: one death in ten thousand, one in a million? The dioxin standards for the states of Minnesota and Virginia, for exactly the same dischargers, differ by more than a thousand times (*19*).

Facing these difficulties, and with each of their decisions subject to legal challenges, the toxic programs of the air, water, pesticide, and related laws fell into a swoon. Mountains of paper spanning decades produced only a handful of standards, against a backlog of thousands of toxic substances. Some of the biggest actors—lead, polychlorinated biphenyls (PCBs), trichloroethene (TCEs), and dioxins to this day—stalled out and were only moved forward through litigation or overwhelming public outcry. For the opponents of these standards, there was always an unexplored factor. That is the essence of science. Meanwhile, global temperatures are rising. Parts of the Arctic ice shelf are breaking off into the sea.

Perhaps the most celebrated mess in environmental policy is the Superfund program, whose cleanups run into millions of dollars per site (*20*). The actual money expended on the cleanups is only part of that sum; a major amount is spent on the science-based determination of "how clean is clean." The disputes, uncertainties, and costs of this approach led Judge Steven Breyer, now a justice of the U.S. Supreme Court, after just one trial of a Superfund cleanup, to write a book calling for the establishment of an unreviewable panel of scientific experts to decide these questions once and for all (*21*).

Second-Generation Environmental Law: Science Rejected

Fortunately, Congress did not buy Judge Breyer's suggestion. It took a different route. As a result, air emissions, water emissions, and toxic discharges have plummeted, for some industries all the way down to zero. In 1972, after 15 years of futility with the water quality standards program, during which the Cuyahoga River and the Houston Ship Canal caught fire; lakes the size of Erie were declared dead; fish kills choked the Chesapeake Bay; and Louisiana's Secretary of Agriculture declared Lake Providence, poisoned by the pesticide toxaphene, safe for humans so long as nobody went near it or ate the fish (*22*); Congress changed the rules of the clean water game and adopted a new standard: best available technology (BAT) (*23*).

The theory of BAT was very simple: If emissions could be reduced, just do it. It did not matter what the impacts were. It did not matter whether a plant was discharging into Rock Creek, the Potomac River, or the Atlantic Ocean. It didn't matter what scientists said the harm was or where it came from (*24*). Just do it. Within 5 years, industrial discharges of conventional pollutants were down by 80% in most industrial categories (*25*). Receiving water quality improved by an average of 35% across the board (*26*). For all BAT-controlled sources, the amendments were a stunning success. Permit writers no longer had to deal with dueling scientists, mounds of impenetrable data, or the pressures of local politics. Once the technology was identified, they had their discharge limit. Compliance was equally straightforward. Even a judge could see it. That made the policy enforceable, and that made it law, and that meant it would happen.

The concept of BAT was the "Eureka!" moment in environmental law. Imitation is a fair measure of success, and other laws were quick to follow and devise their own BAT requirements. The solid and hazardous waste programs adopted BADT (best available demonstrated technology) (*27*), and the Clean Air Act adopted MACT (maximum available control technology) (*28*). Natural resources law followed suit as well, with alternative-based requirements providing clear and enforceable protections for historic sites, parks, endangered species, wetlands, and the coastal zone (*29*). We were no longer trying to calibrate harm. We were requiring alternatives-based solutions.

This said, BAT was no panacea. It bred its own resistance and some industries, through prolonged lawsuits (best available litigation), managed to stave off its application for decades (*30*). BAT also had its own Achilles heel, to be found in how one defined the scope of the proposal. If discharges from pulp and paper mills were at issue, for example, the most obvious way to avoid dioxin residues would be to eliminate the use of chlorine, but if the scope were reduced to pulp mills using chlorine bleach, then the use of chlorine and residues of dioxin were a given. Likewise, if the dredging of clam shells from Lake Pontchartrain was viewed as a search for roadbed materials, then alternative materials such as crushed limestone were readily available; if, on the other hand, it was viewed as a search for clam shells, then there was no alternative to the dredging and BAT failed.

