Penn State Environmental Law Review

Volume 10 | Number 2 Article 11

6-1-2002

Who Owns Science

A. Dan Tarlock

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I. Introduction: Why the Ownership of Science is Contested

Most environmental controversies have a significant scientific component because science has played a major role in identifying the "problem" and in suggesting appropriate remedies. Two common, interlocking issues often recur in environmental disputes: (1) What is the state of the available, relevant science and (2) When is it legitimate to substitute democratically arrived at political decisions for scientific judgment? Science seldom controls the final outcome of the dispute, but policy-makers must generally operate within the parameters of science.[1] The story of the George W. Bush administration's initial rejection and subsequent re-acceptance of the Clinton administration's arsenic drinking water standards is a classic example of how closely the science

* Professor of Law, Chicago-Kent College of Law. A.B., 1962, LL.B., 1965 Stanford University. The argument of this paper reflects my 30-plus-years service on various National Research Council-National Academy of Sciences committees, which were charged with applying state-of-the-art science to a wide range of environmental and water resources policy issues. My views of the role of science in public policy decisions and in informing legal rules continue to evolve, but I wish to thank all of the physical and social scientists and NRC staff who gave me the science and science policy education that I missed in college. All errors of fact and judgment remain mine alone. In particular, I would like to thank Chris Gordon, a Symposium Articles Editor, and Lauren Carothers, the Editor-in-Chief, for editing my article. I would also like to thank the faculty, student organizations, and all the symposium participants. The exchange of views helped me clarify many of my ideas and this article benefited substantially from the opportunity to present it at The Dickinson School of Law of the Pennsylvania State University on January 18, 2002.

1. For example, courts are most willing to reverse agency action as an abuse of discretion when it flies in the face of scientific consensus. *E.g.* Northern Spotted Owl v. Hodel, 716 F. Supp. 479 (W.D. Wash. 1988) (describing the Fish and Wildlife Service's decision to ignore internal and external scientific consensus inrefusing to list Northern Spotted Owl under the Endangered Species Act). Summing up the history of environmentalism, J. DONALD HUGHES, AN ENVIRONMENTAL HISTORY OF THE WORLD: HUMANKIND'S CHANGING ROLE IN THE COMMUNITY OF LIFE 239 (2001) writes, "We must understand our collective actions in terms of what science tells about the operations of the natural systems. But science is not a dogma; it is a search for understanding that always continues. Thus age, with its characteristic skepticism, tends only slowly its accept what science demonstrates, *but it will not accept anything that does not seem to have a scientific basis*." *Id.*

and political issues can become intertwined in environmental disputes.[2]

Science plays such a major role in large and small-scale disputes because it is often the only potential unifying standard among the disparate interest stakeholders who mutually distrust each other.[3] Unfortunately, science often does not satisfactorily eliminate disagreement among opposing parties because of the inherent limitations of the scientific method, the difficulty of adapting to the demands of environmental regulation, and the law's recognition of nonscientific alternative bases for legitimate decision-making.[4]

Resorting to science to solve environmental problems generally poses as many questions as it provides answers to the stakeholders and other participants in a dispute. All parties may formally agree that the dispute should be resolved according to the "best available science." However, all too often the parties seek to support their individual and self-interested positions by resorting to a single view of science and discrediting the science justifications invoked by their opponents. This is a logical outcome of the philosophy of modern science. The universalism claims of modern science support the search for *an* exclusive truth.[5] Good scientists know that many scientific answers are highly contingent, but science's power to legitimate intrusive and costly regulation by invoking the idea of exclusive truth makes the "ownership" of science one of the most contested issues in modern environmentalism. The reason that "ownership" is contested goes to the heart of the

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2. One of the first, and extremely controversial environmental decisions made by the Bush II administration was to suspend a Safe Drinking Water Act rule, proposed by the Clinton-administration EPA, to lower the 1942 arsenic drinking water standards from 50 to 10 ppb (parts per billion). The stated justification for the suspension was that the science behind the rule, which was the product of a ten-year process, was inadequate given the cost of local compliance. As is increasingly the case, the administration turned to a quick National Academy of Sciences-National Research Council study, probably in the hope that the suspension justification would be confirmed. To the surprise of both administration and the environmental community, the study concluded that the EPA had underestimated the cancer risks of arsenic in drinking water. National Research, *Arsenic in Drinking Water,* 2001 UPDATE (2001); *EPA Administrator Christine Whitman Quickly Announced that the Agency Would Adopt a New Standard, Probably 10 ppb*, WASH. POST (Sept. 11, 2001).

3. The widespread acceptance of science does not alone ensure its privileged position. The tension between expertise and democratic control traces back to Plato and Aristotle, but it is a particularly troublesome problem for environmental law, which is an unstable mix of the rational and emotional. Not surprisingly, modern students of political legitimacy, such as John Rawls and Jergen Habermas, have reached radically different views on the role of experts in democratic decision-making. *See* Walter F. Baber & Robert V. Bartlett, *Toward Environmental Democracy: Rationality, Reason, and Deliberation*, 11 KAN. J.L. & PUB. POL'Y. 35 (2001).

4. *Id.*

5. *See, e.g.*, BERNARD WILLIAMS, ETHICS AND THE LIMITS OF PHILOSOPHY 132-155 (1985).

question: What is the basis of environmentalism and environmental law?

One of the many paradoxes of environmental law is its uneasy relationship to science. Environmentalism and environmental law are both products of the Enlightenment's faith in reason and science[6] to benefit society and of post-modern and often anti-rationalist thought. The Enlightenment replaced theology with science as the basis for legitimate public policy. After the seventeenth century, the West has ceased to try to organize society on religious grounds and instead has striven for a rational, empirically supportable social organization. Modern environmentalism and environmental law owe much to this legacy. The careful work of scientists such as Rachael Carson[7] played a pivotal role in alerting society to the dangers of the unrestrained and unassessed use of ecosystems as sinks for chemicals, industrial wastes, and private and public development, which results in their modification and the consequent loss of biodiversity. This legacy continues to shape the formulation of environmental policy.

Thanks to Rachael Carson and many other early influential scientists, especially ecologists, we look to scientists both to help understand the nature of pollution and biodiversity loss and to suggest the necessary environmental protection standards to prevent further degradation from pollution and to restore degraded natural systems. Science and welfare economics provide the most powerful explanation and justification for stringent laws to protect the public from toxic risks and to preserve biodiversity. Toxicology and ecology, along with the applied engineering sciences, have identified a wide range of harms potentially caused by human activities, such as the production and use of synthetic organic chemicals, inadequately treated waste discharges, and unsustainable energy production. These disciplines also provide the

6. The influence of Enlightenment empiricism on environmental law is illustrated by the difficulty of shifting from mechanical to probabilistic theories of risk creation. The legal system's concept of causal relations is firmly grounded in Newtonian theories of cause. "The conventional view of cause . . . reflects the influence of Enlightenment science: this rendition of but for causation coincides neatly with that of Corpuscularian science [a Newtonian belief in universal mechanical laws]. Probabilistic linkage is distinguished from but for cause, but has a nebulous role in Anglo-American reasoning. Probabilistic notions correspond to the casual notions that modern science employs in that they are based on probabilistic evidence rather than simple deductively derived casual chains. Legal scholars have generally not assumed the existence of a singular casual power, nor have they used probabilistic notions in analyses of causation, but rather they have relied on the policy-laden concept of proximate cause to identify the bearer of liability." Troyen Brennan, *Casual Chains And Scientific Links: The Role of Scientific Uncertainty in Hazardous Substance Litigation*, 73 CORNELL L. REV. 469, 490 (1989).

7. RACHEL CARSON, SILENT SPRING (Houghton Mifflin Company 1962) is widely recognized as the most influential intellectual trigger of the modern environmental movement.

basis for regulatory strategies to remedy these harms. Without science, modern environmentalism would be a minor nature veneration and preservation "cult" and would not have the worldwide political support that it enjoys today.

Science is not, however, the sole source of modern environmentalism. The movement has gained much from post-modern thought, which often delights in the irrational and emotional. Modern environmentalism roots are conventionally traced to the Romantic tradition's appreciation of unmodified "nature."[8] Nature "worship" evolved to a weaker norm of "respect for her" and this norm, weak and incoherent as it is, is a powerful source of emerging imperative duties to respect the biosphere. Ironically, the Judeo-Christian tradition, which was originally identified as the cause of environmental degradation,[9] has radically revised its view of the relationship between humans and nature. The major monotheistic religions have sought to draw a distinction between pagan-nature worship and a biblically-based principle of human stewardship of the earth.

All of these nonscientific influences have led to the argument that there are severe limits to the role that science can usefully play in making the hard resource use and risk-management decisions that modern environmentalism demands. The reasons are many, but the basic one is that society wants to know the answer to bottom line questions of cause that mix positive and normative questions. We want to know the answers to questions such as the following: is a river healthy, is an artificial wetland viable, how much pollution can an ecosystem tolerate, is a given level of exposure to a pollutant or toxic substance safe for humans, and will the protection of X acres of habitat prevent the extinction of an endangered species? These are legitimate questions, but science seldom yields clear satisfactory answers to them. Scientists are uncomfortable with these questions because they partially collapse the fact-value dichotomy which science has maintained to differentiate itself from the softer humanities and social sciences and to establish its authority.

The conclusion that many environmentalists have drawn from the argument is that science should be subordinated either to transcendent

8. More recently scholars have suggested that the Calvinistic search for perfection has animated the drive to eliminate pollution to the maximum extent possible. *See* Bradley Bobertz, *Legitimating Pollution Through Control Laws: Reflecting on Scapegoating Theory*, 73 TEX L. REV. 711 (1995).

9. Lynn White's classic article, *The Historical Roots of Our Ecological Crisis*, 155 SCI. 1203 (1967), blamed environmental degradation on the human domination of nature mandated by Genesis, but later scholars have argued that the later Greco-Christian tradition submerged the many stewardship principles in the Old Testament. *See, e.g.*, JOHN PASSMORE, MAN'S RESPONSIBILITY FOR NATURE (1974).

ethical norms or to democratic decisions arrived at through fair and open political processes. This argument is a powerful one,[10] but it fails to appreciate the central role that science must play in the formulation of public policy when the issues have a substantial technical or empirical component. The argument does, however, pose the primary challenge for environmental law and environmentalism. Both environmental law and environmentalism developed as radical "outsider" perspectives that have gained considerable political support by leveling strong criticism of science and technology, and they are still partially "unsocialized" because they rest on norms alien to the western legal tradition. If environmentalism and environmental law are to sustain themselves, they must be fully integrated into the rational western tradition, which ultimately limits sanctioned behavior to demonstrated, concrete harm.

This integration will be difficult because, seductive as it is, the use of science to resolve concrete environmental issues rationally is frustrating for all participants in environmental decision-making. The constraints of the scientific method seldom allow science to provide the answers that society wants. Science seeks truth and approaches it through a long process of experimentation; it is often most comfortable giving answers as ranges of probability rather than bottom line, linear causal relationships. However, the legal system's concept of truth is a relative sliding scale because we only formally seek truth. Ultimately, the legal system is content to settle for decisions that are legitimate by virtue of a fair process rather than true in any absolute sense. This does not stop the legal system from trying to approach scientific truth. For example, we rely heavily on science to provide a causal nexus in many environmental disputes, especially toxic torts.[11]

Environmental disputes are polarizing because they expose the need for a sliding-scale model of cause and push the notion of a legitimate decision about individual responsibility to new limits. Both pollution and biodiversity disputes often turn on projected future risk levels. All decisions must be made under very high conditions of uncertainty; however, we have limited common law or constitutional background

10. A lawyer-scientist has forcefully articulated the limits of science in a powerful critique of the Fish and Wildlife Service's endangered species listing criteria. Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 WASH. U. L.Q. 1029 (1997).