For these reasons, all approaches became necessary in cutting the Gordian knot: engineering, science, tort actions, and, more recently, economic and market incentives. Each approach has its spearheads. The National Resources Defense Council has focused for decades on advancing BAT requirements. Environmental Defense, on the other hand, specialized in science-based litigation over DDT, PCBs, and pesticides and has since taken the lead on economic incentives. Toxic tort actions continue to drive polluters toward abatement, if only as a defense against claims of negligence, and have helped run to ground actors as large as the pulp and paper industry, maritime shipping, and tobacco. There is no longer one way, there are many; and science is no longer king.

Science still, however, plays lead roles. One is to sound the alarm, as it has done for decades and done recently regarding ozone thinning, climate change, and the loss of biological diversity. It is up to science as well to provide a rationale (for example, heavy metals are bad for you) for the requirement of BAT; we cannot BAT the world. It also falls to science to identify substances that are so noxious (bioaccumulative toxins, for example) that they need to be phased out completely, BAT be damned (*31*). Science-based standards play a similar role in federal air and water quality programs: a safety net in situations where, even with the application of BAT or MACT, air and water quality remain unsafe for human health and the environment (*32*). Scientists play the same, and in this case dispositive, role under the ESA, defining a baseline—jeopardy—above which no further impacts will be allowed (*33*). Last but not least is the job of restoration, be it the cleanup of contaminated aquifers, the recovery of the endangered Palila, or the reassembly of ecosystems the size of the Chesapeake Bay and the Louisiana coastal zone.

Four Cautionary Tales

With such power and so much riding on the opinions of scientists, however, four notes of caution are in order.

The first is beware the lure of a return to "scientific management." The technology standards that brought environmental programs out of their stalemate toward success were criticized from day one, and remain criticized today, as "arbitrary," "one size fits all," "inflexible," and "treatment for treatment's sake," outmoded in today's world. What we need, goes the song, is "iterative," "impact-based," "localized" management focused on the scientifically determined needs of this river, that airshed, this manufacturing plant, or that community. It sounds as attractive and rational as it did 40 years ago, but we have tried that for decades and failed. The largest loss leaders of the federal air and water quality acts are the science-based TMDL (total maximum daily load) (*34*) and SIP (state implementation plan) (*35*) programs, which eat up heroic amounts of money, remain information-starved, feature shameless manipulation of the data, face crippling political pressure, and produce little abatement (*11*, *36*). On the natural resources side of the ledger, the most abused concept in public lands management is "multiple use" and the most obeyed is the no-jeopardy standard of the ESA. One is a Rorschach blot; the other is law.

The second caution is the lure of "good science." Every lawyer knows what "good science" is: the science that supports his or her case. All of the other science is bad. If you are opposed to something, be it the control of dioxin or of global warming, the science is never good enough (*37*). See political strategist Frank Luntz's recent advice on climate change: "The scientific debate is closing [against us] but not yet closed. There is still a window of opportunity to challenge the science" (*1*). Is this a quest for "good science" or is it "any old excuse will do" (*38*)? Granted, there have been some colossal whoppers posing as science over the years; the optimistic "rainfall follows the plough" idea led thousands of homesteaders to misery on the Western plains, and Sir Thomas Huxley announced that the world's fishery was so abundant that it was inexhaustible (*39*). Even today one hears voices maintaining that DDT was maligned (*40*). Adding it up, however, most junk science has come from boosters and developers and has erred on the side of unreasonable optimism. When, on the other hand, scientists have said that the ozone layer was thinning, the planet warming, and the fishery disappearing, they were usually ahead of their time, vilified, and on target. With this understanding as background, we see today, in the name of "good science," a proposal for "peer review" of all science-based agency decisions (*41*). The primary targets are decisions made by the Environmental Protection Agency (EPA) and the Department of the Interior. If the EPA proposes an environmentally protective action, it will likely be stalled for lack of consensus among "independent" peers. More studies will be commissioned, years will pass. Administrations will change. The opponents win. If, on the other hand, the EPA decides that TCE does not pose a significant risk to human health, or the Department of the Interior decides not to protect the Preeble's beach mouse as an endangered species, there is no peer review, because no action is being proposed. What you have, then, is a knife that cuts only one way: against environmental protection. All in the name of "good science." Beware of being so used.