11. The common-law requirement that a plaintiff prove that the defendant in fact caused an injury is based on a mechanistic theory of cause. *See supra* note 7, but it is also grounded in the principle of fundamental fairness that underlies the Constitutional protection of due process of law by all branches of government. Daubert v. Merrell Dow Pharms., Inc., 509 U.S. 579 (1993) enshrined this theory of cause in the Federal Rules of Evidence. *See* also Guido Calabresi, *Concerning Cause and the Law of Torts: An Essay for Harry Kalvin, Jr.*, 73 U. CHI. L. REV. 69 (1975).

principles to structure the inquiry posed by these disputes. For example, the corrective justice model of tort liability does not apply to risk prevention regulation.[12] We are not restoring an individual entitlement, but we are creating a new public benefit that does not fit comfortably into the matrix of Hofeldian relationships. We have solved the problem by treating public benefits differently from private rights. This is sound administrative law. Legislatures, as opposed to courts, are not tightly bound by the need to demonstrate the same casual nexus between harmful conduct and sanctioned behavior that we require in criminal and civil litigation, but at some point due process requires a nexus. Therefore, casual relationships are a legitimate part of all public policy inquiries, but they are relaxed compared to the self-imposed standards of science.[13] A lesser standard of proof is appropriate for public health-based regulation because liability can be justified as a form of tax fairly distributed among people who directly profit from harmful activities.[14] Fortunately for the sustainability of governments, we never require a close causal relationship between revenue intake and government performance or a close inspection of the costs and benefits of regulation.

Environmental regulation constantly pushes the limits of current

12. CASS SUNSTEIN, AFTER THE RIGHTS REVOLUTION: RECONCEIVING THE REGULATORY STATE 90-91 (1990).

13. Classic environmental regulation has been defended on the ground that is well within the liberal political tradition because it seeks to restrict individual autonomy only when other individuals are harmed. *See* David A. Westbrook, *Liberal Environmental Jurisprudence*, 27 U.C. DAVIS L. REV. 619 (1994).

14. The Supreme Court's treatment of liability "tax schemes" is mixed. Usrey v. Turner-Elkhorn Mining Co., 428 U.S. 1 (1976) upheld the Black Lung Benefits Act of 1972, which required coal operators to compensate miners who were no longer employed in the industry because the Act was "a rational measure to spread the costs of the . . . disabilities to those who have profited by them." Concrete Pipe & Prods. v. Construction Laborers Pension Trust, 508 U.S. 602 (1993) held that Congress could impose withdrawal liability from a pension fund although such liability was not contained in the contract. But the plurality opinion in Eastern Enters. v. Apfel, 524 U.S. 498 (1998) held that the application of Coal Industry Retiree Health Benefit Act of 1992 was a taking as applied to a mining company that had ceased operations and did not participate in a series benefit plan established under the National Bituminous Coal Wage Agreement that required operators to contribute to retiree health plans so long as they remained in the coal business. The opinion acknowledged that the case was not a classic takings case because there was no appropriation of a property interest and that Congress can impose retroactive liability in national legislation, which adjusts the benefits and burden of national economic life. However, it found that the Act interfered with the company's investment-backed expectations. "Our decisions . . . have left open the possibility that legislation might be unconstitutional if it imposes severe retroactive liability on a limited class of parties that could not have anticipated the liability, and the extent of that liability is substantially disproportionate to the parties' experience." *Id.* at 528. Justice Kennedy concurred in the result but not in the Court's takings analysis because the Act under the Due Process Clause did "not affect an obligation relating to a specific property interest." *Id.* at 544.

scientific understanding. Thus, the most important decisions must be made under extreme conditions of scientific uncertainty, causing commentators to raise serious questions about the legitimacy of many regulatory decisions. This constraint is taken as a given in modern probabilistic science, but uncertainty presents major problems when science is used to impose limits on individual choice. These questions are not traditional scientific questions because each is freighted with a value judgment when the bridge between what science can demonstrate and the final regulatory decision is constructed.[15]

The great legal innovation of environmental law has been to substitute the concept of risk for proof of immediate harmful impact as a basis for regulation.[16] The necessity to make decisions under conditions of scientific uncertainty persuaded courts to accept the argument of scientists and engineers that risk assessments must err on the side of loss prevention by the incorporation of wide margins of safety.[17] The principle of conservative risk assessment has also been adopted by the European Commission[18] and has been extended to the pre-cautionary principle.[19] This emerging international environmental law norm, which is grounded in both United States and German public law,[20] posits that states have the power, if not the duty, to prevent uncertain, future environmental harm, if there is evidence of significant environmental risks, even if our understanding of the magnitude of these risks is incomplete.[21] Crucial questions, such as the burden of proof that the party invoking the principle must sustain, are unresolved,[22] but the

15. Scholars such as Lisa Heinzerling and Wendy E. Wagner have made this point brilliantly. Lisa Heinzerling, *Environmental Law and the Present Future*, 87 GEO. L.J. 2025 (1999); Wendy E. Wagner, *The Science Charade in Toxic Risk Regulation*, 95 COLUM. L. REV. 1613 (1995).

16. *See* Richard J. Lazarus, *Restoring What's Environmental About Environmental Law in the Supreme Court*, 47 UCLA L. REV. 703, 744-49 (2000).

17. *See infra* notes 46-49 and accompanying text.

18. EUROPEAN COUNCIL DIRECTIVE, 93/97/EEC (July 20, 1993).

19. *See* Ellen Hey, *The Precautionary Concept in Environmental Policy and Law: Institutionalizing Caution*, 4 GEO. INT'L ENVTL. L. REV. 303 (1992).

20. HAROLD HOHMANN, PRECAUTIONARY LEGAL DUTIES AND PRINCIPLES OF MODERN INTERNATIONAL ENVIRONMENTAL LAW (1994).

21. The precautionary principle is strongly contested because it introduces too much uncertainty into decision-making. The Supreme Court's increasing reliance on common law baselines to judge the constitutionality of government regulation may require a higher standard of cause in fact for risk prevention regulation than the current precautionary one. However, the Court seems presently unwilling to apply this approach to pollution regulation. Whitman v. American Trucking Ass'n, Inc., 531 U.S. 457 (2001). The Clean Air Act is a valid delegation of legislative power and expressly precludes the consideration of cost in setting National Ambient Air Quality Standards.

22. *See* James E. Hickey Jr. & Vern R. Walker, *Refining The Precautionary Principle in International Environmental Law*, 14 VA. ENVTL. L.J. 423 (1999). The World Trade Organization (WTO) has recognized the legitimacy of the precautionary

principle clearly includes the power to avoid foreseeable, significant risks[23] once there is a credible scientific basis to conclude that a serious risk exists. The precautionary principle can serve as the basis for legitimate decisions based on scientific uncertainty if a reasonable evidentiary threshold for invoking it is established, and mid-course correction mechanisms are created. This has not yet been done.

The failure of science to answer satisfactorily the environmental questions which society has posed in an operational and objective form has led to the contested ownership of science. Scientists once owned science in a fee simple absolute because they controlled both the production and use of scientific knowledge. However, this is no longer the case. When scientists could not provide the answers that society wanted, non-scientists asserted a quasi-tenancy in common in science *i.e.*, they asserted the right to participate in the application of science to the resource use and public policy choices that society must make, from the establishment of toxic risk levels to the definition of what is a species, for purposes of the Endangered Species Act. Lay participants in environmental regulation also assert the right to decide what science is legitimate and when it can and cannot serve as a basis for a regulatory decision. Today, four primary groups vie to control the application of science to public policy: the scientists themselves, environmental regulators, the judiciary, and the lay public. The remainder of the paper compares the cases of the rival claimants for the control of science and finds all of them wanting. It concludes with a brief suggestion about the proper role of science in contested environmental disputes.

II. The Argument: Environmental Law is Science-Bounded

The argument of this paper is that scientists remain the primary, but not exclusive, owners of science because environ-mental law is science-based. I accept the limits of science, which environmental regulation has exposed, and I recognize that while science can legitimize many decisions, it is only one of several sources of legitimate environmental regulation. It is neither a substitute for political decision-making[24] nor a

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principle, but held that it cannot override specific provisions of trade agreements. WTO, *European Communities Measures Concerning Meat and Meat Products (hormones)*, WTO Appellate Body Report, WT/DS26/AB/R (Jan. 16, 1998). See Nathlie Bernasconi-Osterwalder, *The Cartegena Protocol on Biosafety: A Multilateral Approach to Regulate GMOs*, *in* RECONCILING TRADE AND THE ENVIRONMENT 689, 705-713 (Edith Brown Weiss & John Jackson eds., 2001).

23. *See* Gunther Handl, *Environmental Security and Global Change: The Challenge to International Law*, ENVIRONMENTAL PROTECTION AND INTER-NATIONAL LAW 59, 99 (1991).

24. James L. Huffman, *Markets, Regulation and Environmental Protection*, 55 MONT. L. REV. 425, 427-29 (1994).

complete meta-ethical framework to help make normative decisions about human-nature interactions.[25] Environmental protection is a fundamentally modern social construct, which may be undertaken for a variety of reasons or none at all.[26] No constitutional requirement exists mandates that environmental regulation be based on scientific understanding, and, thus, there are non-scientific justifications for environmental regulation, including the simple positive one: the law. My argument equally recognizes that science is not value-neutral, as most competent scientists recognize. Science has no special claim to immunity from public scrutiny,[27] and the assumptions made in constructing models and justifying decisions need to be probed by internal and external standards.

In sum, environmentalism will always rest on an unstable, messy mix of ethical and empirical assumptions. This said, environmental policy and regulation must respect the teaching of science. The power of science to explain and rectify environmental problems places a substantial burden on those who seek to displace or pervert it. At a minimum, the further a decision strays from a strong scientific nexus, the more questionable its legitimacy will be.[28] The argument for the primacy of science rests on three positive and normative propositions.

The first proposition is positive and asserts that science was largely responsible for the creation of the modern environmental movement by identifying problems and solutions and establishing the legitimacy of intensive regulation of human activity. Science, alone, is, of course, not responsible for modern environmentalism. The post-Civil War rise of nature appreciation made important segments of the American public emotionally read to accept environmental protection as an imperative.[29] Other factors such as post-World War II suburbanization and the distrust of government caused by the Vietnam War also contributed to the rise of environmentalism, but science continues to sustain environmentalism and to define the content of protection strategies. The increasing acceptance of adaptive management to conserve biodiversity is an

25. This argument owes a great deal to Christopher Stone's book, CHRISTOPHER STONE, EARTH AND OTHER ETHICS: THE CASE FOR MORAL PLURALISM (1987).

26. Elizabeth Ann R. Bird, *The Social Construction of Nature: Theoretical Approaches to the History of Environmental Problems*, ENVIRONMENTAL REVIEW 255 (1987).

27. For a good articulation of this position, *see* LAWRENCE J. SUSSKIND, NEGOTIATING MORE EFFECTIVE GLOBAL AGREEMENTS 62-81 (1993).

28. I explain this argument in more detail in Dan Tarlock, *Environmental Law: Ethics of Science?*, 7 DUKE ENVTL. L. & POL'Y F. 193 (1996).

29. RODERICK NASH, WILDERNESS AND THE AMERICAN MIND (3rd ed., Yale University Press 1982). This book remains the seminal account of the rise of nature appreciation in nineteenth century America.

example of science's evolving influence. More broadly, science remains the most effective way to constrain anti-environmental political choice:

> Politicians cannot exercise control over environmental outcomes without resource to scientific findings. They may claim that findings are not clear-cut or remain subject to contradictory interpretations, but they are nonetheless dependent on what the practices of science uncover about the laws of nature . . . criteria of proof are at the heart of environmental politics, . . . the outcomes of environmental issues depend as much on the persuasiveness of the evidence as on various criteria of power . . . .[30]

The second normative argument is that the strategy of responding to the contingent and uncertainties inherent in environmental science by reclassifying problems as ethical rather than scientific[31] is not viable in the long run. Once the science-decision nexus is ruptured, the more difficult it is to reach a consensus among the shareholders. Departures from science tend to exacerbate the fears of future adverse consequences and drive people to defend the status quo.