The third caution is the lure of money, which works like the pull of the Moon. One knows where lawyers are coming from; they speak for their clients. For whom does the scientist speak? Apparently truth and wisdom, but who pays for the work? Most academics in the sciences receive their salaries and technical support through grants and outside funding, nearly a third of it from industry. Their promotions and tenure are based on the amounts of money they bring in. In 1998, the *New England Journal of Medicine* published an article with the unremarkable but statistically documented conclusion that there was a "significant difference" between the opinions of scientists who received corporate funding and those who did not, on the very same issues (*42*). Hearing this, do we fall over with surprise? To put it crudely, money talks, and among scientists, the money is too often hidden. Even the conclusions can be hidden, if they are unwelcome to the sponsors. On important public issues, the public never knows.

A final caution is the lure of the "safe" life, the apolitical life, free from the application of what scientists know to the issues around them. One must respect anyone's liberty to choose to be a player or not, and the additional need of the profession for the appearance and fact of objectivity. The question is, notwithstanding: Given the pressure of environmental issues today and their dependence on science, can scientists afford to sit it out? As we speak, an increasing number of scientists are being pulled off of studies, sanctioned, and even dismissed for conclusions that contradict the ideology of their bosses (*43*). This question does not concern who pays for what conclusions. It concerns a duty to act and to defend your own.

In the early 1990s, the so-called Contract with America (*44*) identified a series of laws to be amended or repealed, many of which were environmental. At the top of the list was the ESA. As Speaker of the House Newt Gingrich began work to implement the contract, the ESA was in serious trouble. Gingrich was also, however, an intellectual who at least enjoyed a good discussion. More than that, he harbored a lifelong passion for zoos. Concerned about the fate of the ESA, the curator of the Atlanta zoo, an acquaintance of Gingrich, suggested to him that he have a chat with E. O. Wilson. Gingrich accepted, and Wilson came to Washington along with two other icons of the natural sciences, Thomas Eisner and Stephen J. Gould. It was a long meeting. They agreed to meet again. Over time, Gingrich would assure these scientists that nothing would happen to the ESA that did not have their review and, more extraordinarily, their approval.

It was not an easy promise to keep. The pressure on Gingrich from leaders of his own party was intense. He met again with Wilson *et al.* They held the line. The 104th Congress wound down with two extremely hostile bills out of committee, waiting only for their moment on the floor, which never came. It was a critical moment in environmental policy. It was also a true marriage of science and law.