The third equally normative argument asserts that the view that environmental law is (or should be) grounded in monistic non-anthropocentric "rights of nature"[32] should be rejected. Environmental rights are good rhetoric, but bad law. The project of environmental ethics has so far failed to make the transition from a general ethic such as stewardship to an operation system of rights and duties[33] and is unlikely to do so for the foreseeable future. Science-based precaution, rather than a right, is the most effective way to deal with scientific uncertainty.

III. Rival Claims for Ownership of Science

This section examines the claims of the four principal rivals for the

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30. James N. Rosneau, *Environmental Challenges in a Global Context, in* ENVIRONMENTAL POLITICS IN THE INTERNATIONAL ARENA 257, 258 (Sheldon Kamieniecki ed., 1993).

31. The shift from science to ethics among many in the environmental community is traced in CHARLES T. RUBIN, THE GREEN CRUSADE: RETHINKING THE ROOTS OF ENVIRONMENTALISM (1994). *See also* Donald A. Brown, *After the Earth Summit: The Need to Integrate Environmental Ethics Into Environmental Science and Law,* 2 DICK. J. ENVTL. L. & POL'Y 1, 17 (1992).

32. The case for this proposition has been eloquently made by Christopher Stone, *Moral Pluralism and the Course of Environmental Ethics*, 10 ENVIRTL. ETHICS 139 (1988). The chief proponent of moral monism is J. Baird Callicott. *See, e.g.*, J. Baird Callicott, *The Case Against Moral Pluralism*, 12 ENVIRTL. ETHICS 99 (1990).

33. *See* FREDERICK R. ANDERSON, ROBERT L. GLICKSMAN, DANIEL R. MANDELKER & A. DAN TARLOCK, ENVIRONMENTAL PROTECTION: LAW AND POLICY 61-70 (3rd ed., Aspen Law & Business 1999) for a summary of the philosophical problems that proponents of environmental ethics have failed to solve.

ownership of science. Each has a legitimate claim but none has an exclusive claim. Each argument for exclusivity is flawed. Thus, ownership, *i.e.*, the control of science, must be shared between scientists and the other rival claimants.

A. Exclusive Scientific Control

Since scientists produce science, the case for their exclusive product control seems strong. Nevertheless, the claim that scientists should have exclusive control over the use of science in environmental decision-making is easily dismissed for two related reasons. First, environmental regulation is science-based, but it does not follow that it should be science-controlled. The questions that scientists are asked to answer are not purely scientific in the classic meaning of the term. Scientists, themselves, are well aware of the gap between classic or "conservative" science[34] and science-based decisions posed by the modern environmental regulatory programs.[35] To answer these questions, a choice must be made among alternative inferences from the available data and judgment must be exercised. Thus, scientists can claim no special immunity from external evaluations of the assumptions behind their decisions.[36] These problems are well recognized by the National Research Council, the research arm of the National Academy of Sciences. The National Research Council's Handbook for new committee members has a special section on risk assessment studies. It counsels that "[i]t is critical for each committee working on a study of risk assessment to distinguish clearly between conclusions based on scientific evidence and those based on informed judgment. In cases where scientific proof is incomplete, special care is needed to explain how the committee arrived at its conclusions."[37]

The problems that scientists face in helping society make science-based decisions arise primarily because much of the science needed to provide the answers to environmental problems is regulatory rather than theoretical science. Regulatory science is a new form of applied science

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34. *See* ROBERT N. PROCTOR, CANCER WARS: HOW POLITICS SHAPES WHAT WE KNOW AND DON'T KNOW ABOUT CANCER (1995).

35. *See* William H. Rodgers, Jr., *The Myth of Win-Win: Misdiagnosis in the Business of Reassembling Nature*, 42 ARIZ. L. REV. 297 (2000) for a perceptive discussion of the rise of "trans-scientific" questions and the difficulties that this poses both for those who produce and those who consume scientific knowledge.

36. During the conference, Phillip Harter suggested that the bizarre District of Columbia Circuit Court of Appeal's decision in *America Trucking*, *supra* note 21, can be explained as a rebuke of EPA Administration Carol Browner's lack of candor in justifying the scientific basics of the agency's new particulate and ozone standards.

37. NATIONAL RESEARCH COUNCIL, GETTING TO KNOW THE COMMITTEE PROCESS 13 (1998).

driven by the need to provide scientific answers to causal questions implicit in modern environmental regulatory problems.[38] This challenges scientists because the issues are framed by legislatures and regulators and force the scientific community to adapt its processes and protocols of inference and proof to answer them. This is not bad because it forces science to adapt to new conditions. The emergence of the science of wetland delineation illustrates a science where external forces dictate the research agenda. Prior to the 1970s, the term "wetland" barely existed and had no scientific meaning.[39] It had no established scientific meaning until the Clean Water Act and subsequent court decisions made "wetland" a legal construct. "Wetland" remains an artificial construct to describe a cluster of water-dependent landscapes, but in the past twenty years, a new applied science has emerged to help delineate, protect, and restore these fragile and stressed ecosystems. Today, one can legitimately speak of an operational wetland science.

B. Judicial Control

The judicial claim to control science rests on the benefits of an informed, general "hard look" at the underlying assumptions of an administrative decision or other decision. Courts are constrained by separation of powers principles from making a *de novo* regulatory decision[40] unless the agency acted *ultra vires*,[41] but they have considerable latitude to examine the coherence of the decision. Specifically, courts can examine the intellectual extent to which an agency's decision is logically consistent with scientific precedent and the published literature. This view is implicitly in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, which holds that trial judges must exclude scientifically unreliable evidence in civil actions.[42] Judges, of course, retain the final authority to assess the relevance of evidence in a trial. The issue is the extent of deference to contested experts and contested science. The strength of the *Daubert* model is that it subjects science to an external standard. Scientific experts can have accumulated knowledge, but they are not infallible, nor is peer review always a sufficient check. One of the major lessons of the environmental movement is what society gains when experts are forced to expose the assumptions behind their conclusions and the limitations of their

38. *See* A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121 (1994).

39. NATIONAL RESEARCH COUNCIL, WETLANDS (1995).

40. The term *de novo* means that the courts have the authority to review the legality of an agency's decision without giving any deference to the agency's decision.

41. An agency acts *ultra vires* when that agency exceeds its statutory authority.

42. Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579 (1993).

expertise and current state of knowledge.

The issue is: Who should perform the inquisitorial or censor role? *Daubert* assigns the judicial gatekeeper to the entire federal judiciary role and rests on three crucial assumptions that are at variance with much of environmental science. First, *Daubert* assumes that objective scientific truth exists. Second, the approach assumes that new science is bad science. Third, *Daubert* assumes that science must be held accountable to the state, either by lay judicial or administrative scrutiny of the scientific bases of regulations. The first two assumptions are too simplistic to serve as bases for limiting environmental regulation. For better or for worse, all knowledge is contingent and experimental. The third assumption is a legitimate concern, but the costs of the *Daubert* formulation are high. A major weakness is that the model can be used to discredit new science before it has a chance to establish itself by the conventional canons of scientific validity and, thus, increase exposure to public health and environmental hazards. Thus, new science is not good or bad; it is just science.[43] *Daubert's* mandated screening can be used to discredit new science before it has a chance to establish itself by the conventional canons of scientific validity, and thus, increase society's exposure to public health and environmental hazards.[44]

This strict lay judicial gatekeeper role has effectively reduced the possibility of success in a great deal of toxic tort litigation, but it is even more inappropriate for judicial control of regulatory actions.[45] Courts have, as many people claim, properly shielded much scientific uncertainty from close judicial review by two principles. First, the New Deal-based principle of deference to expertise has been applied to scientific uncertainty, despite several efforts to develop a true hard look theory of review of the scientific evidence used to make decisions "on the frontiers" of science.[46] There continue to be occasional instances of the use of a "hard look" to invalidate risk assessments, primarily under the Occupational Health and Safety Act, which gives the Department of Labor less discretion compared to the Environmental Protection Agency

43. *Cf.* Hyongsoon Kim, *Adversarialism Defended: Daubert and the Judge's Role in Evaluating Expert Evidence*, 34 COLUM. J.L. & SOC. PROBS. 223 (2001) (*Daubert* should be interpreted to limit judicial discretion to exclude evidence).

44. In the *Agent Orange* litigation, In re Agent Orange Products Liability Litigation, 597 F. Supp. 740 (E.D.N.Y. 1984), *aff'd*, 818 F.2d 145 (2d Cir. 1987), a respected federal trial judge announced that "sound epidemiological studies . . . are the only useful studies that have any bearing on causation." *But see* Bonner v. ISP Techs., Inc., 259 F.3d 924 (8th Cir. 2001).

45. *See generally* CARL F. CANTOR, REGULATING TOXIC SUBSTANCES: A PHILOSOPHY OF SCIENCE AND LAW (1993).

46. *E.g.*, Ethyl Corp. v. EPA, 541 F.2d 1 (D.C. Cir. 1976).

(EPA) to err on the side of risk minimization.[47] Second, the argument of scientists and engineers that risk assessments must err on the side of loss prevention by the incorporation of wide margins of safety into regulatory decisions has been widely endorsed by courts.[48]

C. *Expert Administrative Control*

The case for exclusive expert administrative policy formulation control is that effective environmental decision-making ultimately depends on a relatively closed dialogue between elite civil servants and the scientific community. This is basically the European and New Deal model of administrative expertise. Under this model, the decision that results from the dialogue between civil servants and scientists is presumed rational and, thus, should be extremely difficult to challenge. This model partially describes how decisions are made and how courts approach expert decisions. However, American students of European environmental regulation have criticized this model because it lacks political accountability,[49] and expert administrative control is inconsistent with the structural history of modern environmental law.

Environmentalism is one of the first major post-New Deal social movements, which simultaneously carried forward the New Deal tradition of deference to expertise and exposed the myth that expert administration could avoid the value conflicts inherent in all resource-use choices. Environmentalism entered the political arena at the height of the post-New Deal administrative state, but it quickly rejected the assumption that the modern welfare state would produce endless technological progress coordinated by experts.[50] Ironically, it used the conservative challenge to the New Deal administrative state as lawless to convince courts to review (and reverse) agency exercises of discretion. Environmental law began as a guerilla movement, and it is not surprising that the idea of discretion exercised by experts subject to judicial review for extraordinary deviations from statutory authority, which is the heart of conservation-liberal compromise in the Administrative Procedure Act, was rejected by environmental nongovernmental organizations (NGOs) in the 1960s.[51] NGOs turned to the courts to undermine the very idea of

47. AFL-CIO v. OSHA , 965 F.2d 962 (11th Cir. 1992).

48. Lead Industries Association, Inc. v. EPA, 647 F.2d 1130 (D.C. Cir. 1980).

49. Susan Rose Ackerman, *Administrative Law Under Siege: Is Germany a Model?*, 107 HARV. L. REV. 1279 (1994).

50. The classic article is David Sive, *Some Thoughts of an Environmental Lawyer in the Wilderness of Environmental Law*, 70 COLUM L. REV. 612 (1970).

51. Judge Richard A. Posner concisely explains why Post-World War II Americans accepted with relatively little criticism the work of administrative agencies. Richard A. Posner, *The Rise and Fall of Administrative Law*, 72 CHI.-KENT L. REV. 953 (1997).

expert discretion because the Progressive Era and New Deal "expert" resource management agencies promoted endless environmental disruption and degradation.