References and Notes

1. For a complete text of the memorandum, see www.luntzspeak.com/memo4.html.
2. J. Harr, *A Civil Action* (Random House, New York, 1995).
3. Pub. L. No. 89-234, 79 Stat. 903.
4. 42 U.S.C. §§ 4321 *et seq*.
5. 42 U.S.C. §§ 7401 *et seq*.
6. 42 U.S.C. §§ 6901 *et seq*.
7. 42 U.S.C. §§ 9601 *et seq*.
8. 15 U.S.C. §§ 2601 *et seq*.
9. 7 U.S.C. §§ 136a-4 *et seq*.
10. 42 U.S.C. §§ 300 g-1 *et seq*.
11. See generally, W. H. Rodgers Jr., *Environmental Law*, vols. 1 to 4 (West Publishing, St. Paul, MN, 1992). For a more focused critique of the Clean Air Act, see A. Reitze, *Environ. Law* **21**, 1550 (2001); for a similar critique of the water quality standards programs of the Clean Water Act, see O. Houck, *The Clean Water Act TMDL Program: Law Policy and Implementation* (Environmental Law Institute, Washington, DC, ed. 2, 2002).
12. G. Will, "Pondering history's might have been," *The Times Picayune*, 23 February 1998, p. B-7 (flaying scientists for presenting "the human species as a continuum with the swine from which the species has only recently crept," and for "viewing mankind with the necessities of nature").
13. R. Limbaugh, *The Way Things Ought to Be* (Pocket Books, New York, 1992), pp. 160–161.
14. For the administration's "clear skies" initiative, see www.epa.gov/clearskies and www.whitehouse.gov/news/releases/2002/02/clearskies.html. For manipulation of scientific data underlying the initiative, see A. C. Reukin, K. Q. Seelye, "Report by EPA leaves out data on climate change," *New York Times*, 19 June 2003, p. A-1, and D. Z. Jackson, "Undaunted by accusations of cooking the books for war, President Bush deep-fried the data on global warming," *Boston Globe*, 20 June 2003, p. A-15. For the administration's "forest health" initiative, see "Senate begins work on healthy forests bill by approving amendment to House version," *BNA Daily Environment*, 30 October 2003, p. A-14.
15. For the results of federal agency consultations under the ESA, see O. A. Houck, *Colorado Law Rev*. **64**, 277 (1993); for the similar results of the Clean Water Act, see R. W. Adler *et al*., *The Clean Water Act 20 Years Later* (Island Press, Washington, DC, 1993).
16. For more detailed descriptions of these difficulties, see W. H. Rodgers Jr., *Environmental Law*, vol. 2 (West Publishing, St. Paul, MN, 1992) and O. A. Houck, *Environ. Law Regist*. **21**, 10528 (1991).
17. See, for example, FIFRA, TOSCA, and the Safe Drinking Water Act (*9*, *10*). For the difficulties of toxic regulation generally, see R. Percival *et al*., *Environmental Regulation: Law, Science and Policy* (Aspen, New York, ed. 4, 2003), pp. 333–470, and A. Babich, "Too much science," *The Environmental Forum*, May/June 2003, p. 36.
18. For the misleading appearance of scientific objectivity in the programs, see W. E. Wagar, *Columbia Law Rev*. **95**, 1613 (1995).
19. O. A. Houck, *Environ. Law Regist*. **21**, 10551-3 (1991).
20. The saga of Superfund has been long and contentious, but always centered on costs and cleanup standards. See "Superfund: Costs of waste cleanups underestimated, especially if federally funded, study finds," *BNA Environ. Rep. Curr. Dev*. **21**, 1485 (30 November 1990) and "Superfund: Witnesses tell Senate panel they support replacement of ARARs with national standard," *BNA Environ. Rep. Curr. Dev*. **24**, 878 (17 September 1993).
21. S. Breyer, *Breaking the Vicious Circle* (Harvard Univ. Press, Cambridge, MA, 1993).
22. P. Howard, "A happier Cleveland," *Houston Post*, 24 October 1990, p. A2 (describing the 1969 fire on the Cuyahoga River in Cleveland, OH); P. Beeman, "Old Man River in critical condition," *Des Moines Register*, 7 March 1994, p. 1; B. Commoner, (*6*), pp. 94–111 (describing damage to lake Erie); T. Bridges, "La. environmentalists set a course for saving Lake Pontchartrain," *Washington Post*, 24 June 1990, p. H2 (describing damage to Lake Pontchartrain and plans to renew it); J. L. Tyson, "Delicate ecosystem, heavy industry," *Christian Science Monitor*, 14 March 1994, p. 11 (describing pollution of the Great Lakes); "Dozier supports sacrificing lake to use pesticide," *Baton Rouge Morning Advocate*, 25 May 1979, p. B-1 (Lake Providence contaminated by toxaphene).