The distrust of administrative agencies was moderated after the edifice of command-and-control pollution, and biodiversity protection regulation was erected. However, the environmental movement's distrust of expert opinions about the safety and reliability of new technologies and its skepticism of rational risk assessment and management decisions persisted and spread quickly to the regulated community. Post-"New Deal" public interest judicial review was invoked to curb the use of "bad" science. Environmentalists were thus forced to follow the time-honored tradition of pleading in the alternative. They asked that environmentally insensitive decisions be subject to hard look judicial review, but that "conservative" agency risk minimization decisions be accepted under a standard of review that has now become known as the precautionary principle. The net result was the partial deligitimization of the use of science to make public policy decisions.

D. Lay Public Control

The failure of science to deliver the necessary answers or to produce "satisfactory outcomes" has led to claims of law control. There are three divergent strategies to assert control over the use of science. All three ultimately do not decouple science from decision-making, but they differ radically in their view of the legitimacy of science. The strategies can be described as (1) the junk science attack; (2) the ethical bi-pass; and (3) the de-legitimization of science through deconstruction.

The first strategy has been adopted primarily by the regulatory community, although the environmental community has also used it.[52] In general, the regulated community classifies any regulatory initiative not based on traditional science, which leads to a conservative risk assessment decision, as "bad science" and thus illegitimate and *ultra vires*.[53] The dichotomy is, of course, a totally contrived and false one and results in a perversion of science. At its worst, the label "bad" or "junk" is attached to science which contradicts or undermines an industry decision that a chemical, product, or activity does not expose the public to significant long-term risks. At its best, the labels are used to question

52. *E.g.*, Sierra Club v. Marita, 46 F.3d 606 (7th Cir. 1995) (discussing the unsuccessful claim that conservation biology only legitimates science for biodiversity conservation decisions.).

53. *See* Donald P. Hornstein , *Reclaiming Environmental Law: A Normative Critique of Comparative Risk Analysis*, 92 COLUM. L. REV. 92, 562-633 (1992); Howard Latin, *Good Science, Bad Regulation, and Toxic Risk Assessment*, 5 YALE J. ON REG. 5, 89-148 (1988).

the legitimacy of the use of the precautionary principle as too indeterminate.

Environmentalists have generally supported science, but they have also asserted the right of society to go beyond science when a decision insufficiently protects human life or environmental values. In two related "moves," they have either reclassified the problem as an ethical one or deconstructed science. The first allows them to use a non-empirical predicate for regulatory action. For example, to justify the use of risk to limit discharges of toxic chemicals and to preserve ecological integrity, many commentators argue that risk assessment and management is not purely a scientific matter but a question of public policy and ethics.[54] The problem with the argument is that it proves too much. It is true that there is no mathematical model to tell society how much low level risk is acceptable, but the ethical leap to a zero risk society is not only economically irrational but philosophically problematic.[55]

Deconstruction uses post-modern methods to discredit science's claimed monopoly on truth by asserting that science is the social product of the current political process. Post-modern thinking, loosely defined, views all forms of "discourse" as social or political constructs and does not rank the different forms. Thus, ethical postulates or emotional "connections" to a subject are legitimate bases for decision-making. This argument is generally coupled with empirically based criticisms of the use of science to defend? unacceptably high levels of pollution threatening the public health and environment. For example, a recent study of the impact of nuclear technology on the Western landscape, which spans from nuclear weapons' testing to the proposed high level waste repository in Yucca Mountain, links the systems of ecology as described by Eugene Odum (the proponent of the influential ecological theory that natural system tended to be homeostasis if left undisturbed) and other researchers to the destructive hubris of science:

> Like the models used to determine water pathways to Yucca Mountain today, the models used by Odum and others in ecosystems ecology promised control. The managerial ethos conceptually transforms nature into an integrated circuit, hardwired for work and productivity, a cybernetic system-a predictable, self-regulating system.... It is an ethos of control.[56]

Lay control also takes the indirect form of insistence of greater

54. *See supra* note 31 and accompanying text.

55. Sunstein, *supra* note 12; DANIEL FARBER, ECO-PRAGMATISM (1999).

56. VALARIE L. KULETZ, THE TAINTED DESERT: ENVIRONMENTAL AND SOCIAL RUIN IN THE AMERICAN WEST 278-79 (1998).

transparency in administrative decision-making and increased and more meaningful public participation in the process of the decision. These are laudable, democratic objectives, but transparency and public participation are often used to make two inconsistent claims. At times, they are invoked to allow NGOs and others to "unmask" the scientific assumptions behind a policy and argue for a result not fully supported by conventional science. This argument can take several forms. Some use it to argue for a shift from ethics to science, while others, such as Professor Cass Sunstein, used it to promote greater agency accountability.

Professor Sunstein has built on the participatory model of administrative regulation to encourage agencies to be more candid about the uncertainties inherent in modern science-based regulation and to provide better justification and displays of the winners and losers of the regulation. Because conventional science is not structured to answer the questions that the agency must confront, he argues that EPA needs to do a better job of estimating the extent of the adverse effects that it has identified and the reasons that the regulation is suited to the information the agency has developed. This can be done by the preparation of a benefits analysis, which describes in quantitative and qualitative terms the savings from the regulation and sets out at least two alternative regulatory scenarios. The result could ultimately be a common law of health protection based on the candid disclosure of the inferences and assumptions behind a science-based decision.[57]

At other times, transparency and public participation are used to support the assertion that if the lay public was better informed about the scientific nature of the problem, then interested parties would understand the scientific necessity to make a decision. The hope here is that the legitimacy of a science-based decision will be better accepted and serve as a way to bridge divergent interests. For example, this is certainly the case in the argument that public and "stakeholder" involvement is necessary for the successful practice of adaptive management to restore degraded ecosystems.

IV. Conclusion

The hard reality is that environmental policy and law remain bonded by science. In the end, lay judges, administrators, and the public can assert a servitude, but not co-ownership, of science. The relevant question is: How can we bridge the gap between what we want from science and what it can supply? The following are some tentative, non-

57. Cass R. Sunstein, *Is the Clean Air Act Unconstitutional?* 98 MICH. L. REV. 303 (1999).

exhaustive suggestions.

A. Live with Science

There is a need to recognize that most environmental decisions must be science-based. A decision is science-based, if a credible, peer-reviewed, consensus-based panel reviews the decision within the scientific community. This analysis totally rejects the false dichotomy between "good and bad" science or "junk" science as well as *Daubert's* narrow definition of science. The good, bad, or junk science dichotomy must be decisively rejected because it is both unwarranted and it has an increasingly chilling impact on the use of science in regulatory decision-making. Decision-makers must be allowed to propose decisions that represent prudent extensions of the existing state of knowledge.

The emphasis on a credible scientific foundation, rather than a higher but unattainable standard, is sufficient to promote the accountability necessary to integrate science into democratic decision-making processes. The practical consequence is to put the burden of disputing the decision on those who disagree with the science. For environmentalists, this approach means that a simple reclassification of the decision as a value judgment will not be sufficient. A well-reasoned, alternative analysis grounded in science will be necessary. For the regulatory community, the burden will not be different from the one that most courts apply now. A decision can only be impeached by showing the lack of a credible scientific foundation.

B. The Precautionary Principle is Legitimate

Environmental decisions have been based on risk assessment since the early 1970s, but the incorporation of this idea into the precautionary principle has triggered new opposition to the idea. The precautionary principle is a modest extension of "classic" risk-based decision-making in that it explicitly recognizes that decisions can be made on incomplete but evolving scientific evidence. The underlying idea is sound, although the precautionary principle needs to be bounded by two limitations. First, there must a reasonable threshold of scientific evidence before it can be invoked. Second, there must be a continuous feedback mechanism so that the original decision can be reviewed and adjusted in light of new knowledge.

C. Scientists Must Get with the Program

The scientific community must accept the need for more regulatory science and thus redirect research to helping provide answers that society

deems relevant. This will be hard because drawing inferences beyond the box of a fully tested hypothesis by replicable data are a threat to the integrity of science. They subject scientists to the caldron of public scrutiny and perhaps cross-examination in open court. However, science must be prepared to answer the questions that legislatures and the public want answered. This is the opposite of the subordination of science to politics that occurred dramatically in the Soviet Union in the 1930s, but routinely occurs in more subtle forms in environmental regulation and other areas.[58] This will require the greater integration of available information scattered among the many specialties that exist in science and more effective external communication. In short, scientists will have to learn how to think and write like lawyers.

D. The Box is Too Rigid

Environmental decision-making tries to promote certainty, but often certainty comes at the expense of the ability to adjust to new information. To make better science-based decisions, we need more open-ended decision processes that allow for progressive stages of decision-making as knowledge is acquired. This includes the early disclosure of information, an opportunity for stakeholders to question it, and to supplement it with additional sources of information.[59] We need feedback procedures to allow mid-course corrections. In short, the basic idea of adaptive management that we can best make decisions under uncertainty by treating them as modifiable experiments needs to be adapted to all science-based decision-making.[60]

Such processes have another advantage. Often, the underlying objection to a decision is its narrowness. One of the key principles of modern environmental law is that decisions, which have a potential adverse environmental impact, should only be made after considering a wide range of alternatives. This, of course, is the heart of the Section 102(c) of NEPA, but too often regulators and private actors artificially constrict the range of options. The wider the range of options

58. The history of the trump of Marxist ideology over the advances in ecological science that occurred in the Soviet Union in the 1920s and 1930s is a chilling and costly lesson in the subordination of science to politics. *See* DOUGLAS R. WEINER, MODELS OF NATURE: ECOLOGY, CONSERVATION, AND CULTURAL REVOLUTION IN SOVIET RUSSIA (1988).

59. CHARLES ABDALLA ET. AL., ALTERNATIVE CONFLICT RESOLUTION STRATEGIES FOR ADDRESSING COMMUNITY CONFLICTS OVER INTENSIVE LIVE-STOCK OPERATIONS (Final Report for Pennsylvania Department of Agriculture 2001) suggests five hypothesis for the better integration of science and technology in collaborative decision-making.

60. *See* Holly Doremus, *Adaptive Management, the Endangered Species Act, and Institutional Challenges of "New Age" Environmentalism,* 41 WASHBURN L.J. 50 (2001).

considered, the easier it is to build a stakeholder consensus and thus decrease the need to fully resolve all scientific questions.

E. Don't Forget Fairness

The application of science to concrete problems may often concentrate financial risks on a small population. One of the most difficult policy problems that environmental regulators face is how to deal with risks. In some situations, they represent a moral hazard or an unwarranted expectation and are best left uncompensated. Pollution generators will seldom have an expectation of compensation.[61] In other cases, those who may be adversely affected by a science experiment may have a legitimate claim to compensation. Yet in other cases, appropriate public risk-assumption incentives may be warranted.[62]

61. *But cf.* Laguna Gatuna , Inc. v. U.S., 50 Fed. Cl. 336 (Fed. Cl. 2001). In 1992, the federal Environmental Protection Agency issued a cease and desist order to stop the discharge of oil field brine into a dry lake or playa in Lea County, New Mexico. After dead birds were found at the lake, the agency concluded that it constituted "waters of the United States" under the Clean Water Act. *Id.* at 340. Nine years later the EPA withdrew the order after Solid Waste Agency v. United States Army Corps of Eng'rs, 531 U.S. 159 (2001) held that the Act does not extend to waters unconnected to a larger stream system simply because they were used by migratory birds. *Id.* at 174. The court of claims held that this constituted a temporary taking. *Laguna Gatuna*, 50 Fed. Cl. at 343.

62. *See* Barton H. Thompson, Jr., *The Endangered Species Act: A Case Study in Takings & Incentives*, 49 STAN. L. REV. 305 (1997).