23. The Clean Water Act, 33 U.S.C. 1251, 1311, 1314. For a discussion of the success of BAT in the Clean Water Act, see R. W. Adler *et al*., *The Clean Water Act 20 Years Later* (Island Press, Washington, DC, 1993).
24. See *Weyerhauser Co. v. Costle*, 590 F.2d 1011 (D.C. Cir. 1978).
25. EPA, *Water Quality Improvement Study* (Washington, DC, September 1989) (showing BAT discharge reductions by industrial category by 90% and more).
26. See (*25*), showing monitoring results in receiving waters pre- and post-BAT.
27. EPA BADT regulations at 51 Fed. Reg. 40,572 (1986).
28. 42 U.S.C. § 7412 (d)(3).
29. For a discussion of these alternative-based standards, see O. Houck, *Miss. Law J*. **63**, 403 (1994).
30. *Chemical Manufacturers Ass'n v. EPA*, 870 F.2d 177 (5th Cir. 1989).
31. This is the approach of the Great Lakes Initiative under the Clean Water Act (see www.epa.gov/waterscience/GLI/mixingzones/) and of the recent European Water Policy Directive (Directive 2000/60/EC, 23 October 2000).
32. 33 U.S.C. §§ 1312, 1313; 42 U.S.C. § 7412.
33. 16 U.S.C. § 1536.
34. O. Houck, in *The Clean Water Act TMDL Program: Law Policy and Implementation* (Environmental Law Institute, Washington, DC, ed. 2, 2002), pp. 173–178.
35. R. W. Adler, *Harvard Environ. Law Rev*. **23**, 203 (1995).
36. W. H. Rodgers Jr., *Environmental Law*, vol. 1 (West Publishing, St. Paul, MN, 1992); Howard Latin, *Environ. Law* **21**, 1647 (1991); D. Schoenbrod, *UCLA Law Rev.* **3**, 740 (1983) ("The [Clean Air] Act's enforcement also requires more data about pollution effects and controls than science can provide, thereby allowing manipulation that undercuts achievement of the Act's ultimate goals, wastes resources and creates inequities . . . It would be better for Congress to forego the benefits of fine-tuned pollution controls and instead prescribe emission limits for major industries.").
37. L. Greer, R. Steinzor, "Bad science," *The Environmental Forum*, January/February 2002, p. 28 (documenting industry and EPA resistance to data on, among other things, the risks of dioxin); G. Coglianese, G. Marchant, *Shifting Sands: The Limits of Science in Setting Risk Standards* (Social Science Research Network, http://ssrn.com/abstract=443080).
38. Apparently Luntz's challenge-the-science strategy on global warming falls on willing ears. The *New York Times* quotes U.S. Senator James InHofe of Oklahoma: "Could it be that manmade global warming is the greatest hoax ever perpetrated on the American people? It sure sounds like it." (See www.nytimes.com/2003/08/08/opinion/08/KRUG.)
39. M. Kurlansky, *Cod at 122* (Penguin, New York, 1997).
40. H. Miller, "Is there a place for DDT?" *New York Times*, 7 August 2003.
41. A. C. Revkin, "White House proposes reviews for studies on new regulations," *New York Times*, 29 August 2003, p. A-11.
42. H. T. Stelfox *et al*., *N. Engl. J. Med*. **338**, 101 (1998).
43. B. Lambecht, "Government replaces biologists involved in Missouri River talks," *St. Louis Post Dispatch*, 6 November 2003, p. A-1; "EPA biologist resigns in protest of wetlands study" (www.peer.org/press/403.html); see also the firing of a U.S. Fish and Wildlife Service contractor for posting maps showing the distribution of caribou calving areas in the Arctic National Wildlife Refuge (www.latimes.com/news/nation/20010315/t000022700.html).
44. The description that follows is taken from M. Bean, "The Gingrich that saved the ESA," *The Environmental Forum*, January/February 1999, p. 26. Bean is chair of the Wildlife Program of Environmental Defense in Washington, DC.

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www.sciencemag.org/cgi/content/full/302/5652/1926/DC1